

UDC 330.341.1:636

Kernasyuk Y. V.

Kirovograd state agricultural experimental station
of the Institute of Agriculture of the steppe zone of the NAAS of Ukraine

ECONOMIC, SOCIAL AND ECOLOGICAL ASPECTS OF USE OF THE INNOVATIVE SMART FARM TECHNOLOGIES

The theoretical questions of definition of essence of the concept of «smart farm» are investigated, is proved aspects of its economic, social and ecological influence on increase of competitiveness of production and carried out an economic assessment of efficiency of introduction of technological innovations to branches of dairy cattle breeding.

Key words: smart farm, profitability, milk, innovation, effect

Nowadays it is necessary to develop the agriculture sector with the help of innovation technologies as their introduction to the production will give rise to the level of cost-effectiveness and competitiveness of the industry. Moreover, the transfer to the use of innovation technologies in such branches of agriculture as dairy cattle breeding will also result in social and ecological character of development.

The problem under consideration has not gain the wide popularity among the Ukrainian scientists. Thus, it should be analyzed in a more profound way.

First of all it should be noted that the assessment of economical effectiveness and the payback of the decisions involving the innovation technologies which are based on the notion of «smart farm» are among the most important pressing questions for the investigators.

The notion «smart farm» obtained its meaning in Ukraine only in the recent years as a result of the development of investment project in terms of modern farming building.

However, the particular aspects of the term which are connected with the introduction of the automated and robotics innovation systems have been already investigated by the Ukrainian scientists. (Naumenko, Boyko, Lutsenko, Kudlai)

The aim of the article is to study the theoretical essence of the notion «smart farm», to reveal its economic, social and ecological influence upon the increase of production competitiveness and to specify the effectiveness of the introduction of technological innovations in the field of dairy cattle breeding.

The theoretical grounding of the «smart farm» conception has not acquired its terminological standartization.

«Smart farm» is directed to the creation of the basis for the future dairy cattle breeding.» Generally speaking, «smart farm» stands for desire to quicken the process of transfer from the milking management to the management of general farm profitability by means of using the new methods of taking decisions and innovation technologies in order to increase the quality of milk and revenues. (author's italics).

The term was introduced by the Sweden company in the context of using innovation technologies for milk production on the basis of automated and

robotics milking. Later on, other companies started to use the technologies as the general understanding of the complex management of industry conception for achieving its effectiveness.

«Smart farm» is based on the conception of using the innovation automation technology which gives the necessary economic instruments for taking decisions in what concerns the increase of the milk quality, the herd management, the increase of cows' productivity and level of the profitability.

From our point of view, the theoretical essence of the notion under the investigation lies in the necessity of systematic approach concerning its definition. Thus, the definition can be considered as the totality of innovative decisions as for the automated processes by means of adaptive informational cattle-breeding which provide for the profitable production and optimization of resources.

It is necessary to make a short historic glimpse in order to get a complete understanding and comprehension of the intellectual preconditions of production management in dairy farming.

The development of robotics technology system started at the late seventies of the previous century with the rise of such famous milking equipment enterprises as Lely Industries N. V., Gascoigne Melott which later on became a part of Bou-Matic (The USA), Insentec (The Netherlands), etc. As to DeLaval, the world leader in the production of milking equipment and the first supplier of robots to Russia, the company bought all the rights concerning the use of robot milkers from the institute developer in nineteen ninety-two. From this time onward modifications and development of the invention took place, and as a result the year nineteen ninety eight saw the first commercial sales of Dalaval's robots. Approximately at the same time the market witnessed the appearance of other producers in the field of robotics technology. In 2007, the period of the growing interest towards the development of robotics technology, Westfalia Surge GmbH took a license for the production of robots using Punch Graphix N. V. technologies and integrated the majority of sales services in order to make them available for new clients.

The first automated milking equipment was used in nineteen ninety-two in the Netherlands (Lely Industries N. V. robotic-manipulator). The appearance was determined by the following factors:

- high complexity of the milking process;
- increased demands for the milk quality;
- an increased labor costs for operators of machine milking.

The first line of dairy commodities' farms assisted with robotics milking equipment of Delaval in Ukraine appeared in the March of 2013 in the village Vil`na Tarasivska, Bilortserkivskiy region.

The farm is built on the innovative principles of Voluntary milking system (VMS), which is performed by means of a computerized system of production processes and four robotic manipulators. Two employees operate the livestock during one shift. After milking, the milk comes in two coolers with a capacity of 10 tons each.

Voluntary milking system comprises the milking boxes and milking parlours which help to build up a well-organised and balanced working process, namely:

- to perceive lower stress environment;
- not to cause any harm to animals;
- to benefit consumers and society.

The innovative conception «smart farm» is an integrated complex of effective management which consists of eight principal interrelated elements of technology cycle. Among the main components in the formation of milking conception we can enumerate the following:

- 1) effective herd management;
- 2) high-quality production;
- 3) environmentally friendly production;
- 4) systematic integration of the industrial process;
- 5) good care of animals;
- 6) automatisisation and robotisation of production;
- 7) improvement of keeping conditions;
- 8) optimal feeding.

Thus, the main components of the DeLaval's system are as follows:

- effective herd management by means of using the informational support systems and decision-making that permit to control milking, feeding and reproduction of cows in real time ;
- optimal cow feeding due to the use of special programs which help to define and prepare a balanced diet and provide the automated distribution of fodder taking into consideration the conditions of a cow or the group of cows according to the stage of their lactation cycle;
- automatisisation and robotisation of such technological processes as milking and feeding in order to reduce the level of production costs and to increase the profitability;
- Milk quality improvement due to the use of milk cooling technologies which ensure the competitive advantage of the product and the best purchase cost;
- Preservation of cows' health on basis of creation of comfortable conditions for keeping and microclimate management; the timely veterinary care which influences the animals' productivity and the quality of the product positively;
- Environmentally safe production through the use of effective technology solutions for the removal and recycling of organic waste. The technology helps to improve the milking hygiene conditions and the microclimate by reducing the content of ammonia and nitrogen gas in the air.

The last element of the «smart farm» conception needs a further specification. It is well known that the problem of ecological safety in what concerns the utilization of organic waste in the cattle-breeding is one of the most important today and needs a complex solution, the solution that would be accepted by both business and the society. Among the rational ways of solving the problem one can single out the transfer to the ecologically safe control through the use of innovation technologies of anaerobic digestion of organic waste and biogas and bio-fertilizers.

This direction makes a part of «smart farm» conception, since the use of bioenergy technologies for the processing of farms' organic waste (except the utilization of dangerous greenhouse gases) into biogas brings an additional profit.

Economic aspects of the problem under investigation are connected with the formation of the low milk selling prices in the Ukrainian market, what makes the progressive development of cattle-breeding impossible and is one of the reasons of its low profitability. The introduction of the modern robotic milking technology reduces the labour expenses which cover 20-30 % in the structure of the cost price of the dairy production. This results in the appearance of new competitive advantages of the product. However, there exists a negative social effect of reducing of work places. A milking robot of the DeLaval company is able to serve from fifty to seventy cows a day which takes only two operators of mechanical milking. The current tariff rates for the annual labour remuneration show that its savings will amount to one hundred thousands hryvnias, including the extra charge for single social fee. On the other hand, the negative social impact of the reduction of work places can be leveled by improving the working conditions due to the eliminating of hard work. It should be also noted that the biggest economic effect from the use of milking robots can to some extent be observed during the transfer from herd keeping to its destocking.

Comparative return on the use of «smart farm» for automated and robotic cows' milking, depending on the level of profits is shown in Fig. 2.

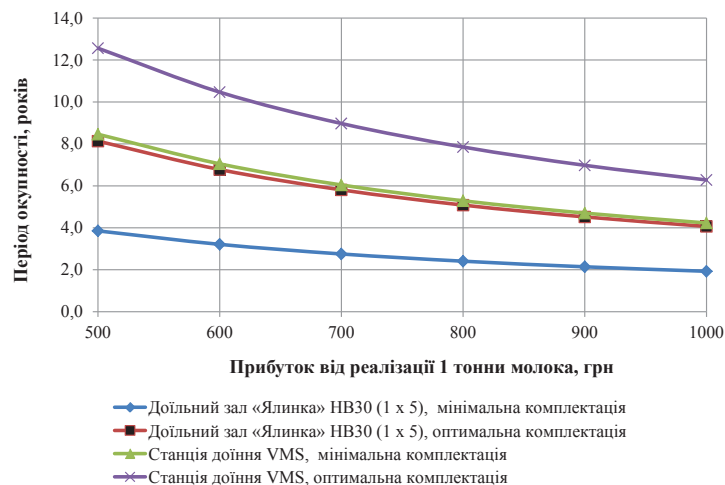


Fig. 2 The calculation table of payback from automated and robotized milking

The calculations take into account that the expected average milk yield from one cow is not less than seven thousands kilogram per year. The number of livestock kept equals fifty in order to make the comparison of technologies more convenient.

The average acquisition price of VMS station equals from 134.7 to 200.000 thousand euro (EUR), while the price of «Yalinka» HB30 class milk parlour for fifty cows with the total of 1 x 5 milking places equals from 60 to 130 thousand euro depending on the additional equipment complectation.

The calculations became a basis for a scientific model. The analysis of the model showed the following:

The milking parlour with the minimal complectation will have the lowest payback period (for about 2 years), while the VSM station payback period will equal to 4 years (under the condition of obtaining the expected profit from 1 ton of milk).

Thus, we can conclude that the competitive development of dairy breeding is largely dependent on market economic conditions the existing price level in the industry. Therefore, the increase of profitability in the dairy production should be realized on the basis of introduction of modern «smart farm» principles.

The use of modern technological solutions based on the automated and robotics technological processes and the use of monitoring and management information systems are among the most efficient factors in the dairy business development.

Under the circumstances, it is important to realize the value of innovative components of modern technologies in the dairy production and government financial support of the industry's attractiveness as they are capable of providing a high return. The negative social effects make a natural result of the transition from traditional to innovative production system in cattle-breeding. However, the negative side can be compensated by means of improvement of working conditions and the level of financial incentives by increasing the production level and improving its quality and profitability.

The further research is needed in order to explore the economic efficiency of the aforementioned technologies and to develop the scientifically-grounded competitive system for dairy production based on innovative «smart farm» concept.

References:

1. Naumenko O. A. Robotizatsiya protsessov doeniya korov – put k resursoberezheniyu / O. A. Naumenko, I. G. Boyko // *Naukoviy visnik Tavriyskogo derzhavnogo agrotehnologichnogo universitetu*. – Melitopol : TDATU, 2011. – Vypusk 1, Tom 3. – S. 19-24.
2. Lutsenko M. Tehnologicheskie i tehnichekoe predposylki sozdaniya molochnykh ferm novogo pokoleniya / M. Lutsenko, I. Kudlay // *Tekhniko-tehnologichni aspekti rozvitku ta viprobuvannya novoyi tekhniki i tehnologiy dlya silskogo gospodarstva Ukraini: zbirnik nauk. pr. – za red. V. I. Kravchuka ta In. – Doslidnitske : DNU «Ukrayinskiy nauk.-dosl. In-t prognozuvannya ta viprobuvannya tekhniki i tehnologiy dlya s.-g. virobnitstva Im. Leonida Pogorllo», 2012. – Vip. 16 (30), kn. 2. – 491 s. S. 275-282.*
3. Vorobyov G. Rozumna ferma // *G. Vorobyov / «The Ukrainian Farmer»*. – 2011. – cherven. – S. 92-93.
4. Tivonchuk Ya. O. Suchasni tendentsiyi konkurentospromozhnogo rozvitku rinku moloka i molokoproduktiv u Frantsiyi / Ya. O. Tivonchuk // *Ekonomika APK*. – 2011. #1. – S. 169-175.
5. Fedorenko V. F. Innovatsionnaya deyatel'nost' v APK: sostoyaniye, problemy, perspektivy / V. F. Fedorenko, D. S. Buklagin, E. L. Aronov. – M. : FGNU «Rosinformagroteh», 2010. – 280 s.
6. Kotov N. T. Osobennosti razvitiya konkurentosposobnykh strategiy zhivotnovodstva / N. T. Kotov, L. A. Miroshnichenko, E. P. Shatalov // *Agrarnaya tema*. – 2011. – # 6 (23). – S. 42-44
7. Ryibalova T. I. Era robotov v molochnom zhivotnovodstve Rossii nachalas [Elektronniy resurs]. – Rezhim dostupu : // <http://www.ikar.ru/m/articles/53/>

8.

Кернасюк Ю. В.

Кіровоградська державна сільськогосподарська дослідна станція
Інституту сільського господарства степової зони
Національної академії аграрних наук України

**ЕКОНОМІЧНІ, СОЦІАЛЬНІ ТА ЕКОЛОГІЧНІ АСПЕКТИ
ВИКОРИСТАННЯ ІННОВАЦІЙНИХ ТЕХНОЛОГІЙ SMART FARM**

Резюме

Досліджено теоретичні питання визначення сутності концепції «smart farm», обґрунтовано аспекти її економічного, соціального і екологічного впливу на підвищення конкурентоспроможності виробництва продукції та проведено економічну оцінку ефективності впровадження технологічних інновацій в галузі молочного скотарства.

Ключові слова: розумна ферма, рентабельність, молоко, інновація, ефект

Кернасюк Ю. В.

Кировоградская государственная сельскохозяйственная опытная станция
Института сельского хозяйства степной зоны
Национальной академии аграрных наук Украины

**ЭКОНОМИЧЕСКИЕ, СОЦИАЛЬНЫЕ И ЭКОЛОГИЧЕСКИЕ АСПЕКТЫ
ИСПОЛЬЗОВАНИЯ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ SMART FARM**

Резюме

Исследованы теоретические вопросы определения сущности концепции «smart farm», обосновано аспекты ее экономического, социального и экологического влияния на повышение конкурентоспособности производства продукции и проведено экономическую оценку эффективности внедрения технологических инноваций в отрасли молочного скотоводства.

Ключевые слова: умная ферма, рентабельность, молоко, инновация, эффект.