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ECONOMIC EFFECTS OF INVESTMENT IN CONSTRUCTION OF FLOOR STORAGE FOR ARABLE CROPS

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Abstract Storage of agricultural products is of very great importance, as it realizes a series of important functions. Reducing fluctuations in market supply, price stabilization and preservation of the quality and weight of grain, are the most important tasks of storage, whereby floor storage can be one of the solutions. In order to determine the economic feasibility of construction of floor storage, it is necessary to analyze the movement of purchase prices, in particular, corn and soybean, as well as to perform an analysis of the total building cost of floor storage. With analyzed investment, where the calculative interest rate is 7%, capital value of 62,095.92 €, respectively annuity income in the amount of 8,840.58 € is realized. The level of interest of invested funds is expressed by internal rate which amounts 13.7%, and the planned investments would return within six years.

Keywords: investment; storage; costs; prices.

1. INTRODUCTION

The objective of storage of agricultural and food products is to equalize fluctuations in market supply, then to ensure regular and continuous supply of raw materials for the processing industry, as well as establishing a balance between supply and demand, resulting in a stabilization of market prices [1]. Tendency to stabilize the prices of basic foodstuffs is one of the main reasons why the most developed countries, but also developing countries, stimulate and encourage the construction of facilities for storage of agricultural products [2].

The concrete example in this paper presents a method for the economic evaluation of investment in the construction of floor storage, with an area of 1,000 m2 and a capacity of 650 t, which is intended for storage of corn and soybean. The desired economic effects are achieved by delaying the sale, or achieving major purchase prices, which would therefore mean more profit. This fact also represents the purpose of the construction of such storage.

Floor storages built its economy on the difference between the real growth of the sales price of grains and oilseeds (in our case, corn and soybean) and the costs of their storage and shrinkage [3]. Based on the analysis of these parameters, in the ten-year period (2004-2013), the main aim of the research is to determine the economic effects of storage, while paying particular attention to the definition of the optimal period for the realization of corn and soybean.

1.1. Materials and methods

For the realization of the set goal of research, the database of the Statistical Office of Republic of Serbia is used (for the period from 2004 to 2013), then the data obtained from the Municipal Administration of Kula, Real Estate Cadaster of Kula, the company specialized in the construction of floor storage, and data obtained from agricultural cooperative from Kruscic, which plans to build a floor storage.

The various scientific methods of knowledge and research are used in the paper, such as analogy, methods of induction and deduction, and methods of analysis and synthesis. Different professional literature was used to create and design the theoretical part of the work, while the economic efficiency of investment was estimated by the dynamic method for evaluating investment (capital investment value, internal rate of interest, annuity method and return on investment).

2.1. The importance of storage

The need for storage of finished products comes from the requisite for delay selling, with the main objective to achieve better economic effects, and higher profits. Storage is particularly important for agricultural products which are seasonal and arrive once a year and they are subject of trade throughout the year [4].

In the economy of countries with favorable conditions for mass agricultural production, the chain of production, trade and processing of grain crops has an important place. Storage of grain crops is a key link in the chain that links farmers, on the one hand, with the subjects of marketing and processing on the other hand.

Storage of grain crops in addition to the basic function of preserving the produced quantity and quality of grain products, also achieves number of other important functions:

• bridges the gap between the seasonal character of production and the continuous nature of processing,
• consolidates fragmented, uncompetitive market quantity produced by individual agricultural producers,
• homogenize and standardize stored quantities, while creating a marketable product with defined quality level [5].

One of the most important roles of the storage are preserving and storing grains, which are essential in the diet of humans and livestock. As it is known, grain production is characterized by highly seasonal character and in most countries only one harvest per year is done. This means, in order to meet the global demand for food, it is necessary to store a big part of the production of wheat, corn, rice, millet, etc. for a period of one month and up to a year.

Increased interest in the construction of centers for reception, drying, storage, processing and handling of agricultural grain products is the result of evaluation of the profitability of these economic activities [6].

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2.2. Floor storages

Floor storage is used for storing and physical protection of the goods or packaged grain [7]. The facility is built like a house of a rectangular type and consists of a floor, which is concrete, then walls, a roof and one or more entrances [1]. Depending on the need, floor storages can be built with fans, windows, artificial lighting, etc. Very often, the floor storage is divided with the walls, in order to use it for storing more crops at the same time.

The basic division of floor storages intended for storage of grain agricultural products, differs the floor unmechanized storage and mechanized storage [8].

Floor unmechanized storage facilities are built of concrete or reinforced concrete elements. In a cross section they have 60 m2 or more, and the height of filling up the grain mass is 5 m. In the top of the roof structure a gallery is built into, which serves to carry the horizontal conveyor. Conveyor brings the grain mass and poured it in several places along the storage. In this way, more than one bunch of grain will be created, what would not have happened in the case of central loading.

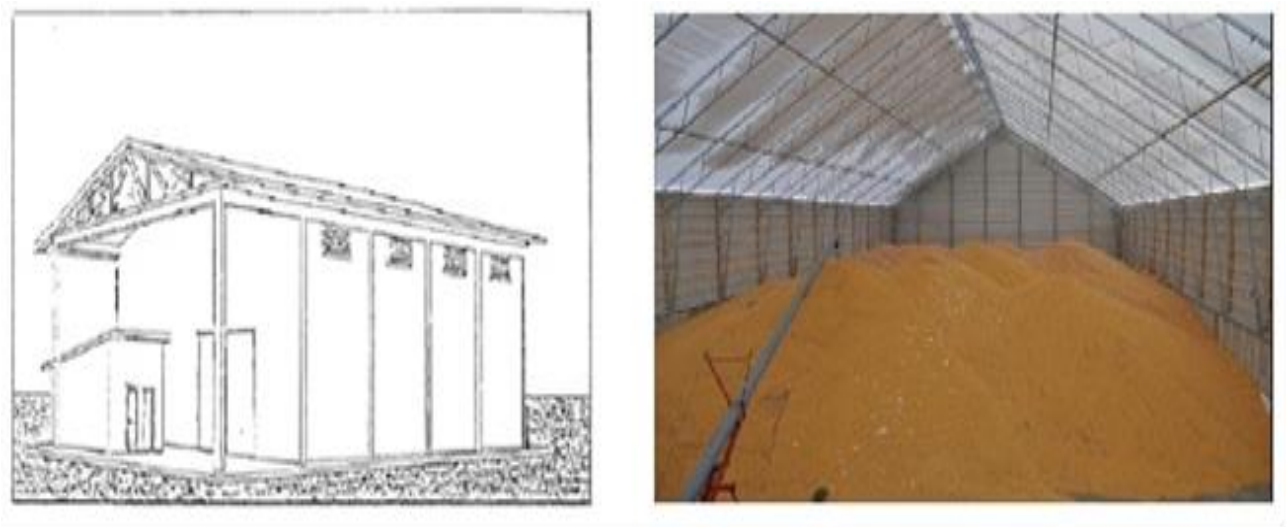

Figure 1. Floor unmechanized storage.

Excluding grain from this area is quite difficult. When the storage is full, emptying is done by opening in the door with gravity pipes directly into the trailer. When the level of grain mass is lower than the opening in the door, pneumatic conveyors are most commonly used for the exclusion.

Floor mechanized storage (bunkers) are similar in shape and size, to the previous one. The difference is that it enables the mechanized discharge of grain mass, because the floor is not horizontal but it is inclined.

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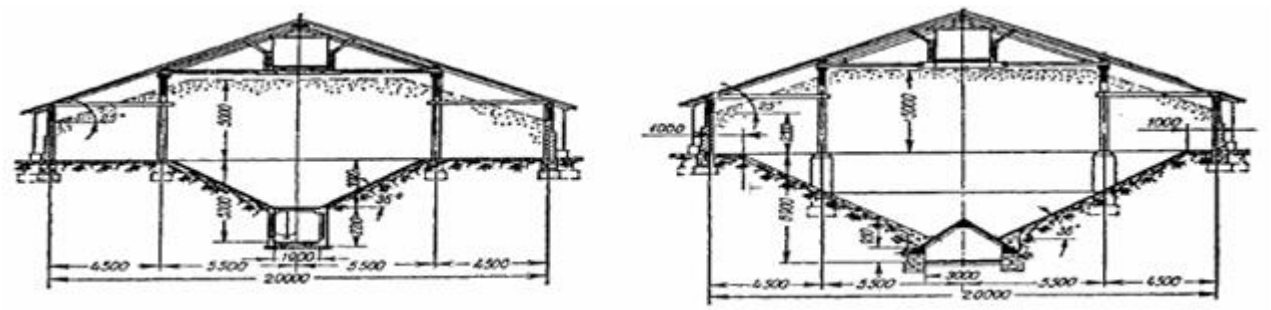

Figure 2. Floor mechanized storage

As already has been said, analyzed floor storage is intended for storage of corn and soybean. Given that this is a direct storing, without preliminary activities, for safe storage of wet grain necessary is to apply the appropriate storage conditions [9]. The most important parameters that affect the security of corn and soybean storage are the temperature inside the grain mass, grain moisture and storage time. With increasing humidity and temperature of the stored grain, it comes to acceleration of undesirable physical, chemical and biochemical processes. The enzymatic processes and processes of breathing are favorited and also the intensive reproduction of microorganisms is happening [10]. The heat released in this processes raises the temperature of grain mass, which leads to self-heating, which adversely affects the suitability of grain for further processing [11]. Importance of properly designed storages and exploitation of storage security elements best testify tragic explosions of the largest silo in the world in Wichita, United States [12] and floor storage in Blaye, France [13].

In order to increase the safety of storage, it is necessary to conduct a series of appropriate measures, where is most important to store corn and soybean only when the grain moisture is at an optimum level. Before importation of grain into the storage, storage must be hygienically correct, and then it is necessary to ensure the unhindered flow of air and of particular concern is maintaining the proper temperature.

2.3. Investment costs

The method of determining the acquiring cost of the investment facilities, respectively the amount of necessary investments depends on whether the acquisition of the means of production (production capacities) is done by purchasing on the market (purchase of agricultural machinery, transport vehicles, cattle breeding stock, etc.), or shall be obtained by building in a certain period. In the first case, the acquiring cost of the investment facilities, respectively the necessary investments are made at one point, and include the purchase price of the means of production, including transport costs to farmers' organization, as well as eventual costs of their preparation for use in the company [14].

The subject of analysis in this paper are construction costs, respectively the amount of investments, which are made during construction of storage capacities. These costs are determined as the sum of all the expenses (investments) at the time of completion of constructing the investment facility. In other words, the total amount of required investments is calculated as the sum of realized investments

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in the period, discounted using the compound interest at the moment of completion of constructing the investment facility.

It is important to emphasize that the entire investments in construction of floor storage fund from their own resources, and that there is no need to include into the calculation the possible costs for interest on borrowed funds from banks.

The total costs of building the investment facility, i.e. floor storage are shown in the following table.

Table 1. Costs of building floor storage with an area of 1.000 m^2.

Serial number	Description	Amount (€)
I	Cost of obtaining documentation for the location permit	620.00
II	Cost of obtaining documentation for the building permit	40,348.00
III	Cost of constructive part of floor storage	128,091.00
IV	Cost of purchasing and installing weighbridge	11,550.00
V	Costs of installing hydrant network	2,868.00
VI	Costs of electrical installations	1,959.00
VII	Costs of obtaining a use permit	2,402.00
VIII	Costs of registration object	90.00

Data from Table 1 (based on authors' estimate) show that the total costs of building floor storage with an area of 1,000 m2 and capacity of 650 t, amount to 187,928 €. In the structure of total investments, the costs relating to the actual construction of floor storage dominate (68.20%). Next are the costs of obtaining building permit (21.47%). In third place, according to the amount of investment needed, are the costs of procurement and installation of the weighbridge, with the participation of around 6%, while all other costs are of less importance, given that their share in the total costs is below 2%.

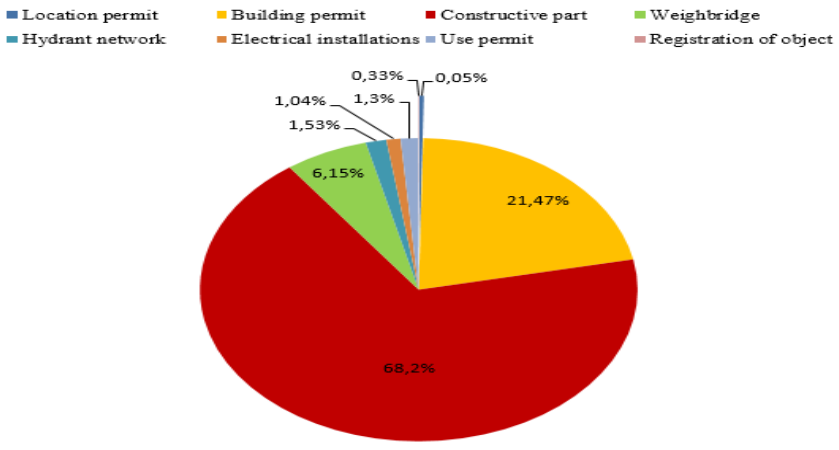

Figure 3. Structure of total investments.

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2.4. Economic effects of storing corn and soybean

Based on the analysis of trends of monthly purchase prices of corn and soybean, in the period from 2004 to 2013, significant seasonal fluctuations were established. As stated above, the purpose of storage of agricultural products is to delay selling until the moment when the price of specific crop (or oilseed) is most preferable. Sales delaying (storage) economy is based on the difference between the growth of purchase price of agricultural products and the costs of their storing. Since in this case it is not used someone else's floor storage for the purpose of storing, but own, storage costs will not significantly affect the final financial result.

Table 2. Average monthly purchase price of corn (€/t).

Year / Month	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
I	80.25	54.83	54.83	81.67	**131.92**	59.58	88.75	144.58	137.42	**192.58**
II	91.33	**61.83**	58.33	83.58	128.25	69.58	88.25	152.00	140.25	191.08
III	91.33	60.42	61.25	80.67	126.00	68.92	87.50	151.92	150.42	175.75
IV	90.50	59.17	59.00	81.17	124.83	72.17	93.00	163.08	145.92	186.25
V	92.50	59.17	62.92	88.17	123.00	88.83	95.92	165.00	162.25	169.75
VI	95.17	59.33	**66.08**	89.58	126.42	**92.58**	101.33	168.83	162.67	163.58
VII	92.67	59.08	63.50	93.08	125.17	88.25	117.00	**177.17**	178.00	154.17
VIII	**100.83**	58.58	65.42	115.33	97.75	75.33	136.00	169.75	207.17	121.58
IX	88.08	56.92	64.25	111.83	71.67	67.25	**138.75**	138.42	**208.42**	116.33
X	56.08	47.42	56.67	**118.33**	60.92	66.75	117.00	127.00	207.83	113.33
XI[1]	46.17	46.83	62.83	121.08	63.00	71.08	120.58	128.92	205.83	116.92
XII	47.42	48.58	71.17	122.08	62.83	79.83	131.92	126.58	201.58	124.67
Max purchase price over year	100.83	61.83	66.08	118.33	131.92	92.58	138.75	177.17	208.42	192.58
Price at the time of harvest	-	46.17	46.83	62.83	121.08	63.00	71.08	120.58	128.92	205.83
Difference	-	15.66	19.25	55.50	10.84	29.58	67.67	56.59	**79.50**	-13.25

[1] Harvest takes place in the month of November, so the grain moisture can reach the level of 14%.

In order to estimate the economic effects of corn storage, it is necessary to analyze trends of average monthly purchase prices in the last ten years (Table 2). This analysis should show is it more profitable for farmers to sell their products immediately after harvest, or to postpone the sale and wait for higher purchase prices. Also, the analysis should demonstrate in what months the purchase prices of corn were the highest, respectively in what period the highest incomes from storing were realized.

Based on table 2 (source: Statistical Office of Republic of Serbia) it can be concluded that in the observed period were different tendencies in the trends of monthly purchase prices of corn per years. First of all, it should be noted that storing was economically justifiable in all the years of the analyzed period, except in the production year 2012, when the highest purchase price of corn was in November (205.83 €/t), but eventually recorded a declining tendency. The highest income from storage was recorded in production year 2011, when the highest positive difference between the month when the harvest of corn was made and the month with the highest purchase price was achieved. This means that it was possible to make a profit of 79.50 €/t, if the sale of stored corn was executed in September 2012. The lowest earnings of corn storage were realized in production year 2007, when the maximum positive price differential compared to the moment of harvest, was only 10.84 €/t, in January next year.

The analysis of monthly purchase prices of corn, in the past ten years, led to the conclusion that the farmers, who have opted for storage, while selling the corn can achieve on average for 35.70 €/t higher price than the one they would get if they did not go for storage.

If it is known that half of the total capacity of the analyzed storage will be used for corn storage, respectively 325 t, it can be concluded that the annual income, just from the corn storage, will amount to 11,603 €.

Also, it is obvious that the highest income of corn storage is achieved in the period from III to X month of storage, i.e. in the period from January to August. With the extension of storage time, the economic effects are increasing, until two months before the arrival of a new crop.

Regarding the soybean, from Table 3 (source: Statistical Office of Republic of Serbia) , it can be seen that the storage was economically feasible in all the years of the analyzed period. The largest income is accomplished in the production year 2011, when the average purchase price in September 2012 was as much as 237.92 € higher than the purchase price of the month in which the harvest of this oilseed was carried out (October). The lowest earnings were generated in the production year 2012, when the maximum purchase price was for just 10.58 € higher than the price that farmers would get if they did not store, i.e. if they decided to sold right after the harvest.

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Table 3. Average monthly purchase price of soybeans (€/t).

Year / Month	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
I	124.42	105.25	146.75	132.58	225.17	213.33	231.58	264.08	287.67	538.08
II	134.58	135.92	156.17	138.92	255.33	243.83	252.33	285.92	301.58	480.08
III	136.83	147.83	158.25	140.08	287.17	252.33	240.83	282.00	313.67	476.67
IV	160.42	153.08	159.75	148.83	247.42	253.75	253.92	288.00	331.08	491.17
V	173.00	150.08	159.42	159.92	277.42	303.92	263.25	267.42	370.25	496.75
VI	178.33	158.25	177.58	158.58	280.67	279.50	264.25	260.75	408.67	490.08
VII	175.92	152.08	180.00	168.58	263.25	282.08	261.58	275.42	437.92	494.92
VIII	145.00	155.17	179.83	166.75	220.58	217.25	271.42	268.83	508.58	458.42
IX	108.92	139.83	135.25	189.67	205.17	208.92	233.08	276.83	516.75	323.17
X	104.00	138.42	133.08	194.67	207.83	215.83	237.83	278.83	527.50	356.92
XI	106.75	139.75	134.17	193.75	206.92	222.50	251.92	278.83	521.58	353.67
XII	109.83	138.92	132.50	199.08	205.75	240.25	241.33	277.08	512.00	377.33
Max purchase price over year	178.33	158.25	180.00	189.67	287.17	303.92	271.42	288.00	516.75	538.08
Price at the time of harvest	-	104.00	138.42	133.08	194.67	207.83	215.83	237.83	278.83	527.50
Difference	-	54.25	41.58	56.59	92.5	96.09	55.59	50.17	**237.92**	10.58

Analysis of monthly purchase prices movement, in the last ten years, shows that the soybean storage per year can make an average earnings of 77.25 €/t. In our case, this would mean that the soybean storage annually provides income of 25,106 €.

Also, as in the case of corn, the largest income from delaying of sale is realized in the period from III to X month of storage, where the economic effects of the storage are increasing with the extension of storage time.

Table 4 (based on authors' estimate) shows that the analyzed floor storage is able to achieve annual net profit in the amount of 35,598 €, only in the case of storing corn and soybean.

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Table 4. Annual economic effects of storage.

Elements of calculation	Amount (€)
Revenue from storage of corn	11,375.00
Revenue from storage of soybean	25,106.00
A. Total revenue	36,481.00
Disinfection	125.00
Disinsection	250.00
Deration	50.00
Calibration of weighbridge	458.00
B. Total expenditure	883.00
FINANCIAL RESULT (A-B)	**35.598,00**

2.5. Indicators of economic efficiency of investment

An evaluation of the economic efficiency of analyzed investment was made on the basis of dynamic methods, specifically methods of capital value, annuity methods, internal rate of return methods and return on investment methods. In order to calculate these indicators, previously it is necessary to draw up a cash flow and economic flow of the project. The costs of the annuity or financial obligations to creditors are attributed to the cash flow, as costs. Given that in this case there is no credit investment because the entire investment is financed from its own sources, these costs are not counted. For this reason, the economic life of a project is identical to financial one.

If the economic efficiency of investment is determined from the difference between total cash income from investment and total cash issuance for investment (usually discounted for the moment when starting to invest), the method of capital value is the object of speaking [15]. In other words, the capital value of the investment can be defined as the sum of the present value of the economic results achieved during the period of its use.

Based on the formula for calculating the capital value of the investment is easy to define criteria for making investment decision. The investment is economically justified when its capital value is non-negative, because only if the net present value is equal to or greater than zero, with the investment can be achieved rate of return equal to or higher than the rate of investment criteria, cost of capital, or the standard rate of return [16]. Since in this case the capital value is positive (C0-,0- = 62,095.92 €), the investment is economically justified.

If the interest level of investment funds is taken as the main criteria for the evaluation of economic efficiency, then it is more properly determined by the method of internal interest rate. Internal rate of return, as otherwise the internal rate of interest is called, can be defined as the interest rate that equates present value of the expected net cash flow from the exploitation of the investment, during its lifetime, to the present value of capital expenditures in the very investment [16]. In other words, the internal interest rate is the interest rate at which the capital value of the investment is zero. In order to

accept an investment, according to this method, it is necessary that the internal rate of return is equal to or higher than the calculative interest rate.

On the basis of the equation for calculating the internal rate of interest, data on the annual cash income and issuance and logarithmic tables for interest on the interest, the internal rate is 13.7%. Given that this calculated internal rate of interest is higher than the calculative interest rate, it can be safely said that the analyzed investment is fully economically justified.

Annuity method, which is also called the method of equal installments, consists in determining the average annual increase (or decrease) of the financial operating result during the period of using the investment object. The average annual amount of net annual benefits of investment is determined by transforming the amount of the capital value in a series of equal annual amounts or the annuities in the planned period of the investment. In order to say for a particular investment that it is economically justified, calculated annuity cannot be negative, i.e. an $\geqslant 0$. In other words, if the average annual income is greater than the average annual issuance, positive investment decision can be made [17]. Considering that in this case the average annual annuity amounts to 8,840.58 €, investment is justified according to this criterion too.

When analyzing investment, it is also necessary to identify a term of return on investments, i.e. to determine the period of depreciation of investments. The process of determining the shortest period of return on investments is based on a calculation of the time at which the sum of annual cash income from investment will be equal to the sum of the annual cash issuance for investment, discounted to the same clearing moment [18].

Based on data about the total value of investments and the amount of net income from investment, it can be concluded that total investments in constructing the floor storage, with an area of 1.000 m^2, can be returned in just the sixth year after commissioning of the facility.

Table 5. Indicators of economic efficiency of investment (based on authors' estimate).

	Indicators of economic efficiency	
$C_{0^-,0^-}$	capital value of the investment (€)	**62,095.92 > 0**
an	profit annuity (€)	**8,840.58 > 0**
	payoff (years)	**sixth**
i	calculative interest rate	**7%**
	internal rate of interest	**13.7% > i**

3. CONCLUSION

In order to determine the economic feasibility of constructing the floor storage, firstly it was necessary to make evaluation of the economic effects of corn and soybean storage. Analysis of trends in the monthly purchase prices of corn has shown that storing is economically viable in all years of the analyzed period (2004-2013), except for the 2012 production year. Agricultural producers who opt

for storage, while selling the corn, can achieve an average of 35.70 €/t higher price than the price they would get if they did not store, i.e., if they sold crops for the purchase price immediately after harvest.

On the other hand, analysis of trends of monthly purchase prices in the last ten years shows that the soybean storage is economically feasible in all the years of analyzed period. Annual earnings from storing are an average of 77.25 €/t.

If the cost of maintaining the floor storage is deducted from the total income, which is achieved from storing corn and soybean, deducting, the clear annual profit is 35,598 €.

Total capital investment in the construction of analyzed floor storage is 187,928 €, with the expected time of return on investment which is in the sixth year after the completion of the project. The capital value of investment (C0-,0-) is 62.095,92 €, while annuity income (an) amounts to 8,840.58 €.

On the basis of the calculated indicators of economic efficiency, the conclusion is that the investment in the construction of floor storage is absolutely economically justified.

Acknowledgements

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