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## Article

### Feasibility justification of implementation of a device for sorting sheep products in the context of industry development

*Reference:* Tsybukh, Andrii/Kravchenko, Olha et. al. (2021). Feasibility justification of implementation of a device for sorting sheep products in the context of industry development. In: Technology audit and production reserves 3 (4/59), S. 33 - 40.  
<http://journals.uran.ua/tarp/article/download/235915/234696/540490>.  
doi:10.15587/2706-5448.2021.235915.

This Version is available at:  
<http://hdl.handle.net/11159/7049>

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UDC 535.243.25:636.3.035:631.164.23

JEL Classification: O13, Q12, Q16

DOI: 10.15587/2706-5448.2021.235915

Article type «Original research»

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## FEASIBILITY JUSTIFICATION OF IMPLEMENTATION OF A DEVICE FOR SORTING SHEEP PRODUCTS IN THE CONTEXT OF INDUSTRY DEVELOPMENT

*The object of research is the methodology of a feasibility study for the introduction of a device for sorting sheep products. Sheep products mean sheep wool, the sorting accuracy of which affects the formation of the sale price of the final product (wool), including the size of the manufacturer's profit, respectively, and the effectiveness and the level of economic efficiency of production. One of the most problematic areas is the subjective assessment of wool quality at the stage of pricing policy formation. This criterion is determined by a set of physical and technological indicators, which include the color of the coat, due to the degree of its melanin pigmentation or yellowing. Such an assessment, at present, is carried out with the participation of the operator, without the involvement of technical means capable of objectively registering and further providing data for the successful selection of sheep and the sale of wool.*

*In the course of the study, a systematic approach to the study of technical and economic processes and phenomena, an abstract logical method, monographic and empirical methods, a comparative analysis method, tabular and graphical methods, as well as a computational and constructive method for substantiating technical and economic indicators of the effectiveness of device implementation were used. The proposed analysis of the implementation of the device allows specialists at the level of enterprises producing sheep products to optimize the formation and implementation of the pricing policy. And it can also be used at the level of government bodies in determining the national policy for the development of sheep breeding and the formation of a strategy for its development. The obtained results of implementation allow:*

- to increase the profit for each head of animals from the sale of better quality wool;*
- to increase the level of profitability, which makes it possible to ensure the payback period for additional capital expenditures of less than two years;*
- to confirm the economic feasibility of using this equipment, since the payback period for additional capital costs does not exceed two years, and the discounted payback period does not exceed the useful life.*

**Keywords:** *sheep breeding products, wool sorting, laser device, pricing policy, economic efficiency, profitability rate, discounted income.*

Received date: 04.02.2021

Accepted date: 29.03.2021

Published date: 30.06.2021

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### How to cite

Tsybukh, A., Kravchenko, O., Pomitun, I., Lysychenko, M. (2021). Feasibility justification of implementation of a device for sorting sheep products in the context of industry development. *Technology Audit and Production Reserves*, 3 (4 (59)), 33–40. doi: <http://doi.org/10.15587/2706-5448.2021.235915>

### 1. Introduction

The main purpose of the implementation of a device for measuring the physical and biological characteristics of the skin and hair of animals, in particular, sheep, is to determine the degree of melanin pigmentation or yellowing of the wool of sheep [1]. This indicator is a necessary criterion for both the quality of the final product, namely wool, and an indicator for effective selection in sheep breeding. Since the sorting is based on the following characteristics: type of wool, fineness, length, condition and color. Due to the laser device for sorting wool by color (shade) by highlighting the lighter one, firstly, the

final sale price of wool is significantly increased. Secondly, due to the selection of animals (based on the quality of the wool), the productivity of animals can be significantly improved. As a result, it is possible to increase the efficiency and effectiveness of production and sale of sheep breeding products in general.

The global problem of the livestock industry remains that the majority of farmers cannot decide on the appropriateness of keeping sheep. Since the validity of the economic efficiency of production and sales of products of the sheep breeding industry is insufficient. In this regard, it is relevant to analyze the current state of the sheep breeding industry, determine the reasons for its decline

and improve the methodology for the feasibility study of introducing an innovative device into the economic activities of existing agricultural enterprises on the example of Ukraine.

## **2. The object of research and its technological audit**

*The object of the research* is the methodology of a feasibility study for the introduction of a device for sorting sheep products. Sheep products are understood as sheep wool, the sorting accuracy of which affects the formation of the sale price of the final product (wool), including the size of the manufacturer's profit, respectively, and the efficiency and level of economic efficiency of production.

One of the most problematic areas is the subjective assessment of wool quality at the stage of pricing policy formation. This criterion is determined by a set of physical and technological indicators, which include the color of the coat, mainly due to the degree of its melanin pigmentation. Such an assessment, at present, is carried out with the participation of a person (operator), without the involvement of technical means capable of objectively registering and further providing data for the successful selection of sheep and the sale of wool.

## **3. The aim and objectives of research**

*The aim of research* is a feasibility study of the introduction of a device for sorting sheep products in the context of the development of the industry, which is necessary for an objective assessment of the color of wool in the process of sorting.

To achieve this aim, it is necessary to complete the following objectives:

1. Analyze the current state of the sheep breeding industry in Ukraine and determine the reasons for its decline.
2. On the basis of statistical methods, determine the key performance indicators of the innovation project.

## **4. Research of existing solutions to the problem**

A small number of works are devoted to the problems of effective development of the livestock industry, in particular sheep breeding, in comparison with the study of the development problems of other livestock industries. Thus, in [2], a brief overview of world sheep breeding is presented, and a detailed analysis of the production and profitability of sheep keeping is carried out using the example of New Zealand. It has been proven that the return on equity in the farming business in New Zealand is about 1 % per annum. But there is no algorithm for increasing the level of return on capital.

Among the main directions of solving the problem of the effectiveness of the sheep breeding industry, the work [3] deserves attention. In this work, the authors argue that aspects of non-financial activities (market, marketing, technical, managerial and environmental) of raising Garut sheep are important during the economic feasibility study of animal breeding. Whereas the financial aspects (investment size, income analysis, investment payback period, net present value, level of profitability, internal rate of return, and others) prove the possibility

of effective business development. Along with this, there is no information on the practical implementation of investment (innovation) projects.

It is also worth noting work [4], in which a group of authors explores alternative approaches to co-production of wool and live weight from dual-use sheep systems to the farm gate. However, these works do not address the issues of a feasibility study for the introduction of an innovative laser device for sorting sheep products in order to increase efficiency and improve economic efficiency.

In Ukraine, during the time of independence and the cancellation of the state order for wool for the needs of educational and military departments, the sheep breeding industry has significantly declined. So, the works [5, 6] are devoted to the development of the livestock sector, in particular sheep breeding, but they have an unresolved issue of the methodology of economic substantiation of the effectiveness of the introduction of new equipment. The work [7] considers the development of the world market for sheep breeding products, but this work does not fully disclose the reasons and consequences of the decline of the sheep breeding industry, in particular in Ukraine. The authors of [8] investigate the state and ways of increasing the export potential of the sheep breeding industry in Ukraine, but the question of the priority of actions to improve the quality of products, especially wool, remains open. In [9], the modern problems of the development of the sheep breeding industry are outlined, and in [10] organizational and economic reserves for increasing the competitiveness of this industry are given. But the question of the methodology of the feasibility study of the effectiveness of the introduction of new means of automation of production processes in the sheep breeding industry remains insufficiently studied.

Thus, the results of the analysis of literary studies allow to conclude that the world experience of conducting the sheep breeding industry, and the current state of the industry development on the example of Ukraine, and the reasons for its decline, require more detailed research. It is necessary to search and substantiate the possibility of improving the performance and efficiency indicators of the industry through the introduction of a new device for measuring the physical and biological characteristics of the skin and hair of animals, in particular sheep.

## **5. Methods of research**

During the research let's use:

- dialectical method of cognition, a systematic approach to the study of technical and economic processes and phenomena;
- abstract-logical method (generalization and formulation of conclusions);
- monographic and empirical (detailing the conjunctural components of the domestic market for products of the sheep breeding industry and a comprehensive assessment of the current state of the research object);
- comparative analysis (comparison of indicators and identification of the dynamics of their changes over time);
- tabular and graphical (visual display of the obtained research results);
- computational and constructive (substantiation of technical and economic indicators of the effectiveness of the implementation of the device).

## 6. Research results

In modern economic conditions, an important factor influencing the economic result of the activity of any manufacturer is a successfully implemented pricing policy, which depends, first of all, on the quantity and quality of the final product. In the production of sheep products, depending on the chosen method of sorting wool by shades, the quantity of the final product of a certain quality depends. As it is known, the final product of the sheep breeding industry is both food (lamb, dairy products) and the bulk of raw materials for the textile and leather goods industry (wool, fur, leather). So, the amount of wool of a certain shade depends on the accuracy of sorting wool by shades. The specified criterion forms the selling price of the final product (wool), including the size of the manufacturer's profit, respectively, the effectiveness and the level of economic efficiency of production.

Based on existing studies, now in Ukraine there is a situation where, on the one hand, agricultural producers of livestock products, being at the very beginning of the price chain, have the least leverage of commercial influence on other participants and therefore are price recipients. The resulting price does not depend on the size and changes in the costs of commodity producers; therefore, it often does not allow obtaining an economically justified return on invested capital [11, 12].

To determine the economic efficiency of the implementation of the proposed device, a computational and constructive method of economic analysis was used, which is common in forecasting and planning production and economic development processes of economic entities. The

specified research method involves the development of several options for solving a certain technical and economic problem of manufacturers, their assessment with the subsequent selection of the best of them.

The first priority is to analyze the current state of economic efficiency of the sheep breeding industry in Ukraine. So, over the past 5 years, the number of sheep and goats is 1.2–1.3 million heads, which is 6–8 times less than the level of the middle of the last century (Fig. 1).

According to the authors of [5], the main reasons for a significant decrease in the number of animals in the sheep breeding industry are both global factors (over the past 15 years, there has been a decrease in the number of sheep in the world by 11–15 %) and internal socio-economic conditions. But at the same time, the authors note that in practice, «domestic sheep breeding, being in a state of crisis, has not lost its productive values, and even exceeded their relative standards due to the high scientific support of selection» [5].

The authors of [10] note that it is the large-scale production in the country that has been practically destroyed so far. The main keepers of animals and producers of sheep breeding products have become households of the population, containing mainly woolen animal breeds previously bred in Ukraine.

Regarding the volume and cost of wool production in Ukraine, it should be noted that over the past 20 years, the production of this product has been halved, namely from 3.4 thousand tons (2000) to only 1.7 thousand tons (2019). Compared to 2010, the decrease is 2.4 times (Fig. 2). The structure of wool production is as follows: 97.5 % sheep, 2.5 % goat.

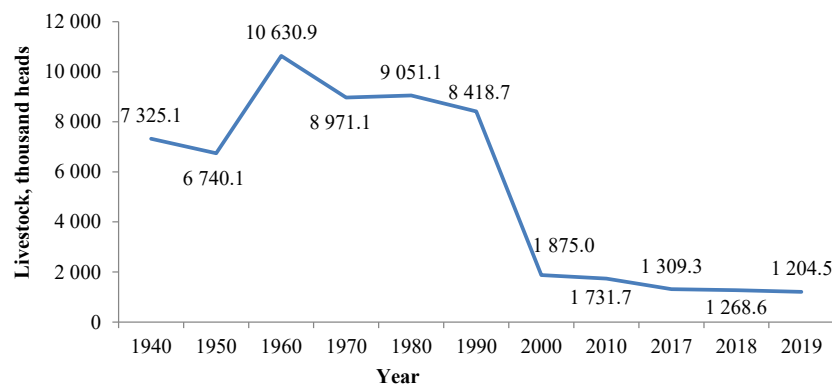


Fig. 1. The number of sheep and goats in Ukraine in 1940–2019, at the end of the year, thousand heads (data of the State Statistics Service of Ukraine [13])

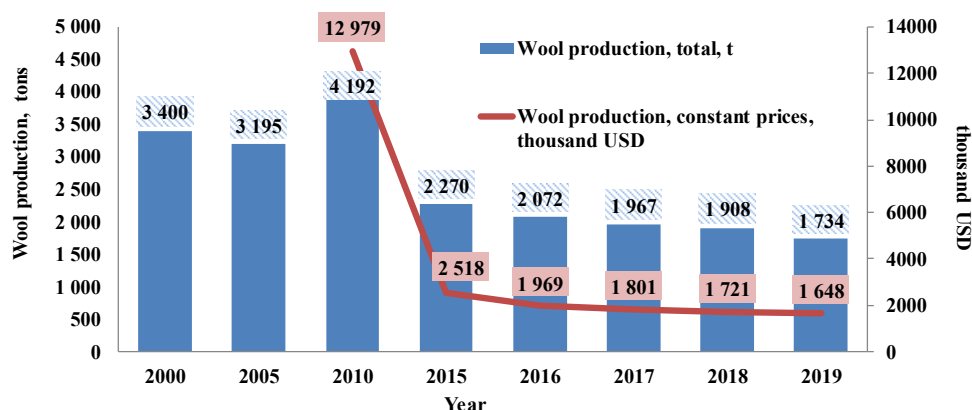
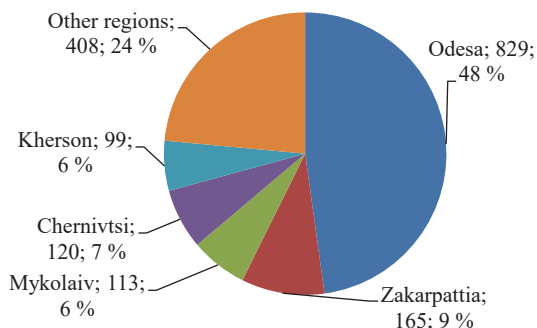


Fig. 2. Wool production (tons) and its cost in constant prices (thousand USD) in Ukraine in 2000–2019 (formed by the authors according to the data of the State Statistics Service of Ukraine [13])

In monetary terms, the cost of wool produced according to the results of 2019 is 1648 thousand USD against 12 979 thousand USD based on 2010 results.

The five leading regions in terms of wool production are as follows: Odesa region, which accounts for almost half of the total wool production (47.8 %); Zakarpattia (9.5 %); Chernivtsi (6.9 %); Mykolaiv (6.5 %) and Kherson (5.7 %). Other regions account for 23.5 % of wool production (Fig. 3).



**Fig. 3.** Volume and share of wool production by regions of Ukraine in 2019, tons; % (formed by the authors according to the State Statistics Service of Ukraine [13])

According to the categories of farms, the production of wool in Ukraine for a long period is carried out by 85–88 % precisely by the farms of the population (Fig. 4). This is also noted by the authors of [10]. Whereas in 2000 the ratio of wool production between enterprises and households of the population was 40 to 60 %.

The author of work [6] names the main reasons for this state of the sheep breeding industry. The author notes that it was precisely «the unregulated and uncontrollable economic processes during the transition period that led to a significant reduction in the number of sheep and the production of sheep products. The main reason for the decline in the industry was the low level of animal productivity and labor productivity, high production costs, as well as the negative impact of the destructive processes of the free market, manifested in extremely low prices for sheep products. Under such conditions, the monopoly of processing

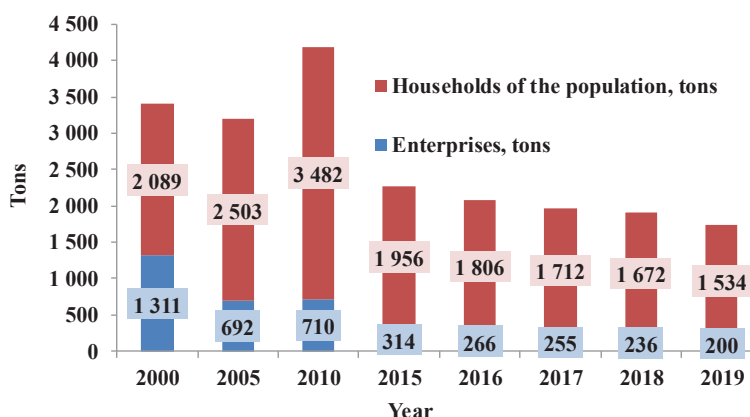
enterprises has grown, which have ceased to accept wool from domestic producers through their insolvency» [6].

So, the next stage of the study is the presentation of the dynamics of prices for sheep products, namely wool (Fig. 5).

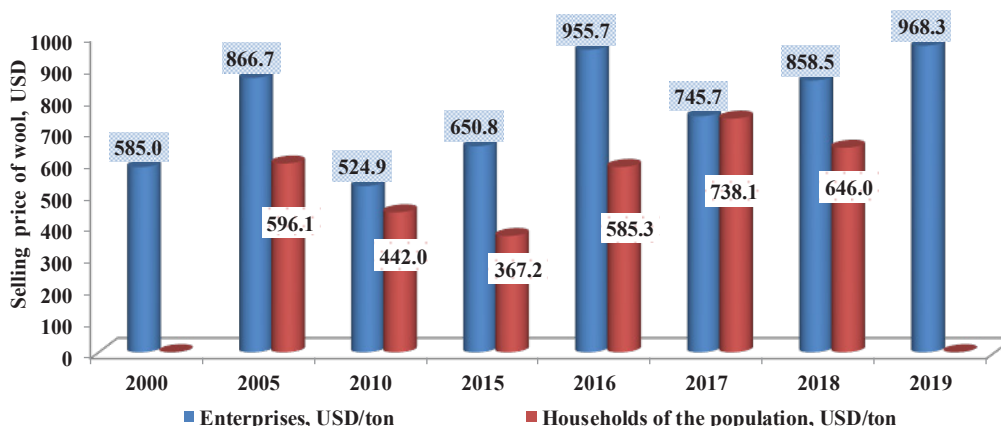
It can be noted that during the entire period the price of wool from agricultural enterprises is on average 35–40 % higher than the price of wool from households, which is explained by the quality of wool. At the same time, according to the results of the last analyzed, the price of wool and from enterprises was 968.3 USD per ton, which is significantly lower than the price on the external market.

The authors of [7] investigated the level of prices in the external market. Thus, the prices for sheep breeding products differ significantly by country. The authors divided the purchase prices for wool in 2018 into three groups. The first – up to 1000 USD per ton (Cyprus, Turkey, Germany, Great Britain, Poland, Ukraine), the second – from 1000 to 3000 USD per ton (Spain, Latvia, Serbia, Kazakhstan, Russia, New Zealand), the third – from 3,000 to 6,000 USD per ton (Uruguay, Norway, Argentina, South Africa). So, Ukraine is in the group of countries with the lowest selling price. The author of [10] points out that «the lack of quality certification in accordance with world standards should be pointed out as a deterrent to export at the present time».

The main indicators of the effectiveness and efficiency of wool production in Ukraine over the past almost 20 years are given in Table 1.



**Fig. 4.** Production of wool by categories of farms in Ukraine for 2000–2019, tons (formed by the authors according to the State Statistics Service of Ukraine [13])



**Fig. 5.** Selling price of wool in Ukraine in 2000–2019, USD/ton (formed by the authors according to the State Statistics Service of Ukraine [13])

Table 1

Indicators of the effectiveness and efficiency of managing the sheep breeding industry in Ukraine in 2000–2019

| Indicators   | Years |       |       |       |       |       |       |       | 2019, in % to: |             |
|--|-------|-------|-------|-------|-------|-------|-------|-------|----------------|-------------|
|  | 2000  | 2005  | 2010  | 2015  | 2016  | 2017  | 2018  | 2019  | 2000           | 2015        |
| 1. Production of wool by categories of farms, total, tons                        | 3400  | 3195  | 4192  | 2270  | 2072  | 1967  | 1908  | 1734  | 51.0           | 76.4        |
| including:   |       |       |       |       |       |       |       |       |                |             |
| – agricultural enterprises   | 1311  | 692   | 710   | 314   | 266   | 255   | 236   | 200   | 15.3           | 63.7        |
| of them:   |       |       |       |       |       |       |       |       |                |             |
| – farms  | 9     | 71    | 128   | 69    | 55    | 55    | 57    | 49    | 544.4          | 71.0        |
| – households   | 2089  | 2503  | 3482  | 1956  | 1806  | 1712  | 1672  | 1534  | 73.4           | 78.4        |
| 2. Average annual shearing of wool from one sheep in farms of all categories, kg | 3.0   | 3.5   | 3.4   | 2.9   | 2.8   | 2.8   | 2.7   | 2.6   | 86.7           | 89.7        |
| including:   |       |       |       |       |       |       |       |       |                |             |
| – in enterprises   | 2.4   | 2.6   | 2.3   | 1.7   | 1.6   | 1.6   | 1.5   | 1.5   | 62.5           | 88.2        |
| – in households  | 3.8   | 3.8   | 3.8   | 3.3   | 3.2   | 3.2   | 3.0   | 2.9   | 76.3           | 87.9        |
| 3. Average prices for wool, USD/t:   |       |       |       |       |       |       |       |       |                |             |
| – from agricultural enterprises  | 585.0 | 866.7 | 524.9 | 650.8 | 955.7 | 745.7 | 858.5 | 968.3 | 165.5          | 148.8       |
| – from households  | –     | 596.1 | 442.0 | 367.2 | 585.3 | 738.1 | 646.0 | –     | –              | –           |
| Profitability level of the sheep breeding industry, %                            | –46.4 | –32.1 | –29.5 | –26.6 | –31.5 | –39.6 | –16.6 | –39.7 | +6.7 p. p.     | –13.1 p. p. |

**Note:** compiled by the authors according to the State Statistics Service of Ukraine [13]; p. p. – percentage points

For 20 years, the volume of wool production by all categories of farms has been halved, over the past 5 years, the decrease is 24 %, to the level of 1.7 thousand tons. The decrease was mainly due to changes in production volumes based on agricultural enterprises. The rate of decrease is 6.5 times compared to 2000 and by 36 % from 2015.

At the same time, the productivity of animals also decreases. Namely: the average annual shearing of wool from one sheep in farms of all categories by 10–13 % to the level of 2.6 kg per head, including the results of 2019 shearing at enterprises is 1.5 kg, in households 2.9 kg.

A universal indicator of the efficiency of production and sales of sheep products is the level of profitability, which is negative during the entire study period. The economic content of the negative value of this indicator shows the amount of the resulting loss per unit of operating expenses. Thus, the average level of unprofitableness in the sheep

breeding industry over the past 20 years is 33 %, which is a consequence of the lack of an effective state strategy for the development of animal husbandry, in particular sheep breeding.

The author of [2] very well explains this «efficiency» of the industry. The author notes that such unprofitability is due to a number of objective and subjective reasons, which are: a low level of livestock reproduction, low purchase prices for wool and the absence of a proper sales market for products. And also the complete absence of state support for the sheep breeding industry, which negatively affects the interest of agricultural producers [2].

The collection of information and processing of data on the economic efficiency of production and sale of wool at an operating agricultural enterprise, namely on the basis of the State Enterprise «Experimental farm «Gontarivka» of the Institute of Animal Husbandry of the National Academy of Agrarian Sciences of Ukraine, Table 2.

Table 2

Economic efficiency of wool production in the «Gontarivka» farm of the Institute of Animal Breeding of the National Academy of Sciences of Ukraine in 2017–2019

| Indicator  | Years   |          |         | Changes: 2019 compared to 2017 |       |
|--|---------|----------|---------|--------------------------------|-------|
|  | 2017    | 2018     | 2019    | +, –                           | %     |
| 1. Average annual number of sheep, Ch.   | 859     | 833      | 1 001   | 142                            | 116.5 |
| 2. Produced wool, kg   | 3 000   | 2 700    | 3 500   | 500                            | 116.7 |
| 3. Production cost of wool, USD  | 1 879.7 | 1 838.2  | 2 707.9 | 828.2                          | 144.1 |
| 4. Realized wool, kg   | 3 000   | 2 700    | 3 400   | 400                            | 113.3 |
| 5. Total cost of wool, USD   | 5 033.8 | 8 139.7  | 7 159.0 | 2 125.2                        | 142.2 |
| 6. Income from the sale of wool, USD   | 4 210.5 | 4 007.4  | 5 686.7 | 1 476.1                        | 135.1 |
| 7. Productivity of animals:<br>– the average annual shear of wool from one sheep, kg | 3.5     | 3.2      | 3.5     | 0.004                          | 100.1 |
| 8. Production cost, USD/t  | 626.3   | 680.5    | 773.7   | 147.4                          | 123.5 |
| 9. Full cost price, USD/t  | 1 677.9 | 3 014.7  | 2 105.6 | 427.6                          | 125.5 |
| 10. Selling price, USD/t   | 1 403.5 | 1 484.2  | 1 672.5 | 269.0                          | 119.2 |
| 11. Profit (loss), USD:  |         |          |         |                                |       |
| a) for 1 t   | –274.4  | –1 530.5 | –433.0  | –158.6                         | 157.8 |
| b) for 1 head  | –0.96   | –4.96    | –1.51   | –0.6                           | 158.0 |
| 12. Marketability level, %   | 100.0   | 100.0    | 97.1    | –2.9 p. p.                     | –     |
| 13. Profitability level, %   | –16.4   | –50.8    | –20.6   | –4.2 p. p.                     | –     |

**Note:** calculated by the authors according to the data of the «Gontarivka» farm of the NAAS of Ukraine; p. p. – percentage points

Let's note that for 2017–2019:

- the number of sheep in the enterprise increases by 16.5 % to the level of 1001 heads;
- the volume of wool production is also increasing by 16.7 % to 3.5 tons;
- the selling price of wool increases only by 19.2 % to 1,672.5 USD per ton;
- the total cost of a unit of production annually exceeds the size of the selling price, which leads to unprofitable production and sale of wool;
- at the same time, the rate of increase in expenses (total cost) exceeds the rate of growth of income (sale price of wool).

These changes have a negative impact on the final indicators of the efficiency of production and sale of wool.

So, in 2019, damage was received for each ton of wool 433 USD, which is 1.6 times more than in 2017; the amount of damage per head of animals is 1.51 USD; for the total number of livestock in the enterprise, the amount of damage is 1515 USD.

Consequently, the level of unprofitable production and sale of wool in an operating agricultural enterprise is 20.6 %, which deteriorates by 4.2 percentage points, since the level of price increase by 1.19 times is less than the rate of increase in costs by 1.26 times.

Among the reasons for this disproportion between the growth in the selling price and the level of costs for wool production is also the lack of sorting taking into account color (shade, degree of yellowing), which does not allow implementing an effective pricing policy.

It is known that the scientific and technical classification of wool is carried out according to such general criteria for evaluating a fleece as the type of wool, fineness, length, condition and color. The indicated at the present stage of human development presupposes the use of more advanced methods of laboratory and organoleptic assessment using laser devices. A rational combination of signs and techniques for assessing the rune, a variety of regulatory regulations is necessary [14]. Taking into account the results of the scientific and technical classification, both the state standards for wool and the pricing policy at each enterprise are built.

The purpose of wool classification is to prepare raw materials for its most efficient processing and rational use, as well as to establish a reasonable price for wool in accordance with its quality characteristics. So, the feasibility study of the introduction of a device for measuring the physico-biological characteristics of the skin and hair of animals, in particular sheep, is a necessary stage in the withdrawal of the sheep breeding industry from a crisis state.

The calculation of economic efficiency was carried out according to the National Standard of Ukraine «Methods of economic evaluation of equipment at the testing stage» DSTU 4397:2005 and in accordance with the Industry standard of Ukraine «Methods of economic evaluation of equipment for animal husbandry» DSTU 46.012 – in 2000 [15, 16]. Also, the feasibility study of the feasibility of introducing a new device was carried out on the basis of statistical methods for determining the effectiveness of an investment (innovation) project [17]. Namely, it was determined:

1) net cash flow (NCF) as the difference between the amounts of receipts (additional profit and the

amount of depreciation) and the company's expenses for a specific period;

2) net present value (NPV) as the difference between the amount of the discounted stream of additional income for the period of operation of the innovative device and the amount of investment costs required for the introduction of a new device;

3) internal rate of return (IRR), which is understood as the value of the discount rate at which the NPV of the project is equal to zero;

4) profitability index (PI), which is the ratio of discounted cash income to the investment costs given on the same date for the implementation of the device and shows the additional income the investor will receive per one conventional monetary unit;

5) discounted payback period (DPP) – the period for which the initial costs of implementing the device will be recouped due to additional income discounted at a given interest rate (in this case, at the annual rate on deposits).

The conditions for the introduction of a new innovative device for testing the physical and biological characteristics of the skin and hair of animals are:

- the cost of the device is 717 USD;
- increase in the selling price of wool due to its sorting by quality – from 5 to 10 %;
- the average annual livestock of animals (sheep) – 1000 heads;
- the planned useful life of the device – 3 years;
- discount rate – 10 % (annual rate on deposits).

The determination of the final and generalizing indicators of the technical and economic efficiency of the introduction of an innovative device helps to select animals on the basis of wool sorting by measuring the physical and biological characteristics of both the skin and their hair, are given in Table 3.

**Table 3**

Technical and economic indicators of wool sorting and distribution of animals with and without a laser

| Indicator   | Without using the device | Implementation of an innovative device |
|---|--------------------------|--|
| 1. Additional capital investments, USD  | x                        | 717.0                                  |
| 2. Livestock of animals (sheep), heads  | 1 000                    | 1 000                                  |
| 3. The amount of final products (wool), kg  | 3 500                    | 3 500                                  |
| 4. Selling price of wool (in the design version increased by 8 %), USD/kg                       | 1.43                     | 1.55                                   |
| 5. Income from product sales, USD   | 5 012.5                  | 5 413.5                                |
| 6. Production cost of products sold, USD  | 2 506.3                  | 2 506.3                                |
| 7. Sales costs (services of third-party organizations for shearing sheep and selling wool), USD | 2 327.2                  | 2 327.2                                |
| 8. Total cost of a unit of production (wool), USD/kg  | 1.38                     | 1.38                                   |
| 9. Profit, total USD  | 179.02                   | 580.02                                 |
| 10. Profit per unit of production, USD/kg   | 0.05                     | 0.17                                   |
| 11. Payback period of additional capital investments, years                                     | x                        | 1.79                                   |
| 12. The level of profitability of production and sale of wool, %                                | 3.7                      | 12.0                                   |
| 13. Net cash flow (NCF) for 3 years, USD  | x                        | 1 920.0                                |
| 14. Discounted cash flow for 3 years, USD   | x                        | 1 591.6                                |
| 15. Net Present Value (NPV), USD  | x                        | 874.6                                  |
| 16. Internal rate of return (IRR), %  | x                        | 56.0                                   |
| 17. Profitability index (PI)  | x                        | 1.22                                   |
| 18. Discounted payback period (DPP), years  | x                        | 2.46                                   |

**Note:** calculated by the authors; x – the value is not determined

Consequently, the amount of additional capital investments in the amount of 717 USD makes it possible to increase the selling price of wool by 8–10 % by sorting it by quality. It becomes possible to increase the profit margin by 0.11 USD per kilogram of wool, or to generate an additional 401 USD profit on all livestock. The level of profitability of production and sale of wool improves by 8.3 percentage points to 12 %. The payback period for additional capital costs will be only 21 months, which in world practice is the best value for an optimal period of 3–5 years.

The obtained indicators of the effectiveness of the investment project also confirm the feasibility of introducing the device, since the profitability index, which shows the size of the investor's additional profit per one monetary unit of additional costs, is 1.22 according to the calculations performed. In addition, the internal rate of return of 56 % significantly exceeds the ceiling, which in this case is the discount rate, or the annual rate on deposits. The discounted payback period is only 2.5 years, which, in contrast to the payback period for additional capital costs, takes into account the market risks associated with the cost of capital over time.

## 7. SWOT analysis of research results

*Strengths.* Based on the determination of the technical and economic results of the introduction of a new device that allows sorting wool, it turned out:

- the amount of capital investments in the amount of 717 USD allows to get additional profit for each head of animals from the sale of higher quality wool;
- the level of profitability increases by 8.3 percentage points to 12 %, which makes it possible to have a payback period for additional capital expenditures of less than two years;
- the internal rate of return of 56 % significantly exceeds the marginal rate of return in market conditions, in addition, the rate of return is greater than one.

*Weaknesses.* The weak side of the implementation of the project for the introduction of an innovative device is the lack of awareness of potential users, namely, producers of sheep breeding products. Informatization requires significant financial costs.

*Opportunities.* The obtained data of the feasibility study for the introduction of a new device confirm the economic feasibility of using this equipment. Since the payback period for additional capital costs does not exceed two years, the discounted payback period does not exceed the useful life, which in this case is the minimum (three years).

*Threats.* Threats for the implementation of the research results are unprofitable production and sale of sheep breeding products. The main reasons for this state of the sheep breeding industry are:

- lack of government support, especially financial;
- underdeveloped channels for the sale of products, in particular wool;
- lack of transparent economic relations between all participants in the livestock market;
- impossibility (mainly financial) of agricultural producers of sheep breeding products to switch to an innovative basis of management due to the lack of a calculated, effective pricing policy at all stages of the price chain (from producer to consumer).

## 8. Conclusions

1. It has been shown that sheep breeding is an important branch of animal husbandry, which provides the textile and leather haberdashery areas with such products as: wool, sheepskin, sheep skins, and the food market with highly nutritious food products such as meat, fat, milk, as well as additional jobs. The current state of the industry functioning both in the world and in Ukraine is in crisis. There is a significant reduction in the number of animals, deterioration in their productivity. In Ukraine, in particular, one can observe a significant loss of profitability in the production and sale of sheep breeding products. Thus, the average loss ratio over the past 20 years is 33 %.

2. The obtained indicators of the efficiency of the investment project confirm the feasibility of introducing the device, since the profitability index, which shows the size of the investor's additional profit per one monetary unit of additional expenses, according to the calculations performed, is 1.22. In addition, the internal rate of return of 56 % significantly exceeds the ceiling, which in this case is the discount rate, or the annual rate on deposits. The discounted payback period is only 2.5 years, which, in contrast to the payback period for additional capital costs, takes into account the market risks associated with the cost of capital over time.

## References

1. Tsibukh, A. V., Lisichenko, M. L. (2020). Color detection device of animal wool cover. *Modern Scientific Researches*, 13 (1), 56–63.
2. Morris, S. T. (2009). Economics of sheep production. *Small Ruminant Research*, 86 (1-3), 59–62. doi: <http://doi.org/10.1016/j.smallrumres.2009.09.019>
3. Ratnasari, I., Hakiq nurdiansyah, D. (2016). Feasibility Analysis of Breeding Sheep Garut. *Proceedings of the 2016 Global Conference on Business, Management and Entrepreneurship*, 15, 120–124. doi: <http://doi.org/10.2991/gcbme-16.2016.21>
4. Wiedemann, S. G., Ledgard, S. F., Henry, B. K., Yan, M.-J., Mao, N., Russell, S. J. (2015). Application of life cycle assessment to sheep production systems: investigating co-production of wool and meat using case studies from major global producers. *The International Journal of Life Cycle Assessment*, 20 (4), 463–476. doi: <http://doi.org/10.1007/s11367-015-0849-z>
5. Binkevycha, V. Ya., Yatsenko, I. V. (2015). Sheep breeding in Ukraine: major trends of industry activity. *Naukovyi visnyk Lvivskoho natsionalnoho universytetu veterynarnoi medytsyny ta biotekhnolohii im. Gzhytskoho*, 17 (1 (2)), 212–220.
6. Boiko, V. O. (2018). Prospects for development and increase of the competitiveness of the sheep breeding in Kherson region. *Ekonomika APK*, 1, 26–33.
7. Zharuk, L., Koval, T., Kozak, O. (2020). Development of the world market of sheep products. *Ekonomika APK*, 8, 60–71. doi: <http://doi.org/10.32317/2221-1055.202008060>
8. Ibatyllin, I. I., Pabat, V. O., Tyrunskiy, V. M. (2014). Current condition and ways of increasing of the export potential of sheep industry of Ukraine. *Ekonomika APK*, 3, 13–23.
9. Kytaieva, A. P., Bezalychna, O. O. (2016). Problemy suchasnoho rozvytku vivcharstva. *Tvarynnytstvo Ukrainy*, 1-2, 2–4.
10. Kozak, O., Bezhenar, I. (2015). Organizational and economic reserves of improving the sheep breeding industry competitiveness. *Ekonomika APK*, 8, 33–38. doi: <http://doi.org/10.32317/2221-1055.201508033>
11. Kravchenko, O. M. (2019). Mekhanizm formuvannia tsinovoho lantsiuha na tvarynnytsku produktsiiu v suchasnykh umovakh rozvytku Ukrainy. *Visnyk Kharkivskoho natsionalnoho tekhnichnoho universytetu silskoho hospodarstva. Ser. Ekonomichni nauky*, 202, 119–131.
12. Kravchenko, O. M., Netetskyi, L. H. (2019). Transmissiia tsiny mizh uchasnykamy ahroprodovolchoho lantsiuha produktsii skotarstva. *Visnyk Kharkivskoho natsionalnoho tekhnichnoho universytetu silskoho hospodarstva. Ser. Ekonomichna nauky*, 206, 98–113.



13. *Statystychnyi zbirnyk. Silske hospodarstvo Ukrainy*. Derzhavna sluzhba statystyky Ukrainy. Available at: [http://www.ukrstat.gov.ua/druk/publicat/Arhiv\\_u/07/Arch\\_sg\\_zb.htm](http://www.ukrstat.gov.ua/druk/publicat/Arhiv_u/07/Arch_sg_zb.htm)
14. Shtompel, M. V., Vovchenko, B. O. (2005). *Tekhnolohiia vyrobnytstva produktsii vivcharstva*. Kyiv: Vyscha osvita, 343.
15. *Metody ekonomichnoho otsiniuvannia tekhniky na etapi vyprovuvannia. Silskohospodarska tekhnika*: DSTU 4397:2005-2005. (2005). Kyiv: Derzhspozhyvstandart Ukrainy, 17.
16. *Metody ekonomichnoi otsinky tekhniky dlia tvarynnytstva. Silskohospodarska tekhnika*: DSTU 46.012-2000 (2000). Kyiv: Minahropolityky Ukrainy, 17.
17. Starchenko, H. V. (2018). *Upravlinnia proektamy: teoriia ta praktyka*. Chernihiv: vydavets Brahynets O. V., 306.

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