

SYLWIA KIERCZYŃSKA, JULIAN WAWRZYŃIAK

THE LEVEL OF APPLE PRODUCTION COSTS AND THE ECONOMIC EFFECTS IN THE SELECTED ORCHARD MANAGEMENT SYSTEMS

*From Department of Food Management Economics
of The August Cieszkowski Agricultural University of Poznań*

ABSTRACT. The aim of this paper was to study the relationships between the economic effects, i.e. gross profit and net income and the production costs. The object of the analyses was 384 quarter of apple orchards located at the 24 intentionally selected farms, involved in apple production in 1996-1999, from the former Poznań province. Taking into consideration the tree plantation system (single- or multi-row) and the number of trees per hectare, the orchard quarters were divided into four groups – the orchard management systems: the traditional, single-row orchards with density up to 1000 trees per 1 ha (1T) and the dwarf orchards – single-row with density 1000-2000 trees per 1 ha (2K) and above 2000 trees per 1 ha (3K) and multi-row orchards (4K).

Key words: net income, gross profit, regression function

Introduction

The result of fruit growing is amount of fruits of definite quality. The quantity of the fruit production multiplied by the price gives the production value. Receiving the production is not the only goal of fruit growing. The aim of fruit growing is to obtain the surplus of production value over the production costs, that is to obtain an income. The positive economic results (income) can indicate that the producer has not only obtained the return of current outlets but also surplus for the reproduction of the fixed capital, for the owner's and his family payment and for the development of the farm and orchard.

It is necessary to bear the costs of nutrition, chemicals, irrigation, cutting, thinning, the soil cultivation and harvesting for producing the excellent and healthy apples. The level of these costs depends on the amount and quality of inputs of floating capital and labour. Apple producers, by bearing higher production costs expect a higher production value but mainly a higher income. **Wawrzyniak** (1996) reports that the growth of the vegetable crops productivity went through an increase of the production costs and ran to the better production profitability.

The aim of this paper was to study the relationships between the economic effects, i.e. gross profit and net income and the production costs. The increase of the production costs should go together with the growth of the income when the production is rational.

Material and methods

The empirical information comes from 24 intentionally selected farms, involved in apple production, from the former Poznań province. The data were collected by interview according to the survey in the years 1996-1999. The inputs of the materials, labour, and yield were collected separately for each quarter of apple orchard (quarter – the part of the orchard set at the given time (year), where the trees are planted with the given density). The object of the analyses is 384 quarters of apple orchards.

The production costs, the production value and the incomes using the fixed prices of 2003 (the same for each quarter) were calculated.

The economic effects are the gross profit and the net income. The gross profit was calculated as a difference between the production value and the special costs (Wawrzyniak 1999). The net income was calculated as a difference between the production value and the total costs. The production value was the product of apples crop and prices. The prices of the apples were diversified by the variety and the quality class. There were used the apples prices from the Wielkopolska Agri-Horticultural Wholesale Market Plc in Poznań where the most of the interviewed fruit producers sold their apples.

The special costs are the part of the direct costs. They were calculated as a sum of the material costs (the pesticides, herbicides, growth regulators, other chemicals, water), the labour costs, the costs of using the tractors and machines (for example fuel), and the costs of services. The total costs were the sum of the special costs and the orchard depreciation, the costs of keeping the tractors and the machines (for example depreciation) and the general costs defined as a 15% of the direct costs (special costs and orchard depreciation).

Taking into consideration the tree plantation system (single- or multi-row) and the number of trees per hectare (density), the population of 384 orchard quarters were divided into four groups setting the orchard management systems (Table 1): the traditional, single-row orchard (1T) and the dwarf orchards – single-row (2K and 3K) and multi-row orchard (4K).

Table 1

Apples orchard management systems
Typy sadów jabłoniowych

Items Wyszczególnienie	Single-row orchards Sady jednorzędowe			Multi-row orchard Sad wielorzędowy 4K
	1T	2K	3K	
Density (number of trees per 1 ha) Zagęszczenie (liczba drzew na 1 ha)	< 1000	1000-2000	> 2000	> 1000
Number of orchard quarters Liczba kwater	143	86	61	94

The formation of the gross profit and the net income along with increasing of the production costs were described by the multiple, parabolic regression function. The regression coefficients were estimated for each of the selected orchard management systems. The independent variables were the total costs and the time variable – because the data had been collected for four years. There were calculated the estimators of the partial regression to eliminate the influence of the year of data collection. The Ordinary Least Squares method was used to estimate the regression function parameters.

Results

The level and variability of costs and incomes

The apple production is the costs absorptive business. The costs of apple production ranged from 6.3 thous. zł/ha to 29.2 thous. zł/ha within all the quarters of the analysed orchards (Table 2). It was caused by different production conditions, the level of material and labour inputs and different yield of fruits. The average production costs amounted 13.4 thous. zł/ha.

Table 2

**The production costs and economic effects in the selected orchard management systems
(thous. zł/ha)**
Poziom kosztów i efektów ekonomicznych w różnych typach sadu (tys. zł/ha)

Items Wyszczególnienie		1T	2K	3K	4K	Overall Ogółem
Total costs Koszty całkowite	range zakres	7.2-17.9	6.9-19.6	9.8-25.3	6.3-29.2	6.3-29.2
	average średnia	11.6	12.8	15.4	15.2	13.4
Production value Wartość produkcji	range zakres	2.2-36.3	5.5-48.4	5.8-73.1	4.0-72.3	2.2-73.1
	average średnia	17.9	21.9	24.1	26.1	21.8
Gross profit Nadwyżka bezpo- średnia brutto	range zakres	-5.6-26.4	-0.8-39.4	-0.3-62.6	-0.7-61.9	-5.6-61.9
	average średnia	10.6	14.5	16.5	18.3	14.3
Net income Dochód czysty	range zakres	-9.9-21.9	-6.4-33.2	-9.6-53.3	-9.8-52.9	-9.9-53.3
	average średnia	6.3	9.1	8.8	10.9	8.4

The apple production costs calculated for the traditional orchards (1T) and for the dwarf orchards with 1000-2000 trees per 1 ha (2K) amounted 11.6 thous. zł/ha and 12.8 thous. zł/ha respectively. They were from 16% to 25% lower than apple production costs calculated for the dwarf orchards with more than 2000 trees per 1 ha (3K) and for the multi-row orchards (4K). The differentiation of the apple production costs between the selected apple orchard management systems were mainly the result of orchard depreciation. It was nearly three times higher for the dwarf orchards 3K and 4K than for the traditional orchard (1T). The special costs were not significantly different between the selected apple orchard management systems.

The surplus of the production value over the special costs, i.e. the gross profit ranged from -5.6 thous. zł/ha to 61.9 thous. zł/ha, the average was 14.3 thous. zł/ha within the analysed 384 orchard quarters. The negative gross profit was obtained for some quarters of each of the selected orchard management systems; it means that even the current outlets for the apple production were not covered.

The gross profit for the traditional orchards (1T) was from 27% to 42% lower than for the dwarf orchards because of the value of production. The production value for 1T orchard was the lowest one despite the good yields (24 t/ha). It was the result of poor quality of the fruits and the selection of old varieties, that often had to be sold as apples for processing (not as dessert fruits).

The production value for the dwarf orchards was higher than for the traditional ones despite of a lower yield (average 23 t from 1 ha for both 2K and 3K orchards). The quality of apples produced in the dwarf orchards was much better than in the traditional ones and the selection of apple varieties covered the market demand. The highest yield (27 t from 1 ha) and good selection of the apple varieties caused that the production value for the multi-row dwarf orchard (4K) was the highest – it amounted about 26 thous. zł/ha.

The net income, i.e. the difference between the production value and the total production costs was also the lowest for the traditional orchards (1T). It happened because the production costs calculated for dwarf orchards were not high enough to outstrip the differences of the production value between the traditional and the dwarf orchards.

The net income for the dwarf orchards with more than 2000 trees per 1 ha (3K) was a little bit lower than for the 2K orchards. It happened because the production costs for 3K were significant higher than for 2K due to higher orchard depreciation. The highest net income was calculated for the multi-row orchard (4K) owing to the significantly higher production value than for the other dwarf orchard management systems.

The running of the economic effects

The growth of the gross profit went through with the increase of the production costs, but it did not happen within all the range of the production costs. It was worth doing for the 1T and 2K orchard management systems only to the given cost level, defined by the regression function (Fig. 1).

In the traditional orchard, at the minimum cost level (7 thous. zł/ha) the gross profit amounted 4.7 thous. zł/ha. Increasing the costs by 88% to 13.1 thous. zł/ha gave the growth of the gross profit by 168%. The gross profit was the highest at this costs level and it amounted 12.5 thous. zł/ha.

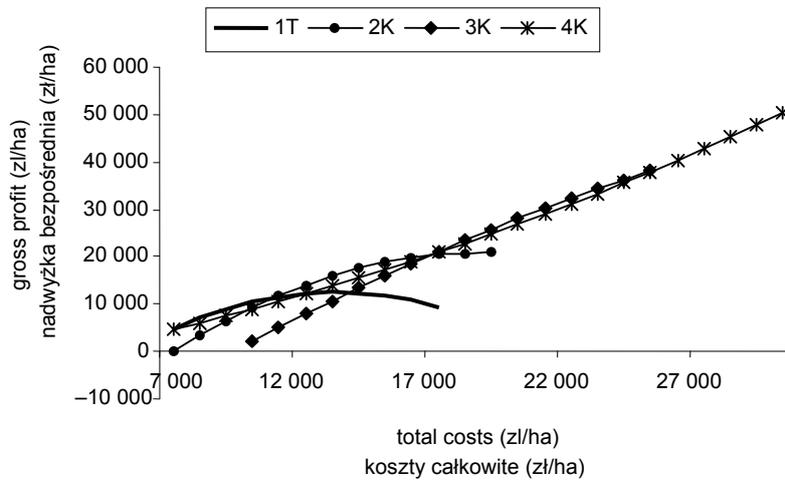


Fig. 1. Relation between the production costs and the gross profit in the selected apple orchard management systems

Ryc. 1. Związek pomiędzy kosztami produkcji a nadwyżką bezpośrednią brutto w różnych typach sadów jabłoniowych

The different relationship between the production costs and the gross profit occurred for the 2K orchard. The gross profit was positive when the production costs were over 7 thous. zł/ha. The 2K orchards were more intensive than the traditional one and the increasing the production costs from 7 thous. zł/ha to 18.7 thous. zł/ha had resulted the growth of the gross profit to the 20.9 thous. zł/ha.

The production costs higher than 13.1 thous. zł/ha for 1T orchard and 18.7 thous. zł/ha for 2K orchard gave the positive gross profit, but the marginal change of this economic effect was negative. It means that each additional unit of costs gave less than 1 unit of income.

The increase of the production costs went together with the growth of the gross profit within all the range of the production costs for the 3K orchard management system. The marginal changes of the gross profit went up at the initial section of the regression function – at the production costs of 9.8 thous. zł/ha, 2.01 units of the gross profit were due to additional 1 unit of production costs. However, at the level of 11 thous. zł/ha of the production costs, the marginal change of the gross profit were the highest and it amounted a 2.94 units. The further increase of the production costs gave the lower marginal changes of the gross profit, but it was still positive. The regression function for the 3K orchards did not reach their maximum that means the upper limit of increasing the production costs was not fixed. It can suggest that the most of the production potential of 3K orchards was not made.

The regression function of formation of the gross profit through increasing the production costs for the 4K orchard was different than for the single-row orchard management systems. It was the growing function with the growing marginal changes of the production costs. It means that every increase of the production costs went through better and better increase of the gross profit. It suggests that production potential of the 4K orchards was large and increasing the amount and quality of material or labour inputs can contribute to better economic effects.

The net income was lower than the gross profit by the orchard depreciation, the costs of keeping of machinery and tractors and the general costs. That is why the curves described the relationships between the net income and the production costs were shifted down in the relation to the curves for the gross profit. It was applied to all the orchard management systems (Fig. 2).

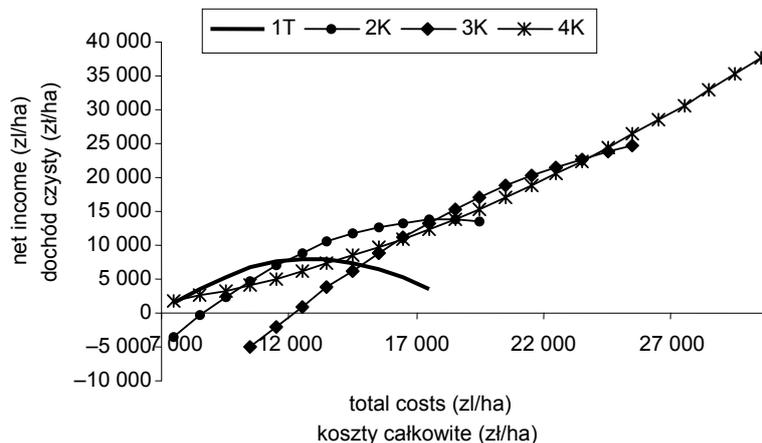


Fig. 2. Relation between the production costs and the net income in the selected apple orchard management systems

Ryc. 2. Związek pomiędzy kosztami produkcji a dochodem czystym w różnych typach sadów jabłoniowych

The net income were positive within the all range of the total costs calculated for the traditional orchards (1T). The increase of the costs went together with the increase of the net income only to the given level of costs, determined by the regression function. The costs higher than 12.4 thous. zł/ha resulted in the negative marginal rate of the net income and its value decreased.

Differently proceeded the regression functions for the 2K and 3K orchards management systems. Increasing the production costs from 7 thous. zł/ha to 8.2 thous. zł/ha for 2K orchard and from 10 thous. zł/ha to 11.7 thous. zł/ha for 3K, the net income went up, but the value of it was negative. The continued increasing of production costs in the single-row dwarf orchards (2K and 3K) went together with growth of the net income, but in case of 2K orchards this relation took place only for the costs amounted 17.7 thous. zł/ha. The continued growth of the production costs in the 2K orchards resulted in the negative marginal changes of the net income, but its value was still in plus. The regression function estimated for the 3K orchard management system did not reach its maximum. It means that within all the range of 3K production costs, every additional unit of costs gave the additional unit of the net income.

The regression function for the multi-row orchard (4K) had the similar course as the function for the 4K gross profit. The increase of the total costs went together with the growth of the net income within all the range of the production costs. The marginal changes of the net income were positive and increasing. It went to show about the unused potential of the multi-row orchard (4K) or about too low inputs of materials and labour.

Conclusions

1. The economic effects of the apple production increased together with growth the production costs in the selected orchard management systems.

2. For the traditional orchard (1T) and the dwarf orchard with 1000-2000 trees per 1 ha, the growth of both, the gross profit and the net income went together with increasing of the production costs only at the level given by the regression function.

3. Each additional unit of the production costs resulted in the growth of the economic effects for the dwarf orchard with more than 2000 trees per 1 ha (3K) and the multi-row orchard system (4K).

4. The gross profit was positive within all the range of the production costs for the traditional orchard (1T) and the 3K and 4K dwarf orchards. The gross profit was negative when the production costs were lower than 7 thous. zł/ha for the dwarf orchard with 1000-2000 trees per 1 ha (2K).

5. The net income were negative and production was unprofitable when the production costs were lower than 8.2 thous. zł/ha for 2K orchard and lower than 11.7 thous. zł/ha for 3K orchard.

6. The net income calculated from the regression function was positive within all the range of the production costs for the traditional orchards (1T) and the multi-row orchards (4K).

Literature

Wawrzyniak J. (1996): Wysokość kosztów a efekty w produkcji warzyw. Pr. Kom. Nauk Roln. Kom. Nauk Leśn. PTPN 81: 313-319.

Wawrzyniak J. (1999): Rachunek kosztów a zarządzanie w przedsiębiorstwach ogrodnich. Prodnuk, Poznań.

POZIOM KOSZTÓW PRODUKCJI JABŁEK A EFEKTY EKONOMICZNE W RÓŻNYCH TYPACH SADU

S t r e s z c z e n i e

Celem pracy było przeanalizowanie kształtowania się efektów ekonomicznych produkcji jabłek w miarę zwiększania kosztów produkcji w różnych typach sadu. Biorąc pod uwagę system sadzenia drzew (jedno- lub wielorzędowy) oraz zagęszczenie, zbiorowość 384 kwater jabłoniowych podzielono na grupy, wyznaczając typy sadu: sady tradycyjne, posadzone w systemie jednorzędowym o zagęszczeniu do 1000 drzew na 1 ha (typ 1T), jednorzędowe sady karłowe o zagęszczeniu od 1000 do 2000 drzew na 1 ha (typ 2K), sady karłowe o zagęszczeniu powyżej 2000 drzew na 1 ha (typ 3K) oraz karłowe sady wielorzędowe (typ 4K).

Wraz ze zwiększaniem kosztów produkcji efekty ekonomiczne produkcji jabłek w analizowanych typach sadu wzrastały. W sadach tradycyjnych i karłowych o małym zagęszczeniu (typ 2K) wzrost nadwyżki bezpośredniej i dochodu czystego towarzyszył zwiększaniu kosztów tylko do określonego poziomu, wyznaczonego przez funkcję regresji. W sadach karłowych o dużym zagęszczeniu (typ 3K) i posadzonych w systemie pasowym (typ 4K) każdej dodatkowej jednostce kosztów towarzyszył wzrost efektów ekonomicznych w całym przedziale kosztów wyznaczonych przez zbiorowość kwater.