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## **THE IMPORTANCE OF COSTS OF PRODUCT INNOVATIONS AND ENVIRONMENTAL PROTECTION IN POLISH DAIRY COOPERATIVES**

### *ZNACZENIE INNOWACJI PRODUKTOWYCH I KOSZTÓW OCHRONY ŚRODOWISKA W POLSKICH SPÓŁDZIELNIACH MLECZARSKICH*

**Key words: dairy cooperatives, financial revenues, new products, environmental protection costs**

*Słowa klucze: spółdzielnie mleczarskie, przychody ze sprzedaży, nowe produkty, koszty ochrony środowiska*

*JEL codes: O38, Q10, Q25*

**Abstract.** The aim of the research was to establish whether the production of dairy cooperatives, measured by sales value, is connected with the product innovations and environmental protection costs. The data related to years 2004 to 2014. It was found that these factors are usually significant. It was further established that those costs are disproportionately high in relation to the dynamics of production and prices of dairy products. It turned out that environmental protection requirements are so restrictive and cost-effective that they can cause skipping dairy cooperative to the increasing financial, technological and law difficulties. Apart from that the increase of product innovations drops significantly suggesting that the supply is near to saturation in terms of assortments on the market.

### **Introduction**

The paradigm of the modern economy is becoming stronger concern for the environment. It is therefore important to combine economic objectives with other conditions such as, among others, taking care to preserve the good state of the environment. It means not only take the declarative verbalization of obvious targets, but real action, here and now. The aim of the research was to establish whether the production of dairy cooperatives, measured by sales value, is connected with the product innovations and environmental protection costs. The period of research concerned the years 2004, 2006, 2008, 2010, 2012 and 2014.

The research results may be generally apply to all dairy cooperatives in Poland. It should be noted that as of January 1, 2004 there were 214 dairy cooperatives. However, in 2004, 50 cooperatives were excluded because of the merger or other significant organizational changes [Klepacki 1984]. The remaining 164 cooperatives, i.e. 76.64% of general population, ranked in ascending order by total assets and drawn every fourth cooperative. The sample consisted of 40 cooperatives. In this study, complete and reliable data were gathered from 32 randomly selected cooperatives continuously operating in the study period [Grabiński et al. 1982, Borkowski et al. 2003]. In subsequent years it was observed decreasing number of dairy cooperatives. Therefore the studied cooperatives accounted for about 20% of operating all dairy cooperatives.

The study estimated regression models for the production of dairy cooperatives, measured by revenues from sales in thousands PLN. In the first stage they were selected indicators, which constituted a potential explanatory variables. The choice of these variables was due to their prevalence in the literature. They were selected following potential explanatory variables (tab. 1).

The costs of environmental protection in general is the sum of the following categories: fees for emissions into the atmosphere, fees for exceeding the permissible standards of pollutants into the atmosphere, fees for exceeding the permissible noise standards, investment spending on environmental protection, the cost of solid waste management, the cost of sewage costs training in the field of environmental protection and training costs for farmers – milk suppliers in the field of environmental protection. Bearing in mind that among the set of potential explanatory variables

Table 1. Potential explanatory variables for multiple regression models  
 Tabela 1. Potencjalne zmienne objaśniające do modeli regresji wielorakiej

X1	Total employment [pcs.]/Zatrudnienie ogółem [szt.]
X2	Employment in manufacturing [pcs.]/Zatrudnienie w produkcji [szt.]
X3	Employment in the administration [pcs.]/Zatrudnienie w administracji [szt.]
X4	Employment related to environmental protection [pcs.]/Zatrudnienie związane z ochroną środowiska [szt.]
X5	The volume of sales of dairy products in total/Ilościowa sprzedaż wyrobów mleczarskich ogółem [t]
X6	Purchase of milk [million liters]/Skup mleka [mln l]
X7	The average procurement price of 1 liter of milk from the cooperative member with all derivatives [PLN/liter]/Przeciętna cena skupu 1. litra mleka od członka spółdzielni z wszystkimi pochodnymi [zł/l]
X8	The average amount of milk processed by the cooperative during the day in the year [thous. l]/Przeciętna ilość mleka przerabiana przez spółdzielnię w ciągu doby w roku kwotowym [tys. l]
X9	Fees for cooperative emission of pollutants into the atmosphere and exceeded limit values for these pollutants and noise [thous. PLN]/Opłaty spółdzielni za emisję zanieczyszczeń do atmosfery i przekroczeń dopuszczalnych norm tych zanieczyszczeń oraz hałasu [tys. zł]
X10	Expenditure on investments related to environmental protection [thous. PLN]/Wydatki na inwestycje związane z ochroną środowiska [tys. zł]
X11	The costs of solid waste management [thous. PLN]/Koszty gospodarki odpadami stałymi [tys. zł]
X12	The purchase costs of cleaning agents and detergents [thous. PLN]/Koszty zakupu środków czystości i detergentów [tys. zł]
X13	The costs of water consumption [thous. PLN]/Koszty zużycia wody [tys. zł]
X14	The costs of electricity consumption [thous. PLN]/Koszty zużycia energii elektrycznej [tys. zł]
X15	The costs of wastewater [thous. PLN]/Koszty odprowadzania ścieków [tys. zł]
X16	The costs of thermal energy from coal, oil and gas [thous. PLN]/Koszty energii cieplnej z węgla, gazu i ropy [tys. zł]
X17	The costs of training in the field of environmental protection [thous. PLN]/Koszty szkolenia pracowników w zakresie ochrony środowiska [tys. zł]
X18	Costs of training farmers in the field of environmental [thous. PLN]/Koszty szkolenia rolników w zakresie ochrony środowiska [tys. zł]
X19	Financial outlays on innovative activity [thous. PLN]/Nakłady finansowe na działalność innowacyjną [tys. zł]
X20	The level of expenditure/total expenditure on R & D [thous. PLN]/Poziom wydatków/nakładów ogółem na działalność B+R [tys. zł]
X21	The number of assortments [units]/Liczba asortymentów [szt]
X22	The dynamics of the number of assortments, 2004 = 100%/Dynamika liczby asortymentów 2004 = 100%
X23	Environmental costs in total [thous. PLN]/Koszty ochrony środowiska ogółem [tys. zł]
X24	Total assets/Suma bilansowa
X25	Own funds/Fundusze własne
X26	Total costs/Koszty ogółem

Source: own study

Źródło: opracowanie własne

should choose those that are strongly correlated with the dependent variable, while weakly correlated with each other, it was used the analysis of correlation coefficients [Ramanathan 1995, Pindyck, Rubinfeld 1998, Kufel 2007]. The estimation of the regression function for the revenue from sales made separately for each year. An evaluation was carried out using t-test and Fischer-Snedecor test.

### Environmental protection in the literature, legal acts and agricultural practice of the European Union

The EU action on environmental protection and sustainable production represents, among others, the EU strategy in this area by the year 2020 [EC 2010]. It includes three priority areas:

- smart growth, by developing the knowledge economy and innovation;
- sustainable growth, carried out by the low-carbon economy, effectively a resource;
- an increase in the level of employment and ensuring economic and social cohesion.

This strategy recognizes that the food industry with the specifics of individual sectors, it may be the source of many threats to the environment, namely soil, water, air, plants, animals and humans

[Dz.U.62.627, Dz.U.2004.173. 1807]. The key environmental protection in the food industry is primarily water and sewage, waste management, with particular emphasis on organic waste, air protection, soil protection and protection against noise [Konieczny et al. 2005, Jarczyński 2013]. Compared with other industries, the food industry stand out: a large water consumption per unit of product, burdensome sewage, waste generation, noise emitted by the device and often outdated technology [Arvanitoyannis et al. 2008]. It should also be remembered that the agri-food industry has its specificity, which distinguishes it from other industries. It is about the instability of agricultural raw materials [Chądzyński 2013, Chyłek 2007]. The result is that companies avoid the transport of raw materials over long distances. They work in the agricultural resource bases especially in cooperative form in milk processing industry [Dz.U.1982.30.210]. A significant factor affecting the agricultural and food processing are the fluctuations in the supply of agricultural raw materials due to climate and natural, which impinge on the organization of production. Another important factor affecting the processing plant is the raw material dispersion system and the necessity of maintaining close ties with manufacturers. Agricultural production and processing of raw agri-food products is associated almost always with the development of many types of production residues [Burak et al. 2005]. Agricultural raw materials generally are not fully utilized. Also arise waste resulting from the use of machinery and equipment [Danalewich et al. 1998].

The increase in the intensification of agricultural production, especially in the first two decades of the Common Agricultural Policy of the European Union has led to a significant increase in food production [Żmija 2006, Stańko 2008, Urban et al. 2010, Juszczuk, Balina 2014], but also contributed to the deterioration of the environment, the quality of agricultural products and living conditions of animals and led to the overproduction of food [Bjorling-Poulsen et al. 2008]. The consequence of this was an imbalance in the implementation of economic, ecological and ethical aspects. But in general economic objective outweighs the environmental goals and ethical [Runowski 2007]. The observed imbalance aroused much controversy. The consumers see more clearly the need to achieve environmental and ethical profits.

The social power of consumers increases and it becomes necessary revision of the existing management purposes [Friedman 1970]. Conducive ago introduced in agricultural policy legal and financial instruments, in addition, media campaign and education leads to a change in public awareness of the perception of non-production and non-economic aspects of manufacturing activity in agriculture [Sznajder 2008]. In general, the development goals formulated in the programming documents relating to the agricultural sector, focus on the implementation of more efficient and environmentally friendly technologies, attaches great importance to the modernization of the production process and improve standards of environmental protection [Flachowsky et al. 2008]. Upgrading and modernization of farms and the food industry have to prepare for the challenges posed by the single European market. An additional element – in particular for agricultural products processing sector, was bring companies to the requirements and standards of the EU in terms of safety, quality and standards of business [Dz.U.117.1011]. The European Union put a strong emphasis on the adaptation of production to market needs and environmental protection. The particular importance are investments aimed at improving production hygiene [Dz.U.61.417.2007], improving environmental standards, improving production safety and improve food safety [Garg et al. 2011].

Environmental policy shows the highest association with economic policy because it based on the use of natural resources, capital and human resources [Seremak-Bulge 2005]. Efficient use of environmental resources should assume an infinitely long duration of these resources, without specifying the upper limit of the material needs and desires of people [Hadryjańska 2010, Juszczuk, Nowak 2013]. Saving resources can be made especially through the intelligent use of energy and raw materials. Many savings in the management of natural resources gives re-use them. The basis of the idea of sustainable development is a concern for quality of life, manifested in the pursuit of sustainable development of civilization in an environment of preserved natural beauty. Sustainability of development is that the activities related to its implementation are difficult because it is still open and dynamic.

### **Econometric modeling, taking into account the environmental costs and the number of assortments in dairy cooperatives – research results**

Having determined, by analysis of correlation coefficients, potential explanatory variables, using backward stepwise regression and the method of least squares, 6 multiple regression models were constructed for sales. The results of tests are reported in table 2. Econometric models explaining the average value of sales for each year covered by the study. It is worth noting that all models fulfilled the conditions imposed by the method of least squares. Namely, they characterized normality distribution of residues, lack of heteroscedasticity and the lack of alignment between the explanatory variables [Juszczak, Balina 2014].

It was established that the value of sales in 2004 decisively influenced by three factors: milk purchase, the cost of wastewater and the number of assortments finished products. The increase in milk purchase at this time about 1 million liters was associated with an increase sales value by nearly 1,180 million PLN. In addition, an increase in the cost of sewage 1 thousand PLN was associated with an increase in sales value of only about 16 PLN. Moreover, at that time, the introduction of one additional product resulted in an average increase sales value by nearly 1,517 million PLN. In 2006, determining the value of sales turned out to be four variables: purchase of milk, costs of cleaning agents and detergents, sewage costs and the number of assortments finished products. In 2008 for the production and sales, the key factors were: the volume of milk collection, the average procurement price of one liter of milk from the cooperative member (including all derivatives), the cost of electricity consumption, the cost of disposal of sewage and the cost of thermal energy from coal, gas and oil. It is significant that the first two variables were stimulants with a relatively high regression coefficient and the other three with a low level. Namely, an increase in milk purchase of 1 million liters was associated with an increase in sales of 1.374 million PLN. moreover, due to the improvement of the quality of milk it's price increase of 1 cent per liter was associated with an increase in the value of sales in dairy cooperative of nearly 1,529 million PLN. The increase in the cost of waste water by 1 thousand PLN was associated with the increase in the production and sale of only 3.75 PLN. Subsequently in 2010, the key Factors for production value and sales turned out only two variables: employment and investment expenditures related to environmental protection. The first of these was a strong stimulant, while the other was a destimulant – an increase of 1 thousand PLN. was associated with a decrease in production and sales by nearly 72 thousand PLN. This could be caused by legal restrictions in this area, which is in this year turned out to be important as the financial impact. Probably a minus sign of the coefficient of the regression pointed the very late start of these kind of investments.

In 2012, the value of the production and sale of dairy products was a result four decisive factors, these were: total employment in the cooperatives, investment expenditures related to environmental protection, the cost of sewage and the number of manufactured assortment of dairy products. However, the disadvantage was that the value of the regression coefficient with the employment was lower than before. In addition, more importantly, the value of the regression coefficient with the number of ranges shows that increasing the number by one was associated at that time, only less than 115 thousand PLN increase of production value and sales. This may mean that practically from 2012, the market reacted poorly for further increase of new dairy products. This may suggest that at this stage of social and economic development further enhancing economic efficiency by product innovation is difficult to achieve. The other two variables at the time are destimulantes. Generally because of the mandatory and restrictive nature of the requirements related to the protection of the environment can be considered that these restrictions were for dairy cooperatives severe and probably environmental investment been taken too late. Apart from that the cost of the sewage were disproportionately high relative to the price of dairy products and the value of sales.

In the last year of the study, in 2014, the total number of factors influencing in a decisive way on the scale of production measured by the value of production and sales has not changed, but the key factors in comparison to the previous year changed substantially. These variables turned out to be: the volume milk purchase, the cost of electricity consumption and costs of sewage.

Table 2. Models of multiple regression for the sales of dairy products [thousand. zł]  
*Tabela 2. Modele regresji wielorakiej dla wartości sprzedaży wyrobów mleczarskich [tys. zł]*

Variable/Zmienna	The regression coefficient with the key variables in the individual years of research/ <i>Współczynnik regresji przy kluczowych zmiennych w poszczególnych latach okresu badawczego</i>					
	2004	2006	2008	2010	2012	2014
Constant/Stala	-35 517,2	-20 379,20	-15 6462	-95 458,8	-89 613,90	-20 037,4
X1				815,652	789,263	
X6	1 180,20	889,873	1 374,02			1 842,83
X7			152 880			
X10				-71,948	-52,158	
X11						
X12		40,7663				
X13						
X15	0,0160158	0,0214785	0,00375069		-0,0284004	0,00717792
X16			-0,00568428			0,00987078
X21	1516,90	928,046			114,612	
R <sup>2</sup>	0,970694	0,995172	0,962339	0,920888	0,9644	0,993094
JB	66,1519	11,66088	91,2010	5,74645	8,79719	17,4618
$\chi^2$ test for JB/dla testu JB	5,99146	5,99146	5,99146	5,99146	5,99146	5,99146
The hypothesis of normal distribution of residuals – confirmed/ <i>Hipoteza o normalności rozkładu reszt – potwierdzona</i>						
T. White	9,48773	12,5919	14,0671	7,81473	12,5916	12,5916
$\chi^2$ for test/dla testu T. White	31,9577	23,7042	31,9995	14,9682	26,5564	31,9502
The hypothesis of homoscedasticity model residuals – confirmed/ <i>Hipoteza o homoskedastyczności reszt modelu – potwierdzona</i>						
VIF	$X_6 = 2,288$ $X_{15} = 2,527$ $X_{21} = 4,039$	$X_6 = 3,692$ $X_{12} = 2,226$ $X_{15} = 3,649$ $X_{21} = 6,407$	$X_6 = 1,240$ $X_7 = 1,453$ $X_{14} = 1,841$ $X_{15} = 1,861$ $X_{16} = 1,248$	$X_1 = 1,003$ $X_{10} = 1,003$	$X_1 = 5,717$ $X_{10} = 1,035$ $X_{15} = 3,152$ $X_{21} = 9,354$	$X_6 = 1,363$ $X_{14} = 1,285$ $X_{15} = 1,682$ $X_{16} = 1,009$
The hypothesis about the lack of alignment of explanatory variables – confirmed/ <i>Hipoteza o braku współliniowości zmiennych objaśniających – potwierdzona</i>						

Source: own research

*Źródło: badania własne*

Increasing the purchase of milk by dairy cooperative of one million liters was associated in 2014 with an increase sales value by nearly 1,843 million PLN. It is important that this increase was the highest in the whole study period and may provide that the value added of dairy products increased and it should be assessed positively.

## Conclusions

1. The costs of waste management practices in dairy cooperatives in the study period were high. This could be due to incurred penalties, too late investment of sewage treatment plants, as well as with too high fees for sewage collection and use by outside sewage their often monopolistic position on the local market. In any case, the costs of wastewater at that time were disproportionately high in relation to the dynamics of production and prices of dairy products. In addition, environmental requirements are very stringent and economically effective. Their skipping can lead dairy cooperative to the increasing financial, technological and legal difficulties. Therefore, efforts to protect the environment and compliance with the law in this area as well as reducing the costs associated with the use of the environment are necessary.

2. In the total costs incurred for environmental protection by cooperative dairy sector the largest share was constituted by the cost of sewage. Probably the key to reducing these costs is to build their own treatment plants focused on the biodegradation of waste water. Probably it will be related to the further concentration of production and the concentration milk purchase which of course is a rather complex issue.
3. The product innovations in dairy cooperatives measured by the number of produced assortments each year grew. In 2004 it was on average over nearly 31 products and at the end of the period, i.e. in 2014 this number increased almost to 44 articles. Nevertheless the increase of the number dairy assortments drops significantly. It suggests that the number of dairy assortments on market approaching to saturation. It can be assumed that the introduction of a new assortment of greater added value will probably lead to the withdrawal of another less popular and profitable.
4. The study shows that the total costs for environmental protection in the research period accounted for 0.5% of the total costs. So more or less every two hundredth currency unit is spend in the Polish dairy cooperatives for activities related with environmental protection. It is important that the profitability of dairy cooperatives is generally very low and increase the cost for any purpose can cause rapid deterioration of liquidity and profitability of the production Therefore the financial efforts of dairy cooperatives to protect the environment should be assessed as relatively high.
5. In the research period small and medium sized cooperatives had a downward trend in milk collection volume. Purchase grown primarily in the largest cooperatives. Bearing in mind the necessity of increasing the financial profit it should be emphasized that small and medium-sized co-operatives have an exceptionally difficult task. The key in this regard may be more attractive and improve quality of processing in which the cost of raw materials will tend declining despite rising purchase prices of milk.

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### Streszczenie

Celem artykułu jest ustalenie, czy na produkcję spółdzielni mleczarskich, mierzoną wartością sprzedaży, wpływają w sposób kluczowy innowacje produktowe oraz koszty związane z ochroną środowiska. Stwierdzono, że czynniki te są istotne. Dane dotyczyły lat 2004-2014. Ustalono, że koszty zagospodarowania ścieków są niewspółmiernie wysokie względem dynamiki produkcji i cen artykułów mleczarskich. Okazało się, że wymogi dotyczące ochrony środowiska są tak restrykcyjne i ekonomicznie skuteczne, że ich pomijanie może doprowadzić spółdzielnię mleczarską do coraz większych trudności finansowych, technologicznych i prawnych. Ustalono również, że tempo przyrostu liczby artykułów mleczarskich wyraźnie spada, co sugeruje zbliżanie się różnicowania asortymentowego podaży do stanu nasycenia.

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