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INNOVATIONS IN THE FIELD OF SUSTAINABLE DEVELOPMENT IN THE DAIRY INDUSTRY ON THE EXAMPLE OF THE 10 LARGEST POLISH COMPANIES®

Innowacje z zakresu zrównoważonego rozwoju w branży mleczarskiej na przykładzie 10 największych polskich firm®

Key words: innovation, dairy industry, binary variables, clusters, District Dairy Cooperatives.

The article attempts to assess the use of innovations in the dairy industry in the area of sustainable development in this sector. By analyzing the available literature, articles and magazines, trends and barriers to the use of preferred innovations in the dairy sector were identified.

Słowa kluczowe: innowacja, branża mleczarska, zmienne binarne, klastry, Okręgowe Spółdzielnie Mleczarskie.

W artykule dokonano próby oceny wykorzystywania innowacji w branży mleczarskiej z obszaru zrównoważonego rozwoju w tym sektorze. Analizując dostępną literaturę, artykuły i czasopisma wskazano trendy i bariery stosowania preferowanych innowacji w sektorze mleczarskim.

INTRODUCTION

The contemporary food market, which is characterized by high risk and uncertainty, is constantly changing. Consumer preferences and the aggressive competition of food processing companies have a particular impact on the dynamics of changes in this area. Companies wishing to remain competitive, to develop and be expansive on the domestic and global market, are obliged to implement innovations covered by the sustainable development program¹.

Obtaining up-to-date and objective information on systemic consumer behavior in the market is a path leading to the development of companies in a dynamic environment. In order to compete in a turbulent environment, food processing companies must evaluate their products from the perspective of consumers and competitors. Inspired by the recommendations of the sustainable development program, they should constantly monitor their offers and improve them by implementing new technologies and techniques that improve and eliminate undesirable properties of products, important for a potential consumer.

¹ Work on new products begins with the so-called basic research, which consists in determining the basic technical properties of a product (its basic functions) and the technology that will allow to obtain these properties [15, p. 10].

The evolution of the concept of innovation has resulted in a broader definition of innovation. In subsequent editions of the Oslo Manual [8, 9, 10], innovation is understood as the introduction of a new or significantly improved product (good or service), process, new marketing method or a new organizational method to the work environment or external relations of the organization. Such activities can be considered innovative when the product, process, marketing or organizational method is new or significantly improved on the enterprise scale [6, pp: 159–164].

In the source literature [1, 4, 7, 11] the most common are divisions of innovation into product and process, but since the publication of the Oslo Manual [8], more and more attention has been paid to organizational and marketing innovations.

Analysis of the potential effects of using key organizational and technical innovations in food processing

AH Jasiński [4, p. 6] distinguishes three basic types of innovation: (1) product (new products), (2) process (new production processes) and (3) service (new services).

The Oslo Manual [8, 9, 10, 11, 12] also distinguishes organizational innovations that consist of changes in the organization and management of a company or changes in

the organization of work. Their purpose may be to reduce costs, increase labor productivity or gain access to scarce assets. Jasiński and his team [5] believe that organizational innovations relate to, inter alia, to employee training systems, principles of learning and sharing knowledge within the company, creating new business models and managing in the enterprise. L. Białoń [1] and AH Jasiński [4] define organizational innovations as management innovations. The Oslo Manual [8, 9, 10, 12] also distinguishes between marketing innovations that are not of interest in this article.

On the other hand, organizational and technical innovations can be defined as organizational innovations supported by new technologies or with technical support [4, p. 7]. The authors of the article believe that the group of key organizational and technical innovations in food processing includes the following modern logistics concepts and management solutions:

1. Introduction of a logistic solution to prevent and counter extreme weather conditions and their degradation,
2. Unification, at the European Union level, of measures to prevent the collapse of bee colonies,
3. Creating a platform to fight global speculation on the commodity markets, causing an increase in food prices, which implies a crisis situation in poor regions of the world, using the logistic concept of the Control Tower,
4. Statutory transfer, to the domain of the EU Government Center, of responsibility for food safety,
5. Intensification of research and development works towards the development of oil substitutes, which will eliminate the uncontrolled increase in food prices,
6. Protection against chemical soil contamination to prevent the killing of plants, animals and trees,
7. Producing genetically modified food friendly to the human body.

In the constructed model of food processing management, the initiator of the introduction of key organizational and technical innovations that affect the organization and functioning of the Polish food industry should be the National Government Center.

From the perspective of time, research seems to be quite important for our considerations [2] and analyzes [3] carried out by M. Chądzyński. They allowed the author to formulate, inter alia, such a conclusion that the examined dairy cooperatives² in the years 2004-2012 they focused their innovative activities mainly in the area of production, purchase, distribution and product, and to a lesser extent on packaging and marketing. The dairy cooperatives analyzed by him mainly implemented technological, technical and packaging innovations. They implemented the least organizational and marketing innovations.

MATERIALS AND METHODOLOGY OF RESEARCH

The main research instrument was a critical comparative analysis of materials, studies and reports of 10 Polish milk processing companies, which together have the vast majority

of the milk processing market in Poland (data from 2020). The subjects of the research sample (dairy cooperatives and commercial law companies) were selected on the basis of the sales volume data submitted for 2020 to the National Court Register. It includes (in order of sales volume): MLEKOVITA Group, Mlekpól SM, Piątnica OSM, Polmlek Group, Danone Sp. z o. o., Łowicz OSM, Zott Polska Sp. z o. o., Lactalis Polska Sp. z o. o., Koło OSM, Sierpc OSM.

Based on the available data presented by the 10 Polish milk processing companies of the research sample, 11 binary dependent variables reflecting complexity were defined and the versatility of innovations aimed at implementing sustainable development in the surveyed organizations.

The dependent binary variables are defined and grouped as follows:

- three binary variables representing product innovations (bv_prod_1 - bv_prod_3), where:
 - bv_prod_1 means the production of new, innovative products consistent with the principles of sustainable development,
 - bv_prod_2 represents the implementation of significantly improved, innovative products consistent with the principles of sustainable development,
 - bv_prod_3 concerns the use of innovative components from the production process of products consistent with the principles of sustainable development,
- four binary variables representing process innovations (bv_proc_1 - bv_proc_4), where:
 - bv_proc_1 means the implementation of a new or improved innovative production process consistent with the principles of sustainable development,
 - bv_proc_2 represents the use of new or improved innovative manufacturing techniques consistent with the principles of sustainable development,
 - bv_proc_3 concerns the application of new, innovative technologies in the process of sustainable production,
 - bv_proc_4 represents the application of new, innovative technologies aimed at the implementation of sustainable development in the auxiliary activities of the enterprise,
- two binary variables representing marketing innovations (bv_market_1, bv_market_2), where:
 - bv_market_1 concerns innovative changes in the design of a sustainable product,
 - bv_market_2 represents innovative changes in packaging aimed at achieving sustainable development,
- two binary variables representing organizational innovations (bv_org_1, bv_org_2), where:
 - bv_org_1 means innovative organizational methods regarding internal, sustainable principles of the company's operation,
 - bv_org_2 concerns innovative organizational methods in the field of corporate relations with the environment in the field of sustainable development.

Each of the binary variables is assigned a value of 1 if the analyzed organization introduces innovations in the field of sustainable development in the studied area or 0 otherwise.

2 32 dairy cooperatives participated in the research, the time scope covered the years 2004–2012.

The total number of points collected using 11 binary variables allows to determine the level of consistency or differentiation of the research sample and to categorize each result in one of five possible clusters³:

- cluster 1: 10 – 11 points - excellent level of implementation of innovations in the field of sustainable development,
- cluster 2: 8 – 9 points - very good level of implementation of innovations in the field of sustainable development,
- cluster 3: 6 – 7 points - good level of implementation of innovations in the field of sustainable development,
- cluster 4: 4 – 5 points - satisfactory level of implementation of innovations in the field of sustainable development,
- cluster 5: 0 – 3 points - insufficient level of implementation of innovations in the field of sustainable development.

The main limitation of the analysis was the inconsistency in the reporting and presentation of data in the analyzed categories by the research sample organizations. It should also be remembered that non-financial reporting in the field of sustainable development is not obligatory in Poland and that none of the surveyed entities is a public joint-stock company, which results in limited access to sources of information and data on research sample entities and their activities in the studied area.

ANALYSIS AND RESEARCH RESULTS

None of the analyzed organizations was included in the highest cluster (No. 1). 2 out of 10 surveyed enterprises (which constitutes 20% of the research sample) were classified to the second cluster - representing a very good level of implementation of innovations in the field of sustainable development. In this cluster, there are Piatnica OSM and Danone Sp. z o. o., both entities achieving a score of 8 out of 11 possible points in the same categories of binary variables, i.e. *bv_prod_1*, *bv_prod_2*, *bv_proc_2* - *bv_proc_4*, *bv_market_2* and *bv_org_1* and *bv_org_2*. In the category of innovations applied in the organizations assigned to this cluster, the following deserve special attention: the implementation of ISO 9001 and ISO 14001 standards, the food safety system according to HACCP and the environmental management system, as well as the international certificate International Food Standard, which contribute to the implementation of innovations in the field of sustainable development. Moreover, high rates of waste recovery and recycling, as well as the use of electricity from renewable energy sources both in the production process itself and in the auxiliary activities of enterprises, contributed to obtaining the best result in the tested sample.

3 definition of M Porter: „[...] a geographic concentration of interconnected firms, specialized suppliers, service providers, companies operating in related sectors and related institutions (for example universities, standardization bodies and industry associations) in specific fields competing with each other, but also cooperating” [13]; normative definition in the Polish legal system: „a cluster is understood as the spatial and sectoral concentration of entities operating for economic development or innovation, and at least ten entrepreneurs operating in one or more neighboring voivodeships, competing and cooperating in the same or related industries and connected with an extensive network of formal and informal relationships.

Most enterprises – 40% of the research sample, i.e. 4 out of 10 surveyed organizations, were qualified to cluster no. 3, representing a good level of implementation of innovations in the field of sustainable development. This cluster includes: Łowicz OSM, Zott Polska Sp. z o. o., Lactalis Polska Sp. z o. o. and Polmlek Group. The first three entities obtained a score of 7 out of 11 possible points in the adopted categories of binary variables, the last of them by 1 point less. In this cluster, the diversity of scoring in individual categories of binary variables is much greater than in the case of cluster 2. The only consistent categories of binary variables in which all entities obtained points are: *bv_prod_2*, *bv_proc_2* and *bv_org_2*. In the category of innovations applied in the organizations assigned to this cluster, it deserves special attention to solutions for product innovations consisting in the development of new products, taking into account their impact on the natural environment by reducing the consumption of natural resources, reducing waste and pollutant emissions, as well as created in accordance with the principles of organic and certified farming in this regard.

In terms of the use of new or improved innovative manufacturing techniques consistent with the principles of sustainable development, improving the efficiency of production machines in order to increase the productivity and quality of products while reducing the harmful environmental impact, including emission of pollutants to soil, water and air and reducing CO₂ emissions deserve special attention. In addition, it is important to improve energy efficiency through the use of electricity from renewable sources (wind), which will allow the complete elimination of CO₂ emissions in the milk processing.

The greatest commitment of the surveyed entities is observed in the category of packaging innovation:

- the introduction of aluminum-free packaging, thus reducing the consumption of fossil raw materials and increasing the share of renewable raw materials in the packaging,
- reducing the amount of packaging materials and using materials that have a lower impact on the environment,
- introduction of packaging 100% suitable for recycling,
- responsibility for collection and recycling of packaging,
- leading research on the possibility of using mono-foil in packaging in order to minimize the impact on the natural environment.

The surveyed entities also attach great importance to communication with internal and external stakeholders in the field of sustainable development.

Another 20% of the respondent companies dealing with milk processing (Mlekovita Group and Sierpc OSM) achieved a satisfactory level in the implementation of innovations in the field of sustainable development and were qualified to cluster no. 4, achieving respectively a score of 5 and 4 out of 11 possible. The activities of the Mlekovita Group with an environmentally friendly approach to product packaging result in the reduction of the grammage of plastics in the packaging. In terms of application of new, innovative technologies aimed at the implementation of sustainable development in the company's auxiliary activities, environmentally friendly boiler houses and combined heat and power plants have been implemented.

OSM Sierpc, on the other hand, has implemented and is implementing a number of pro-ecological innovations in the production process, including: modernization of the energy management of the cheese department, change of production processes to reduce the water consumption rate, construction of an automated water treatment station which goal is to meet all restrictive savings standards in filter rinsing. OSM Sierpc has also taken a number of activities aimed at reducing water consumption, including:

- modernized and stable media management: water, sewage,
- continuous analysis of water consumption enabling the control of its use in the plant,
- the use of the most efficient production technologies in terms of the use of water,
- reuse of water, e.g. for washing devices, machines,
- modernization of the sewage treatment plant.

OSM Sierpc also uses new, innovative technologies aimed at implementing sustainable development in the production and auxiliary activities of the enterprise:

- use of energy tanks to recover heat from whey and cold from milk - stored at 4°C, which allows for energy savings for pasteurization and subcooling of products,
- construction of own sewage biogas plant and a system for generating thermal energy exclusively from biogas produced from sewage, which is a pioneering solution in the Polish dairy industry,
- construction of a water boiler room with economizers allowing the use of flue gas to heat the plant premises.

As a result, the production plant leaves almost no carbon footprint, which is unique among milk processing companies.

The remaining 2 surveyed organizations, i.e. Koło OSM and Mlekpól SM, were qualified to the insufficient level cluster no. 5 and obtained respectively 3 and 2 points out of 11 possible.

CONCLUSIONS

The conducted analysis (taking into account its limitations described earlier) clearly shows the awareness of the surveyed entities about the need to implement innovations in the field of sustainable development. Nevertheless, the level of implementation leaves room for progress. It should be taken into account that innovative investments aimed at the implementation of sustainable development are both costly and time-consuming, hence the full effects of this action may only be observed in the future. The analysis also shows that in the case of most of the surveyed entities, the implemented innovations relate to: the use of new or improved innovative

manufacturing techniques consistent with the principles of sustainable development (9 out of 10 surveyed entities), the implementation of significantly improved, innovative products consistent with the principles of sustainable development and the use of new, innovative technologies aimed at the implementation of sustainable development in ancillary activities of the enterprise (in both cases 8 out of 10 surveyed entities) and the use of new, innovative technologies in the process of sustainable production (7 out of 10 surveyed entities). However, none of the companies in the research sample made innovative marketing changes in the sustainable product design. This means that enterprises focus on cost-intensive and time-consuming process and product innovations instead of reaching for “low-hanging fruit” in the form of marketing or organizational innovations. innovative technologies in the process of sustainable production (7 out of 10 surveyed entities). However, none of the companies in the research sample made innovative marketing changes in the sustainable product design. This means that enterprises focus on cost-intensive and time-consuming process and product innovations instead of reaching for “low-hanging fruit” in the form of marketing or organizational innovations.

WNIOSKI

Przeprowadzona analiza (biorąc pod uwagę jej ograniczenia opisane wcześniej) jednoznacznie wskazuje na świadomość badanych podmiotów o konieczności wdrażania innowacji z zakresu zrównoważonego rozwoju. Niemniej poziom wdrażania pozostawia przestrzeń do postępów. Należy wziąć pod uwagę fakt, że inwestycje innowacyjne mające na celu wdrażanie zrównoważonego rozwoju są zarówno kosztowne, jak i czasochłonne stąd pełne efekty tego działania mogą zostać zaobserwowane dopiero w przyszłości. Analiza wskazuje także, że w przypadku większości badanych podmiotów wdrażane innowacje dotyczą: wykorzystania nowych lub ulepszonych innowacyjnych technik wytwarzania zgodnych z zasadami zrównoważonego rozwoju (9 z 10 badanych podmiotów), wdrożenia znacząco ulepszonych, innowacyjnych produktów zgodnych z zasadami zrównoważonego rozwoju oraz zastosowanie nowych, innowacyjnych technologii mających na celu wdrożenie zrównoważonego rozwoju w działalności pomocniczej przedsiębiorstwa (w obu przypadkach 8 z 10 badanych podmiotów) oraz zastosowania nowych, innowacyjnych technologii w procesie zrównoważonej produkcji (7 na 10 badanych podmiotów). Żadne z przedsiębiorstw próby badawczej nie dokonało natomiast innowacyjnych zmian marketingowych w projekcie produktu zrównoważonego. Oznacza to, że przedsiębiorstwa koncentrują się na kosztochłonnych i czasochłonnych innowacjach procesowych i produktowych zamiast sięgnąć po „nisko wiszące owoce” w postaci innowacji marketingowych czy organizacyjnych.

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