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# SUGGESTIONS OF DEVELOPMENT OF AGRICULTURAL FARMS, SPECIALISED IN MILK PRODUCTION

## SUGESTIE ROZWOJU GOSPODARSTW ROLNYCH SPECJALIZUJĄCYCH SIĘ W PRODUKCJI MLEKA

**Summary:** In the paper, the development of dairy farms was described; different factors, determining the development of milk production were considered. They include, for example, the application of modern technical and technological solutions.

The development of milk-producing farms requires constant investments and extending their activities e.g. by a direct sale. In the article, the financial-economic analysis of investing on a given farm was carried out. It has revealed that such investment is profitable and brings advantages. The planned investment is characterized by many strong points and the most important one includes a financial stability of the farm and the openness of the owner to novelties. The weakest side of the investment is a big distance from the site of milk sale. It has been found that the competitiveness of Polish farmers is affected by innovations and modern technologies, introduced to the farms.

**Keywords:** agricultural farm, dairy cattle, milk production, innovative technologies

**Streszczenie:** W artykule opisano rozwój gospodarstw mleczarskich i wzięto pod uwagę różne czynniki determinujące rozwój produkcji mleka. Obejmują one na przykład zastosowanie nowoczesnych rozwiązań technicznych i technologicznych.

Rozwój gospodarstw produkujących mleko wymaga ciągłych inwestycji i rozszerzenia ich działalności, np. przez sprzedaż bezpośrednią. W artykule przeprowadzono analizę finansowo-ekonomiczną inwestycji w danym gospodarstwie. Okazało się, że taka inwestycja jest opłacalna i przynosi korzyści. Planowana inwestycja charakteryzuje się wieloma mocnymi stronami, a najważniejszą z nich jest stabilność finansowa gospodarstwa i otwartość właściciela na nowości. Najsłabszą stroną inwestycji jest duża odległość od miejsca sprzedaży mleka. Stwierdzono, że na konkurencyjność polskich rolników wpływ mają innowacje i nowoczesne technologie wprowadzane do gospodarstw.

**Słowa kluczowe:** gospodarstwo rolne, bydło mleczne, produkcja mleka, innowacyjne technologie

### Introduction

The situation on Polish dairy market in 2015 was affected by two opposite tendencies. One of them was liquidation of dairy quotas and, hence, a greater freedom in undertaking the decisions by milk producers and processors. The second tendency includes the consequences in exceeding the dairy quotas and the related financial penalties [20].

Modern technical-technological solutions in the dairy farms have the influence on the increase in profitability, supplementation of knowledge on the dairy herd as well as on more effective time management. The profits, resulting from the application of innovative technologies are meaningful and affect the generation of the successive modern solutions [18].

The introduction of modern technical and technological solutions in agricultural farms has a principal meaning due to

the adaptation of Polish agriculture to the EU requirements and rising of the economic effectiveness of the farms [4].

Innovation in the agricultural sector must consider the specificity of the discussed sector of economy, first of all, biological and spatial character of production; it is connected with the long manufacturing cycles, dependence of production on the quality of agricultural manufacturing space and seasonality of production [9]. Reorganization of production in the farm may be related to the change of the production direction, diversification of the income sources or organization of the farmers in the producers' groups and transfer of modern technologies connected with the introduction of the precision agriculture [8].

The contemporary agriculture is subjected to very dynamic changes and development in many aspects, in particular, via application of innovative machines and equipment in

manufacturing processes. In the farms, many new technologies have been introduced; they improve the conducted work, affect the time and energy saving and in-time performance of the operations; they increase also significantly the quality of farm management and by this, production capacities of a given farm. Apart from new machines and technologies, we have also to mention a development of communication and transfer of information in agriculture. At present, the agriculture requires defined, specialized, reliable and current information. A farmer must update his knowledge as well as the tendencies and prognoses in the agricultural sector in which the specialization is carried out [15, 1]. In respect of modern animal breeding, a special attention should be paid to such instruments as genetics, technology of cattle management and monitoring, technologies of milk production, modern reproduction and farm management systems [22]. The number of farms, possessing modern equipment including standard application of computer is increasing every year; however despite their potential, farmers utilize specialist software in a small degree although it supports farm management and development. The farmers are not aware of their potential; they do not know the full possibilities of computerization [6, 3, 13]. The so-called decision-supporting systems [11] and the systems of animal monitoring [22] become more and more important.

The changes concerning the new technical and technological solutions are recorded in the field of animal production. Most of them are connected with the modernization of farm premises, adaptation to the hygienic and veterinary requirements, set by the receivers of agricultural products (e.g. milk), increase of the number of animal population, improvement and facilitation of service work and ensuring the appropriate animal welfare [16, 19]. Modernization in the cowsheds included, first of all, rebuilding and assembling new equipment. The systems of animal service, removal and storage of manure and animal feeding systems have been mechanized and automated (Fig. 1 – Fig. 4). The milkshed is a fundamental component of animal protection from the harmful effects of external factors and it should be so designed, constructed and equipped as to meet all requirements of animal welfare [17, 21].

*Fig. 1. View of milk barn with feeding corridor [photo made by the employees of the Institute]*



*Fig. 2. Milking parlour of „herringbone“ type [24]*



*Fig. 3. View of a milking robot [photo made by the employees of the Institute]*



*Fig. 4. Cooling tank for milk [photo made by the employees of the Institute]*



Introduction of modern technologies, employed in the milk production causes the improvement of the conditions of animal management, effectiveness of feed utilization as well as improvement of working conditions and decrease in labour consumption. The increase in a raw material production is a result of the mentioned changes. A high yield and minimization of work outlays may be obtained via introduction of modern systems of the milk production in a farm e.g. owing to the application of milking robots (Fig. 3) or milking parlours (Fig. 2) [2, 8]. The farms equipped with automatic milking system may monitor milk quality and animal health state more precisely.

Apart from the introduction of modern technologies, the modern methods for development of agricultural farms, specialized in milk production include also a direct sale of the raw milk, using automatic milk vending machine („mlekomat” in Polish) [10], what allows obtaining the additional income, besides selling the milk to a dairy plant.

### The aim, the scope and the methods of the studies

The aim of the conducted studies was to develop a conception of farm development in aspect of increasing the production profitability. The scope of the studies included the analysis of a dairy-specialized farm on the grounds of the agricultural farm, situated in the Mazovian voivodeship, Ostrołęka province, Goworowo community. The studies were conducted in the period of October 2016 until March 2017 based upon the analysis of the materials collected during the visits at the agricultural farm and the documentation received from the owner of the farm. Also, SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the planned investment in the farm was carried out.

The total area of the farm at the moment of analysis was equal to 102 ha. The cultivation of maize and cereal mixtures

was the main direction of vegetal production in the farm. The population of the animals consisted mainly of the dairy cattle (91 heads), including 63 HF cows.

Additionally, the materials, obtained from the companies dealing with the production of milk vending machines were utilized. Finally, there was developed the conception of the change in the distribution of the produced milk, adding the direct milk sale ([project).

### The results of the studies and discussion

The main investment which is expected to bring the additional incomes obtained from the farm is a milk vending machine. As the farmer does not possess a sufficient amount of his own means for financing the discussed investment, the solution will come from the means obtained from the preferential credit of NT (New Technologies) line. The financial-economic analysis considered a specificity of the studied farm, the success of which would depend on some different factors, including the most important ones: demand on milk from „automatic machine” and failure-free performance of the mentioned device. The example of the milk vending automatic machine is given in Fig. 5.

When undertaking a decision on the purchase of milk vending machine, we should expect certain formalities; first of all, a farmer should submit the application to the competent veterinary service and Sanepid (Sanitary Inspection). It is necessary to obtain the confirmation of the technological project of the plant, on the way of the administrative decision of the provincial veterinary surgeon and then, to obtain the entry in the register of the plants, conducting the economic activity in a form of direct sale. The sale of raw milk is then subjected to supervision of Veterinary Inspection. In the case of the milk sale from the automatic vending machine it is necessary to ensure

Fig.5. „Mlekomat” – Milk vending machine [23]



the appropriate protection from contamination and unfavourable atmospheric conditions.

The choice of the appropriate device and its location is a very important issue. The farmer may sell the raw milk in automatic device which is situated at the territory of his farm, market or e.g. retail shop. However, the choice of the proper place includes not only its situation e.g. near trade supermarket but also the respective distance from the farm. The longer is the distance, the higher become the costs of milk delivery. In the light of the present costs of fuel, it may be a very important element which affects the profitability of the whole investment. A simplified cost and income analysis concerning automatic milk vending machine based upon the data from T-milk company has been given below.

The purchase of the milk vending machine is the greatest expense born by the farmer. At present, there is a wide offer on the market in this respect; the cost of the simplest device is 30 000 PLN; the most expensive one – more than 100 000 PLN. The choice of the appropriate version (more expensive, cheaper) should be very reasonably analysed because it decides about the time of the investment return and, consequently, the undertaken risk. It was demonstrated that the purchase of the most expensive version caused that the return of the investment was prolonged in the period of up to 2 years.

When analysing financing of the investment, i.e. the purchase of automatic milk vending machine, we should take into consideration that the companies offer the sale in instalments, leasing or credit. The calculations given in Tab. 1 assume the purchase of the device with financing obtained from the credit with interest rate equal to 9.87% ·year<sup>-1</sup>. The own input of the farmer is 20% of the investment value. The cost of

the credit service during the first year in investing (interests) at the investment = 35 000 PLN would amount to ca. 2800 PLN. The payments for location are widely differentiated; the more convenient is the place, the higher the payments are. The monthly expense is found on the level of 200-500 PLN (300 PLN was adopted). The payment for electric energy is 100-250 PLN·month<sup>-1</sup>. In the case of the analysed farm, the payments 100 and 200 PLN were adopted.

When analysing the outlays on the milk transport, the distance of 100 km in one direction and twenty passages per month were adopted for calculations (Goworówek – Warsaw). The remaining costs are found on the level of ca. 500 PLN (e.g. cleaning agents). The costs of service during the first two years are not born (the period of guarantee is 2 years + additional insurance for the successive three years in the price of milk vending machine).

The sale of milk being possible to be reached during a year is about 40-50 thousand litres. The selling price of milk in vending machine is shaped on the level of 3 PLN·litre<sup>-1</sup>. The prices are rather differentiated and may reach even more than 4 PLN. On the other hand, the prices of milk obtained by the farmers in the dairy plants differ very much from the presented above costs and they amount to 1.3 PLN·litre<sup>-1</sup> – 1.8 PLN·litre<sup>-1</sup>. In the calculations, the actual price in the analysed farm was adopted, i.e. 1.65 PLN·litre<sup>-1</sup>.

With the mentioned above assumptions, the surplus of income from the sale of milk in the milk vending machine in relation to the sale in the dairy plant is equal to 74 000 PLN and 82.500 PLN in the remaining examples. We should pay attention to the fact that the mentioned surplus comes from the difference in the price of milk sale in the vending machine and in the dairy

Tab. 1. Simplified financial-economic analysis of the studied farm in the case of the purchase of milk vending machine (prices in PLN) [own elaboration]

Variants	Variant I	Variant II	Variant III	Variant IV
<b>Investment costs</b>	35 000	60 000	85 000	125 000
<b>Costs of credit service (interests)</b>	2 763.6	4 737.6	6 711.6	9 870
<b>Payment for the place</b>	3 600	4 800	6 000	6 000
<b>Electric energy</b>	1 200	1 200	2 400	2 400
<b>Milk transport</b>	20 000	20 000	20 000	20 000
<b>Other costs</b>	500	500	500	500
<b>Costs in total:</b>	<b>28 063.6</b>	<b>31 237.6</b>	<b>35 611.6</b>	<b>38 770</b>
<b>Annual sale in litres</b>	40 000	40 000	50 000	50 000
<b>Selling price per 1 litre in vending machine</b>	3.5	3.5	3.5	3.5
<b>Sale value</b>	<b>140 000</b>	<b>140 000</b>	<b>175 000</b>	<b>175 000</b>
<b>Price of milk purchase per 1 litre at dairy plant</b>	1.65	1.65	1.65	1.65
<b>Value of milk sold to the dairy plant</b>	<b>66 000</b>	<b>66 000</b>	<b>82 500</b>	<b>82 500</b>
<b>Surplus of income from milk vending machine</b>	<b>74 000</b>	<b>74 000</b>	<b>92 500</b>	<b>92 500</b>
<b>Surplus of income – costs</b>	<b>45 936.4</b>	<b>42 762.4</b>	<b>56 888.4</b>	<b>53 730</b>
<b>Return of investment in the years</b>	<b>0.761923</b>	<b>1.403102</b>	<b>1.494153</b>	<b>2.326447</b>

plant, that is, it makes the additional income of the milk producer. We should also stress that the considerable costs are generated by transport (distance Warsaw – Goworówek). When bearing in mind the existing demand on such healthy and traditional products, we may expect development of selling markets; owing to this fact, it will be possible to invest additionally (e.g. the purchase of the successive milk vending machine and placing it in another site in Warsaw).

## SWOT analysis

SWOT analysis is the universally employed and recognized method of strategic analysis of a given enterprise. Due to its universal application, the discussed method may be employed in the identification of significant problems and their solutions in the agricultural sector; it may be applied when considering the strong and weak points of different planned investments. It facilitates the assessment whether a given investment has a chance for development and bringing the appropriate incomes. It also allows undertaking the proper measures enabling the effective activity as well as allowing forecasting the chances and threats to a given undertaking [5].

On the grounds of the above SWOT analysis it may be stated that the planned investment has many strong points where financial stability of the farm and open attitude of the owner to the changes are the most important elements. On the other side, the weak point on the planned undertaking includes a long distance from the place of the milk sale.

According to Jankowski and Sosnowski [2011], specialization of farms in milk production and their concentration, the increasing number of dairy herds and the increase of milk yield are the main determining factors of obtaining the stable sources

of incomes by the farmers. In the examined farm, the number of dairy cows and their yield is increased every year.

The increase in cow milk yield and production performance in the farms plays a decisive role in the improvement of profitability [13]. In the examined farm, the own capital played a significant role but in the case of financing the investments, foreign capital was also meaningful.

According to Kałuża and Gintar [2014] the modern technical and technological solutions concern all domains of agriculture, from furnishing of farm premises, via agricultural machines and equipment, computerized systems, precision agriculture and biological progress to the investments, giving the additional income source. In the analyzed farm, a constant development is recorded: equipment of the cow house, application of computer in the farm for herd management and well equipped machinery park. The modern technology includes the purchase of automatic milk vending machine which will become the innovation on a local market and, simultaneously, it will bring the additional source of income.

The agriculture is subjected to dynamic changes in order to adapt to the existing social and economic conditions [Borusiewicz 2009]. The examined farm belongs to the highly developmental, dynamic units, being flexible to the needs of the market and the requirements of the consumers. The way to success consists - first of all - in modernization of infrastructure and production engineering, introduction of innovative technological solutions and application of the modern management methods [12]. The owners of the analysed farm are open to the new technologies what is manifested in the application of appropriate computer systems for farm management and searching for innovative solutions such as purchase of automatic milk vending machine and its use in the direct sale.

Tab. 2. SWOT analysis (own elaboration)

Strong points of undertaking	Weak points for investing
<ul style="list-style-type: none"> <li>• Farm has a convenient communication with a planned targeted site of milk vending machine</li> <li>• Owner of farm updates his knowledge and possesses a long time experience</li> <li>• Farm specialized in milk production</li> <li>• Very well equipped park of machines and agricultural devices</li> <li>• Possession of own capital and the possibility of obtaining credit for planned equipment</li> <li>• Well established market position gives a guarantee of stabilized incomes</li> <li>• Obtaining of natural raw material – what is very much desired on the market</li> </ul>	<ul style="list-style-type: none"> <li>• Considerable distance to the milk sale place (100km in one direction)</li> <li>• Relatively high price of milk vending machine</li> </ul>
Chances for investment	Threats to the investment
<ul style="list-style-type: none"> <li>• Increase of popularity of organic food consumption</li> <li>• Margin higher than in the case of the sale carried out by other channels</li> </ul>	<ul style="list-style-type: none"> <li>• Technological barrier, problems connected with the operating the milk vending machine by the consumers,</li> <li>• Difficulties with the obtaining the permit for installing the milk vending machine in the attractive places</li> </ul>

## Summing up and conclusions

Investing in development of the dairy farms is profitable and brings many advantages. The planned investment, presented in the publication, has many strong points and its implementation will allow increasing the incomes coming from milk sale and developing outlet market via utilization of the new forms of direct sales of the raw milk in the devices, called automatic milk vending machines ("Mlekomat" in Polish). The sale of the milk in the discussed form brings also profits for the consumer who may buy any quantity of fresh non-pasteurized milk at any time of the day or night; it may lead to the increase of milk consumption. At the beginning, a farmer must bear high costs of purchase of the discussed equipment from his own means or obtaining a credit; he must plan appropriately the transport matters as not to increase his expenses. Despite the born costs, he may expect a considerable surplus of the income, coming from the milk sale from the discussed automatic machine as compared to the direct sale to the dairy plant. Owing to the increased income, the farmer may develop further his farm and invest in the purchase of the successive vending machine in order to increase the sale.

## Literature

- [1] Borusiewicz A. 2009. Wykorzystanie specjalistycznych programów komputerowych i Internetu w gospodarstwach rolnych. Acta Sci. Pol. Technica Agraria 8(3-4) s. 3-8.
- [2] Botreau R., Veissier I., Butterworth A., Bracke M.B.M. and Keeling L.J. 2007. Definition of criteria for overall assessment of animal welfare Animal Welfare 16, s. 225-228.
- [3] Cupiał M. 2008. Zapotrzebowanie na programy komputerowe w rolnictwie na przykładzie gospodarstw województwa małopolskiego. Inżynieria Rolnicza 9(107), s. 55-60.
- [4] Dąbrowski K. 2008. Uwarunkowania technicznej modernizacji towarowych gospodarstw rolnych w okresie przemian. Zeszyty Naukowe OTN 22, s. 271-288.
- [5] Grajewska A.K. 2011. Kierunki rozwoju gospodarstwa mlecznych w Polsce do 2014 roku w świetle analizy SWOT, równań trendu i metody PEST, Roczniki Ekonomiczne Kujawsko-Pomorskiej Szkoły Wyższej w Bydgoszczy, 4, str. 193-221.
- [6] Grudziński J. 2006. Technologie informacyjne w systemach doradczych zarządzania gospodarstwem rolnym. Inżynieria Rolnicza 58(80), s. 207-213.
- [7] Jankowski K., Sosnowski J. 2011. Wpływ intensywności gospodarowania na efekty produkcyjne gospodarstw mlecznych. J. Res. Appl. Agric. Eng. 56 (1), s. 55-58.
- [8] Kałuża H., Ginter A. 2014. Innowacje rolnicze w gospodarstwach młodych rolników. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu 361, s. 89-92.
- [9] Kałuża H., Rytel M. 2010. Innowacyjność w świetle studium przypadku gospodarstw rolniczych z gminy Mokobody. Roczniki Naukowe Seria t. XII, Z. 5, s. 68-69.
- [10] Kisiorowska M. 2012. Mlekomy - nowy sposób bezpośredniej sprzedaży mleka surowego w Polsce. Eneengineering Sciences and Technologies, 4(7), s. 72-82.
- [11] Kozłowski R. J., Weres J., Rudowicz-Nawrocka J. 2011. Komputerowe systemy wspomaganie decyzji w zarządzaniu gospodarstwem rolniczym. Instytut Inżynierii Rolniczej, Uniwersytet Przyrodniczy w Poznaniu, Ekspertyza AgEngPol, ss. 64.
- [12] Krzymuski J. (red.). 2003. Komputerowe systemy wspomaganie decyzji w zarządzaniu gospodarstwem rolniczym. Wydawnictwo Prodrug, ss. 65.
- [13] Lorencowicz E., Figurski J. 2008. Ocena wykorzystania komputerów i Internetu w indywidualnych gospodarstwach rolnych. Acta Sci. Pol. Technica Agraria 7(3-4), s. 29-34.
- [14] Malaga-Toboła U., Kocira S. 2013. Intensywność organizacji produkcji w ekologicznych i konwencjonalnych gospodarstwach mlecznych. J. Agribus. Rural Dev. 1(27), s. 153-165.
- [15] Mueller W., Boniecki P., Joachimiak H. 2008. Internetowy system wspomagający zarządzanie usługami rolniczymi. Inżynieria Rolnicza 9(107), s. 227 - 233.
- [16] Nawrocki L. 2009. Technika a dobrostan bydła. Oficyna Wydawnicza Politechniki Opolskiej. ISBN: 978-83-60691-54-0, ss. 222.
- [17] Neja W. 2011. Co powinno znajdować się w oborze? Hodowca Bydła, 11, s. 33-37.
- [18] Nowoczesne technologie w produkcji mleka. W: <http://www.farmer.pl/produkcja-zwierzecz/bydlo-i-mleko/nowoczesne-technologie-w-produkcji-mleka,59833.html>, dostęp na dzień 16.09.2015r.
- [19] Romaniuk W. 2000. Kierunki rozwoju mechanizacji i technologii chowu bydła. Inżynieria Rolnicza 2(13), s. 147-154.
- [20] Seremak-Bulge J. 2015. Krajowy rynek mleka w 2015 r. Przegląd Mleczarski 8, s. 43-50.
- [21] Szlachta J. 2007. Analiza systemów zarządzania stadem krów. Problemy Inżynierii Rolniczej 1, s. 67-75.
- [22] Wójcik P. 2013. Nowoczesne technologie w produkcji bydła mlecznego. CDR w Brwinowie, s. 5-26.
- [23] <http://www.bialystokonline.pl/kolejny-mlekomat-pojawil-sie-w-bialymstoku,artykul,84454,8,1.html>, dostęp 10.08.2017 r.
- [24] <http://odrzehowa.com.pl/zaklad/krowy/unia.html>, dostęp 9.08.2017 r.

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