

# Assessment of Effectiveness of Supply Chain Operations on Ecological Safety Assurance Tools of Dairy Herd Reproduction

Natalia N. Karzaeva<sup>1</sup>, Olga I. Solovyova<sup>2</sup>, Anna Yu. Voronina<sup>3</sup>

<sup>1,2,3</sup>Russian State Agrarian University-Moscow Timiryazev Agricultural Academy, Moscow, Russia,

<sup>1</sup>k-nn@yandex.ru

<sup>2</sup>rokotyanskay\_v\_v@mail.ru

<sup>3</sup>avoronina@rgau-msha.ru

**Abstract**— In the modern research, the assessment of effectiveness of introduction and application of technologies that minimize negative impact on the region ecology is carried out by boundaries dividing of ecological and industrial systems. In this research supply chain operation effects proposed to assess the impact of mechanisms for ensuring ecological safety based on integrational approach to determination of boundaries of ecological and industrial systems, and identification of ecological safety objects. The article substantiates the possibility of recognition of farm animals as ecological safety objects. Their dualistic nature is revealed as the biological resources of the system and an integral part of the natural environment. The methods used by specialists for the economic evaluation of the ecological safety tools application are analyzed and, proposed to use the differences between costs of its acquisition, use and expenses occurred when ignore it as an indicator of effective using of a specific tool for ensuring ecological safety. The article presents the results of the experience on the use of herbal medicine "VENERA" in the treatment of acute and sub chronic endometritis of cows that showed its high (100%) therapeutic efficiency against *Streptococcus pyogenes*, *Proteus vulgaris*, *Staphylococcus aureus* and *Escherichia coli* - endometritis pathogens. The experience of using herbal medicine "VENERA" showed time reduction of treatment and recovery of animals, restrictions of milk that makes it top priority compared to medicine for milking herd use. According to the economic evaluation of results of using the invented new form of veterinary herbal medicine VENERA, its use will reduce economic losses from cow diseases, including expenses of their treatment and losses of milk production during the recovery period of cows.

**Keywords**— *ecological safety, supply chain operation, dairy farming, economic evaluation, herbal medicine, herd reproduction.*

## 1. Introduction

Ecological safety arguably is central place in the system of the life activity of society, including

industrial sphere. The rapid pace of enormous changes in the human environment determines the increasing role of ecological factors in decision-making processes in technical, technological and economic spheres. As an independent object of study, the ecological safety has been considered relatively recently. Many Russian scientists carry out theoretical studies in the field of ecological safety: V.A. Vlasov, V.F. Protasov, V.I. Danilov-Danilyan etc.

However, in scientific research of ecology, in ecological-oriented projects of organization of the agricultural enterprises activities the traditional approach is to recognize the environmental economic entity as the subject of threats impact. The economic effect of the proposals developed as a result of scientific study, or technical and technological solutions in the framework of the projects is estimated on the basis of environmental impacts. Such an approach is indicated in the researches of the following authors: A.Yu. Bryukhanov, E.V. Vasilva, V.V. Gordeev, Yu.N. Nikulin, V.N. Surovtseva, V.E. Khazanova, E.V. Shalavin [1-11].

However, firstly, this approach does not include biological assets (of animals) in the composition of objects exposed to threats, and, as a result, does not take into account the economic consequences of the negative impact of hazards or the positive impact of tools to prevent it [12-17].

The economic problems of threats implementation of ecological safety, including negative impact of functioning of agricultural organizations are determining by difficulty of two processes: first, revealing of consequences list of realization of these threats, and second, collection and formation of information on its cost estimation.

The dualistic nature of a biological asset (of animals) in the operation of an economic entity, due to its belonging to a biosystem, on the one hand, and to production resources, on the other hand, predetermines the need to take into account the impact of ecological safety tools on it, in particular, herbal medicine and its economic evaluation [18-22].

The subject of this study is herbal medicine "VENERA", considered as a tool to ensure the

ecological safety of the reproduction of dairy herds, and the economic evaluation of its use. The use of herbal medicine in veterinary in Africa, Asia and Latin America, as noted by K.K. Atindehou, W.M. Kone, M.C. Luján, G.J. Martínez, is still relevant. The interest in the use of herbal medicine is growing in developed countries.

The main goal of this study was development on the basis of the ecological safety concept of economic systems micro level of effectiveness assessment model of using environmentally friendly herbal medicine "VENERA" for the treatment of acute and subchronic endometritis of cows. There are no analogues of this herbal medicine that predetermined the following tasks:

- identification of objects and threats of ecological safety of the livestock organization;
- justification of the effectiveness assessment method of ecological safety tools in a livestock organization;
- economic evaluation of the use of herbal medicine "VENERA" in the treatment of acute and subchronic endometritis of cows.

## 2. Methods

The methodological basis of the research is the fundamental principles of economic theory, the theory of ecological safety, as well as special economic regulations of the agricultural organizations. The justification of approach of animal's recognition of an agricultural organization as an object of ecological safety. The general scientific methods of synthesis and analysis were used.

After laboratory research, probation and dose testing, and the scheme of herbal medicine "VENERA", a scientific and production experience was conducted at the "PROMETEY" Farm in the Krasnodar Territory.

For this experiment were selected:

- a) three groups of cows (10 heads in each group) with the first sexual cycle and after calving after 21 days;
- b) two groups of cows (10 heads in each group) who had a difficult parturition and endometritis.

For the clinical testing of the medicine during 15 days in the morning and evening used the following doses:

- first herd (three groups of cows with first sexual cycle):
  - group №1 - by 25 ml;
  - group № 2 - by 35 ml;
  - group № 3 - by 55 ml;
- second group (two groups of cows, who had a difficult parturition and have endometritis):
  - group № 1 - by 35 ml;
  - group № 2 - by 55 ml.

The method of results comparison with the aim to identify the most effective medicine was not used due to the lack of this medicine analogue.

## 3. Results

For the moment, the scientists do not have a unique approach of ecological safety determination. There is different approach to disclosure its substance even in legal documents.

Thus, the Law "On Environmental Protection" uses a substantive approach: ecological safety is "the condition of environment protection and vital human interests from the possible negative impact of economic and other activities, natural and man-made emergencies, and their consequences" [1]. And in the Law "On Ecological Safety", adopted at the twenty-second plenary session of the Inter-Parliamentary Assembly of the CIS member states on November 15, 2003, in accordance with the functional approach, the ecological safety is "a system of political, legal, economic, technological and other measures aimed at guaranteeing the protection of the environment and the vital interests of a person and citizen against the possible negative impact of economic and other activities, natural and man-made emergencies in present and future"[2]. But according to the norms of both laws, the human and his environment are recognized as objects of ecological safety. At the same time, the human environment is a complex system, and scientists and experts recognize the flora, fauna as its elements [3].

Due to the fact that the environment is an object of ecological safety, a source of threats are "situations of a nature" (natural) and human activities results (man-made) [1, 2, 23]. V.F. Protasov considers "applied (mostly outdated) technologies and other components of the enterprise's production system dependent on them — raw materials, components, energy carriers, manufactured products, wastes, emissions, and so on.

It is necessary to indicate that as an internal source of threat could be personnel capable to violate technological regulations and safety rules".[4]. As part of global environmental threats, V.I. Danilov-Danilyan pays special attention to "rapidly increasing extinction of biological species (including those of commercial and economic importance), which also cease to be a renewable resource", "widespread reduction in the diversity of ecosystems, and the number of plant and animal species that lead to destabilization of the environment and irrecoverable losses of the gene pool"[5]. Therefore, the task of preserving Russia's bioresources, along with the state of the environment, the quality of atmospheric air, water, soil, according to all scientists and specialists, is a priority in the organization of ecological safety [6].

Usually, flora and fauna included into the ecological safety that are integral part of environment. Nevertheless, environment consists of all animals, including live-stock animals. Therefore, bioresources are not limited by birds, fish, and animals living in natural conditions, but also include domestic and live-stock bions. Due to the fact that live-stock animals are also included in the production process of agricultural enterprises and are part of biological resource.

The dualistic nature of live-stock animals that was indicated earlier [7], predetermines its special role in the system of ensuring ecological safety. On the one hand, it is threats object and needs in protection. On the other hand, due to the fact that animals participate in the formation of agricultural products estimation as biological resources they also form an estimation of environmental risks.

The reproduction processes and reproduction of biological resources have impact to financial results of agricultural enterprises activity[24].

Thus, V. Surovtsev underlined that a change in the number of cows from 1,100 to 1,400 heads leads to the profit increase of the tested livestock enterprises almost twice [8]. Live-stock breeders scientists point out an influence on the reproductive function of cows diseases of their genital organs, which are currently one of the key problems of veterinary medicine. High productivity and, therefore, profitability of sexually mature cows is possible only if they are healthy, fertilized regularly and bring viable calves.

Prolonged disorders of the reproduction process, including endometritis, lead to rawness and infertility of animals, an increase in the service period, a shortage of calves, as a result, a decrease in milk production [3, 24]. The resolving of these problems required the regulation of the requirements for drugs used for the prevention and treatment of bovine endometritis, the scientists underlined the main three:

- minimum period of milk rejection;
- fast and maximum distribution of the active substance;
- a wide range of antibacterial activity of the medicine.

The scientists are currently actively searching the medicine for treating of cows endometritis-sick that are safe and easy to use without intrauterine intervention and do not lead to milk rejection.

In recent years, interest in the use of alternative methods for the treatment of animals, including phytomedications, is growing rapidly around the world. In developed countries, herbal medicine are still used in veterinary medicine in Africa, Asia and Latin America [9,10]. The long-term experience of veterinary specialists has shown that use of herbal medicine in animal husbandry, along with other organizational and economic measures, give a good result.

#### 4. Discussion

The scientists developed the veterinary herbal medicine "VENERA" taking into account the abovementioned requirements for the treatment of endometritis of cows, reducing their service-period duration, the risk of endometriosis, and increase of calves yield. The scientific and production experiment conducted in "PROMETHEY" farm in Krasnodar Territory, after the laboratory research, testing and draught probation and its application scheme.

During the experiment created:

a) 1 experimental herd: three groups of cows by 10 heads in each. The selected cows characterized by the first sexual cycle and after calving after 21 days;

b) 2 experimental herd: two groups of cows by 10 heads in each. The selected cows had difficult parturition and endometritis.

During the clinical study the "VENERA" medicine applied during 15 days in the morning and evening in the following draughts:

– the first herd: group №1 - by 25 ml; group № 2 - by 35 ml; group № 3 - by 55 ml;

– the second herd: group № 1 - by 35 ml; group № 2 - by 55 ml.

After the completion of experiment the observation under the compensation of sexual recurrence. After insemination and establishment of pregnancy, an analysis of indicators characterizing reproductive function was carried out: fertility, fertilization index, the period of the beginning of treatment to the restoration of sexual recurrence, from the start of treatment to fertilization, the service period.

In the result of studies, the following outcomes obtained (table 1):

**Table 1.** Indicators of reproductive capacity of cows

Indicators	Disease prevention in the first sexual cycle (21 days)1 experimental herd			Treatment of effects after difficult parturition, 2 experimental herd	
	I group	II group	III group	I group	II group
Quantity of animals in the group, heads	10	10	10	10	10
Recovering, heads	7	9	6	10	7
Therapeutic effectiveness, %	40	99	30	99	40
Treatment duration,	23+2,0	15+1,9**	25+2,0	15+1,5**	24+1,5

days					
Service-period duration, days	83,9±1,8	77,1±2,0*	86,2±2,0	77,2±2,0*	83,9±1,9
Cows average weight, kg	488,20±47,3	488,20±47,3	488,20±47,3	540,60±51,3	540,60±51,3
Daily average milking at the beginning of experiment, kg	37,53±4,97	37,53±4,97	37,53±4,97	38,53±7,25	38,53±7,25
Index semination	1,80	1,35	1,92	1,45	1,89

The best results obtained in the second group of the first experimental herd and in the first group of the second herd where the 35 ml of medicine was used: therapeutic efficiency reached 99% and 100% of recovery or restoration of the reproduction function. The duration of the service-period in II group reduced by 6.8 days (8.2%) compared with I group and III group by 9.1 days (11%).

The duration of the reproduction function using 35 ml was 15 days, which is 8-10 days faster than in I and III groups in the first herd. Moreover, the

semination index was 1.35, which is 0.45-0.57% and 25-30% better compared with I and III groups, respectively.

Thus, the most effective draught is 35 ml of the medicine as a phylactic and for the treatment of endometritis with 15 days duration of treatment, an average.

Indicators of reproductive capacities characterize the process of convalescence namely the duration of the service - period (Table 2).

**Table 2.** Duration of service-period, days (  $M \pm m$ ,  $n = 10$  )

Norms	Healthy animals	Check group	II group 1experimental herd	I group 2experimental herd
60 - 90	70,8±3,5	83,9±1,8	77,1±2,0	77,2±2,0

The decrease of the service period duration by 7 days as a result of taking the medicine "VENERA" in both experimental groups (II group 1 experimental herd and I group 2 experimental herd) compared to the check group is near to the expected indicators of healthy cows in this herd (tab 2).

The results of introduction of technology into the production that allows provision of ecological safety should be assessed economically. The scientists: A. Yu. Brukhanov, E.V. Vasilev, E.V. Shalavina propose to apply three indexes for assessment of ecologically safe technologies: effectiveness index of technology introduction, index of enumerated expenses of 1 tonne substance utilization, ecological and economic impact [9].

The first effectiveness index of technology introduction ( $E_i$ ) is calculating by the following formula:

$$E_i = Z / (L_b - L_e), \quad (1)$$

Where is:

$Z$  – operating costs of proposed technology;

$L_b$  – nitrogen emissions for basic technology performing;

$L_e$  – nitrogen emissions of the proposed technology implementation.

The authors propose to assess the technology effectiveness only based on operating costs, related to disclamation of check indicator that describe basic and proposed (experimental) technology. However, the authors ignore capital costs to technologies that could change a lot.

The second index of expenses of 1 tonne of substance utilization ( $I_u$ ) is calculating by the following formula:

$$I_u = (Z_k + Z_e) / K_a \quad (2)$$

Where is:

$Z_k$  – specific capital costs for 1 tonne of fertilizers produced and applied;

$Z_e$  – specific operating costs for 1 tonne of fertilizers produced and applied;

$I_a$  – nitrogen retention index of manure utilization technology.

This index also does not take into account the capital costs of proposed technology implementation.

The third index of ecological and economic impact ( $I_{eee}$ ) is calculating by the following formula:

$$I_{eee} = V_y + V_e + P \quad (3)$$

Where is:

$V_y$  – income of the crop sale obtained by using organic fertilizers;

$V_e$  – income of sale or profit of using additional economic resources (as a result of the processing of bio-or generator gas);

$P$  – ecological effect of negative impact reduction to the environment.

It is difficult to implement the information support of index calculation, since it is almost impossible to determine the amount obtained yield by using only organic fertilizers, eliminating the influence of climatic factors (temperature, precipitation, etc.).

The economic assessment of ecological technologies introduction, including farm animals

care should be based on the comparing method of capital and current costs sum with the magnitude of the risks of environmental threats impact in case of not using these technologies. Under this risk should be understood "events of material or financial damage in the implementation of various types of hazards that are probabilistic in nature" [12, p.46].

The comparing method of the ecological technology cost and possible wastage in case of absence to assess the economic efficiency of the use of herbal medicine "VENERA" involves the procedure of identifying threats to the health and life of the cow and, consequently, the economic threats to the agricultural organization. The threats include: reduction of the herd quality (reproduction, productivity), production volumes and quality of agricultural products (milk and meat).

The effectiveness of herbal medicine "VENERA" can be calculated by using the following algorithm. At the first stage, the total damage is determined as the damage amount due to the shortage of milk and yield:

$$D_g = D_1 + D_2 \quad (4)$$

$D_g$  – total damage;

$D_1$  – damage of shortage of milk, rubles;

$D_2$  – damage of shortage of yield.

Damage of shortage of milk ( $Y_1$ ) could be calculated by the following formula:

$$D_1 = 0,1\% P_d \times N_i \times P, \quad (5)$$

where is

0,1% - index of shortage of milk per 1 day infertility;

$P_d$  – productivity per one fodder cow per year, kg;

$N_i$  – quantity of infertility days (service-period – 30);

$P$  – purchase price for 1 centner of milk, rubles

Damage of yield shortage ( $Y_2$ ) calculated by the following formula:

$$D_2 = 0,003 \times N_i \times C, \quad (6)$$

Where is:

0,003 – index of shortage of beeflings per 1 day infertility;

$C = 3,61 \times P$ .

The prevented damage ( $D_s$ ) is equal to the difference between the damage received in the check group and the damage received in the experimental group of animals:

$$D_s = D_1 (\text{check}) - D_1 (\text{experimental}), \quad (7)$$

The prevented damage per animals group is calculated as multiplication of the prevented damage per cow ( $D_s$ ) and the number of animals in group ( $N$ ):

$$D_{gr} = D_s \times N, \quad (8)$$

The economic impact to animals group ( $E_{gr}$ ) is calculated as the difference between the prevented damage to animals group ( $D_{gr}$ ) and the cost of introducing a new technology ( $S$ ):

$$E_{gr} = D_{gr} - S, \quad (9)$$

The cost effectiveness of new medicine introduction is defined as the quotient of economic effect dividing by animals group  $E_{gr}$  to the costs of new technology introduction ( $Z_n$ ):

$$EF = E_{gr} : S \times 100\%,$$

Where is (10)

The economic efficiency of the herbal medicine "VENERA" application in the frame of conducted research is 39%.

The herbal medicine "VENERA" as the tool of ecological safety will allow:

- increase the reproduction of cows (11%);
- reduce the incidence of reproductive organs;
- reduce the duration of the service-period (interparturition period);
- increase the immunity of calves.

All results (except increase the immunity of calves) are identified and measured in physical units:

- reproduction – quantity of parturied cows,
- reduce the incidence – quantity of healthy cows,
- duration of the service-period,
- quantity of obtained milk – tonne.

All indicators can be estimated in terms of value.

Comparing the cost of the purchase of herbal medicine "VENERA" and its use for cows treatment taking into account the potential losses, we get an impact indicator of the tool introduction.

## 5. Conclusions

1. As a result of the study, we justified the inclusion of farm animals and birds, fish to the ecological safety objects besides animals, fish and birds living in natural conditions.

1. We discovered the dual character of farm animals that are part of natural environment objects and are biological resources of live-stock organization.

2. We underlined the threat to economic safety of live-stock organization the reduction of cows reproduction.

3. We have substantiated that the assessment of ecological safety should be carried out based on method of costs comparing of preventing threats and losses occurred if ignore it.

4. In result of experiment with herbal medicine "VENERA" proved that it will allow:

- increase reproduction functions, and as result reproduction of dairy herd;
- reduce the incidence of reproductive organs;
- reduce the duration of the service-period (interparturition period);
- improve the immunity of calves.

As an indicator of the herbal medicine effectiveness in the prevention and treatment of gynecological diseases of cattle, you can use the difference between the costs of the purchase and use of herbal medicine and losses due to reduce the reproduction and milk production.

## References

- [1] On environmental protection: Federal Law No. 7-Φ3 on January 10, 2002 / Consultant Plus. [Electronic resource]. - Access mode: <http://www.consultant.ru> (appeal date: 09/10/2018)
- [2] On environmental safety: Model law (Decree of 15.11. 2003 N 22-18) / Consultant Plus. [Electronic resource]. - Access mode: <http://www.consultant.ru> (appeal date: 09/10/2018)
- [3] Vlasov V.A. Public administration in the field of environmental protection and environmental management: theory and practice questions / V. A. Vlasov // *Municipal Management*. - 2014. - № 5. - p. 11-12.
- [4] Protasov V.F. Ecology and nature management in Russia / V.F. Protasov. - M.: Finance and Statistics, 2014. - 528c.
- [5] Danilov-Danilyan, V.I. Environment. Between the past and the future. The world and Russia (the experience of environmental and economic analysis) / V.I. Danilov-Danilyan [et al.]. - M. : 1994. - 133p.
- [6] Lopatina V.N. Problems of ensuring ecological safety / V.N. Lopatina // *Scientific works collection*. - 2003. - № 8. - p. 189-190
- [7] Solovyova O.I., Karzaeva N.N. Economic problems of ensuring the ecological safety of the reproduction of dairy herds / O.I. Solovyov, N.N. Karzaev // *Proceedings of the International Academy of Agrarian Education*. - 2018. - № 42-2. - p. 40 – 45
- [8] Surovtsev V.N., Nikulina Yu.N., Gordeev V.V., Khazanov V.E. Efficiency of technological modernization of dairy cattle breeding / V.N. Surovtsev, Yu.N. Nikulina, V.V. Gordeev, V.E. Khazanov // *Dairy and beef cattle*. 2017. - №4. - p. 5-9.
- [9] Martínez G. J and Luján M.C. Medicinal plants used for traditional veterinary in the Sierras de Córdoba (Argentina): An ethnobotanical comparison with human medicinal uses// *J Ethnobiol Ethnomed*, 2011; 7: 23;
- [10] Kone W.M., Atindehou K. K. Ethnobotanical inventory of medicinal plants used in traditional veterinary medicine in Northern Cote d'Ivoire (West Africa) // *South African Journal of Botany* 74 (2008) 76–84).
- [11] Bryukhanov, A.Yu., Vasiliev, E.V., Shalavina E.V. Problems of ensuring the ecological safety of livestock and the best available methods for solving them / A.Yu. Bryukhanov, E.V. Vasiliev, E.V. Shalavina // *Regional Ecology*. - 2017. - № 1. - p. 37- 42
- [12] Karzaeva, N.N. Fundamentals of economic security: a textbook / N.N. Karzaeva - M. : INFRA-M, 2017. -p. 275
- [13] Selomo, M. R., & Govender, K. K. (2016). Procurement and Supply Chain Management in Government Institutions: A Case Study of Select Departments in the Limpopo Province, South Africa. *Dutch Journal of Finance and Management*, 1(1), 37. <https://doi.org/10.20897/lectito.201637>
- [14] Silva, J. L., Ornelas, J. D., & Silva, J. C. (2016). Supporting GUI Exploration through USS Tool. *Journal of Information Systems Engineering & Management*, 1(4), 51. <https://doi.org/10.20897/lectito.201651>
- [15] Gerami, Y., & Kordlouie, H. (2016). The effect of audit tenure and size on conservatism in Tehran Stock Exchange. *UCT Journal of Management and Accounting Studies*, 4(4), 9-16.
- [16] Mazana, M. Y., Montero, C. S., & Casmir, R. O. (2019). Investigating Students' Attitude towards Learning Mathematics. *International Electronic Journal of Mathematics Education*, 14(1), 207-231. <https://doi.org/10.29333/iejme/3997>
- [17] Verayiah, R., Mohamed, A., & Halim, S. A. (2018). Reactive power tracing index LQP\_LT for voltage unstable load bus identification in power systems. *Indonesian Journal of Electrical Engineering and Computer Science*, 12(3), 889-898.
- [18] Al-Khalifah A. The Strategic Stabilization of Private Banks and Insurance Company in the Financial Service Sector. *Journal of Humanities Insights*. 2018;02(04):161-6.
- [19] Farah T, Kalsoum C. Analysis of E.Coli from Waste Effluents of a Farm Business. *Medbiotech Journal*. 2018;02(03):85-6.
- [20] Agara T. The Role of Woman in Terrorism and Investigation of Gendering Terrorism. *Journal of Humanities Insights*. 2017;01(02):46-56.
- [21] Alahdadi N, Razaghi M. Investigation of Lifestyle and Identity Changes of Khorramabad Residents in Iran. *Journal of Humanities Insights*. 2018;02(02):51-9.
- [22] Al Tariq Z. Clinical, Biochemical and Immunological Profiles of HIV Patients Developing Immune Reconstitution Inflammatory Syndrome (IRIS). *Medbiotech Journal*. 2018;02(01):21-8.
- [23] Alizadeh F, Lahiji M. Suitable Delivery System in Small E-Commerce Companies. *Journal of Humanities Insights*. 2018;02(04):167-71.
- [24] Ampatzidis YG, Vougioukas SG, Bochtis DD, Tsatsarelis CA. A yield mapping system for hand-harvested fruits based on RFID and GPS location technologies: field testing. *Precision Agriculture*. 2009;10(1):63-72.