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Cost-benefit Analysis of an Apple Orchard in the Republic of Srpska

Nemanja JALIĆ[1*], Karmen PAŽEK[2], Željko VAŠKO[1]

[1]University of Banja Luka, Faculty of Agriculture, Bulevar Vojvode Petra Bojovića 1a, 78000 Banja Luka, Republic of Srpska, Bosnia and Herzegovina

[2]University of Maribor, Faculty of Agriculture and Life Sciences, Pivola 10, 2311 Hoče, Slovenia

ABSTRACT

The aim of this study was to investigate the economic impact of an investment in an apple orchard in the Republic of Srpska, using the cost-benefit analysis method. All investment costs, annual production costs, production volumes and annual revenues were collected through an unstructured survey of the leading fruit production company in the Republic of Srpska "Agroimpex Nova" and based on similar studies from the region on this topic. Investments in fixed assets, materials, services, salaries, loans and depreciation costs were structured and calculated for a period of 15 years. In addition, all quantities produced and other revenues were totaled. Payback period, net present value (NPV) and internal rate of return (IRR) were calculated as the main economic indicators for this production. The total expenditure of the project is €2,836,316 and the net income for 15 years of the project is €5,054,705, so the net cash flow is €2,218,389. The net present value for the assumed discount rate of 6% is €927,691. The net present value per hectare is €46,385. The undiscounted payback period is 7.973 years. At a discount rate of 6%, the payback period is 9.313 years. The internal rate of return is 16.13%. The calculated results suggest that the investment in an apple orchard in the Republic of Srpska is economically feasible and represents an opportunity for future investment in agricultural production.

Key words: Cost-Benefit analysis, apple orchard, Republic of Srpska

INTRODUCTION

Apples are the most widely grown fruit in the world. According to FAOSTAT data, an average of 818,648,603 tons of apples were produced worldwide and 162,502,111 tons in Europe from 2010 to 2019. Apples are among the top 3 fruits (by production volume, after bananas and melons) in terms of total production, harvested area, and export potential, globally over a long period of time (van Rijswick, 2018). Apple production is extremely important for both domestic agriculture and the processing industry. Continued production growth is predicted, primarily due to expansion of the area under intensive fruit production (Užar et al., 2019). The Republic of Srpska has extremely pronounced comparative advantages for this production, which are mainly low labor costs and favorable climatic conditions for this production with high quality of produced fruits. The population of the Republic of Srpska has traditional habits of buying and consuming apples. Another advantage is the export orientation of apple production, especially to the Russian Federation, whose imports have been reoriented due to EU sanctions. Apple is the second largest fruit produced in the Republic of Srpska, right after plum (FAOSTAT, 2021). According to the Agency for Statistics RS (2021), the average apple production in RS in 2010-2019 was 41,885 tons per year. According to the same source, an average production of 20 tons per hectare was recorded in the last three years in 2,271 ha of intensive apple orchards. But the yield in all apple orchards is really low, only 3.3 tons/ha (FAOSTAT, 2021), as there are still few intensive orchards in Bosnia and Herzegovina (Vaško et al., 2011).

**Correspondence to:*
E-mail: nemanja.jalic@agro.unibl.org

The decision to invest in new farms involves great risks and uncertainties, is complex and multifaceted, and requires the evaluation of a number of economic, legal, and other factors (Pažek and Rozman, 2007). One possible method for valuing a new business or investment opportunity is the traditional discounted cash flow method (Pažek and Rozman, 2011). Cost-benefit analysis (or benefit-cost analysis) provides a transparent record of the data, assumptions, and analysis considered in making the decision when well documented (Robinson and Hammitt, 2011). Computer-based simulation models combined with financial cost-benefit analysis (CBA) can capture many of these factors and their interactions, providing useful decision support for the farmer (Pažek and Rozman, 2007). CBA is usually defined as an activity that allows the inclusion and comparison of costs and benefits that an investment project may cause in the wider or narrower social environment. CBA should take into account as many financial, economic, social and other factors as possible in order to assess the financial and economic viability of projects (Čupić, 2009). The main objective of this study was to model an intensive apple orchard under the climate and market conditions of the Republic of Srpska and assess its costs and benefits using the CBA method by calculating the net present value, the internal rate of return, a time period in which the investment will pay back, and the amount of risk, inflation, and capital that will withstand the investment.

MATERIALS AND METHODS

The interview method was used to collect data on the level and structure of investments, revenues, prices, income and costs. According to Pažek et al. (2004), in order to derive the annual cash flow budgets and investment costs of a given project, it is necessary to determine the technical parameters of investments and planned production. For this purpose, the historical real on-farm data of the fruit producer "Agroimpex Nova", the leading company in Bosnia and Herzegovina in apple and pear production, were used. Thus, the parameters used in the model are based on data from accounting and an interview with the chief engineer of the company. The main activity of the company "Agroimpex Nova" is the production and sale of fruit and the production of planting material. The history of these plantations dates back to 1959, when the company was founded in the municipality of Gradiska. The company's plantations cover 700 hectares, of which 350 hectares are planted, with apple and pear predominating. The plantations are located in the foothills of Kozara, at an altitude of 150-300 m, and have very good climatic conditions throughout the year. The production is based on an intensive technology with a high planting density on low-growing rootstock trees. In addition to the native soils, which provide excellent fruit quality, the orchards are equipped with an anti-hail net, an anti-frost system and a drop-by-drop irrigation system, which create the conditions for intensive fruit production. The structure of input-output data from the survey of Mamuza and Vaško (2013) was considered in the design of inputs and outputs in this model. Also, the chapter "Analytical calculations of apple production" by Jeločnik et al. (2021) was used for the structure and projection of costs and benefits of an orchard in the tested model. Veić et al. (2006), a guide recommended by the Croatian Ministry of Agriculture for the establishment of new orchards, was used as another source for the design of apple production.

The subject of the study is a cost-benefit analysis of an apple orchard on 20 ha in the north of the Republic of Srpska. The investment year is 2022 and 2021 prices were used. Based on the basic production process assumptions, the transformation of inputs into outputs was tracked and the realized revenues and expenses were calculated during the 15 years of the life of an investment. The analysis begins with fixed asset investments. Then, the cost of materials for the fifteen years was analyzed. Also, expenses for paid services, gross wages, depreciation of assets, and loans were calculated for each year of the period. The next part of the analysis is a calculation of revenues and the distribution of total revenues. An estimate of the required permanent working capital is also made. Cash flow and net cash flow are derived from the previous data.

The final stage of the investment appraisal is the calculation of the net present value (NPV), payback period and discounted payback period, and internal rate of return (IRR). NPV represents the difference between discounted annual cash inflows and outflows increased by the initial value of the investment. The difference represents the total net financial gain or loss (Ivanković and Vaško, 2013).

$$\text{NPV } (S_0) = \sum_{t=1}^{n} Vi \frac{1}{(1+k)^t} - I$$

Where: *Vi* is net cash flow (BAM), k is discount factor, t is period, I are investment costs.

The discounted payback period (DPP) is the moment in time when the discounted cash inflow is equal to discounted cash outflow. Discounted payback is a method in which we strive to respect the time value of money (Gavrić, 2016). This methodology calculates the time necessary to equalize discounted net cash flows with investment cost and the values of all other costs made in production.

$$I = \sum_{t=1}^{tp} Vt \frac{1}{(1+k)^t}$$

Where: *Vt* is discounted cash flow (BAM), k is discount factor, I are investment costs.

The IRR is the discount rate at which the net present value is zero. For this reason, it is also called the break-even discount rate (Pažek and Rozman, 2007). This is the interest rate for the project investment that takes into account the present value of cash flows. The main objective of the internal rate of return is to balance the investment cost of the project and the future cash flows of the project expected during the project life. The internal rate of return can be calculated in three ways: (1) the iteration method, (2) the interpolation method, or (3) using a financial function in Microsoft Excel (ISR). After you have determined the first positive NPV and the first negative NPV, you can calculate the internal rate of return of this cash flow using the trial-and-error method.

$$\text{IRR} = p_k + \frac{P_{k+1} - P_k}{NSV_{k+1} - NSV_k} * (0\text{-NSV})$$

Where: p_k is the discount rate when NPV is positive, p_{k+1} is the discount rate when NPV is negative, NPV_k for discount rate k, NPV_{k+1} for discount rate k+1 (Vaško, 2019).

RESULTS AND DISCUSSION

The technology and intensity of apple production have an extremely large impact on the success of the business in this industry. For this reason, the intensity of the studied plantation was set to the highest possible level, as well as the production technology. It is a dense planting with 2,700 seedlings/ha of low lush rootstocks (M9) with about 5 premature shoots, which allows early fruiting. Golden Delicious, Red Delicious, and Gala Standard cultivars were selected. Jeločnik et al. (2021), citing other authors, agree that apple orchard production, which includes full agrotechnical equipment and the use of modern equipment, can be a very capital-intensive production. It usually includes the installation of a drip irrigation system best suited for the apple, frost and hail protection systems, shade nets, fertilization, and more.

This plantation is fenced with concrete pillars and wire. Of the infrastructure facilities, the construction of offices and an auxiliary facility for mechanization is planned. A high-tech irrigation system, an anti-frost system and a hail protection system have been set up to avoid the risk of weather disasters. This orchard implies the existence of a cold store where the harvested fruits are stored until the optimal apple price. At the very beginning of this investment project, it is planned to purchase a new tractor with attachments, small inventory, picking boxes and a box for the transport and storage of the harvested apples with a capacity of 350 kg. The item for raising the plantations includes the cost of the investment and the first two years, when the income is lower than the expenses. This includes primarily the aforementioned soil preparation, preparation of the investment project, labor needed for planting, fuel and lubricants, pesticides and fertilizers, care in the first and second year, seedlings and seedling replacement. The total investment cost is €43,540 per hectare of orchard (Table 1). The orchard was financed from the investor's own funds and a loan of €255,646 (interest rate 3.7%). The loan is repaid by equal annuities of € 33,440 per year with a grace period of 12 months.

Pruning and thinning of seedlings after planting are carried out every year, as well as the application of pesticides and fertilization with mineral fertilizers. Harvesting is done manually, after which the sorting of the fruit is tackled. Input costs do not include the cost of pesticides and mineral fertilizers in the first two years, nor do they include the cost of fuel and seedling replacement (Table 2). These costs are attributed to planting costs, which are included in the capital cost table. The hoses of the irrigation system are replaced every four years and increase the total amount of input costs by €16,873. After the fourth year, the total material cost is slightly more than €47,000, except in the years when the irrigation hoses are replaced.

In the further analysis, the costs of services were processed, which amount to € 8,027 per year in the years of full yield. The costs of permanent labor and seasonal labor amount to €30,667 in the first year and €81,807 in the full yield years, mainly due to increased harvesting costs. The permanent workforce consists of an orchard manager and two fruit engineers. Seasonal workers are hired for harvesting and pruning the orchards. A loan of € 255,600 was also taken out at an interest rate of 3.7%. The total interest cost for repaying

Table 1: Investment in fixed assets (€[1])

Type of fixed asset	Unit	Quantity	Price	Total	Investment in a year
Purchase of land	ha	20	3,323	66,468	0
Orchard fence	m	4,800	15.3	73,628	0
Office premises	m^2	100	102.3	10,226	0
Cold storage	m^2	250	511	127,823	3 year
Mechanization facility	m^2	120	86.9	10,430	0
Tractor with attachments	set	1	46,016	46,016	0
Reading boxes (kangaroo bags)	one	210	35.8	7,516	1, 6, 11, year
Transport boxes 350 kg	one	1,800	61.4	110,439	0
Raising orchard	ha	20	9,186	183,723	1, 2, 3, year
Feasibility study	Lump-sum	1	1,534	1,534	0
Pillars	one	1,418	6.14	8,697	0
Wire	kg	9,400	1.28	12,015	0
Net	m^2	19,500	0.36	6,580	0 and 8 year
Anti-frost system	System	1	69,024	69,024	2 year
Irrigation system	System	1	61,355	61,355	0
Working capital	-	-	-	75,339	0-15 year
Total investment	ha	20	43,540	870,813	0-15 year

Source for the investment budget are personal investment fund and loan.

1 1 € = 1,955830 BAM (The Central Bank of Bosnia and Herzegovina, https://www.cbbh.ba/currencyexchange/)

Table 2: Input costs (€)

Inputs / year	1.	2.	3.	4.	5.	6.
Pesticides and fertilizers			32,654	32,654	32,654	32,654
Spare parts for machines	511	1534	2,557	3,835	5,195	5,195
Fuel			4,486	4,486	4,486	4,486
Write-off of small inventory, office supplies	460	920	2,403	3,579	3,579	3,579
Transportation	256	358	511	584	584	584
Seedling replacement			614	614	614	614
Water hose replacement				16,873		
Total input costs	1,227	2,812	43,225	62,625	47,112	47,112

Table 3: Total income (€)

Income / year	1	2	3	4	5	6
Apple sales income	0	46,630	93,260	186,519	373,039	373,039
I class	0	41,415	82,829	165,659	331,317	331,317
II class and industrial use apple	0	5,215	10,430	20,861	41,721	41,721
Fuel subsidy	0	0	1,336	1,336	1,336	1,336
Subsidy for fruit quantity (total)	0	6,902	13,805	27,610	55,220	55,220
Total income	0	53,532	108,400	215,465	429,594	429,594

the loan over 10 years is €58,095. The cost of amortization is €21,751 in the first year, €26,682 in the second year and €44,919 from the third to the fifteenth year.

The subsidies per kg of apples sold are shown in Table 3. The ratio of the first and second class of apples is 60:40%. In the total income, the sale of the first class of apples has the largest share. The second largest contributor to the income amount is the income from the subsidy paid for the amount of apples sold. This is followed by income from the sale of the second class of apples. The smallest income comes from the fuel subsidy. In the first year, no income was recorded at all. In the second, third, and fourth years, income grows and in the fourth year is about 50% of the highest possible income for whole crop. From the fifth to the 12th year, income is projected at €429,594. In the last three years in which the project is implemented, the income will decrease because the yield of the orchard will decrease.

A detailed cost-benefit analysis (CBA) can be defined as an economic technique used in public decision-making that seeks to quantify the benefits (advantages) and disadvantages (costs) associated with a particular project or policy (Kutumbale et al., 2019). This analysis helps each producer evaluate their business, how much it will bring in, and whether or not it is economically viable.

Table 4: The net cash flow of the project (€)

	Total
Cash Inflow	5,054,705
Total income	4,850,152
Residual value	204,553
Cash Outflow	2,836,316
Investment in fixed assets	802,053
Investment in current assets	32,583
Input costs	661,855
Services	118,247
Gross salaries	1,163,483
Interest	58,095
Net Cash Flow	2,218,389

Table 4 shows the total net inflows and outflows over a 15-year period. The net cash flow of this apple orchard is high (€2,218,389) compared to the initial investment. A similar stance is taken by Jeločnik et al. (2021), who claim that market-oriented on-farm apple production can be very profitable under the production conditions of Serbia, which has a similar climate to the Republic of Srpska, but only if it involves the application of comprehensive agricultural techniques.

Further Figure 1 shows that net cash flow (undiscounted) becomes positive in the seventh year. However, considering that the calculation starts with year zero, we can say that the payback period is 7.97 years. Thus, the revenues from this project will exceed the costs after almost eight years.

The main indicator of financial cost-benefit analysis is the net present value (NPV), which is calculated as the difference between the sum of discounted investment cash flows and investment costs (Pažek et al., 2004). It is assumed that the level of government policies, costs, tariffs, subsidies, climatic changes and other production factors is quite stable in the specified period, so the discount rate of 6% is applied (Ćejvanović et al., 2005). In this case, the NPV value at the end of the project is €927,691, which is also acceptable (Figure 2). The discounted return period with an interest rate of 6% is 9.313 years.

This project is able to sustain an internal rate of return (IRR) of 16.13%. Ćejvanović et al. (2005) also concluded that the apple orchard project has an IRR of 17.3%. These rates indicate that investments in high-intensity apple orchards are financially viable, which is also confirmed by Jeločnik et al. (2021), who claim that market-oriented apple production on

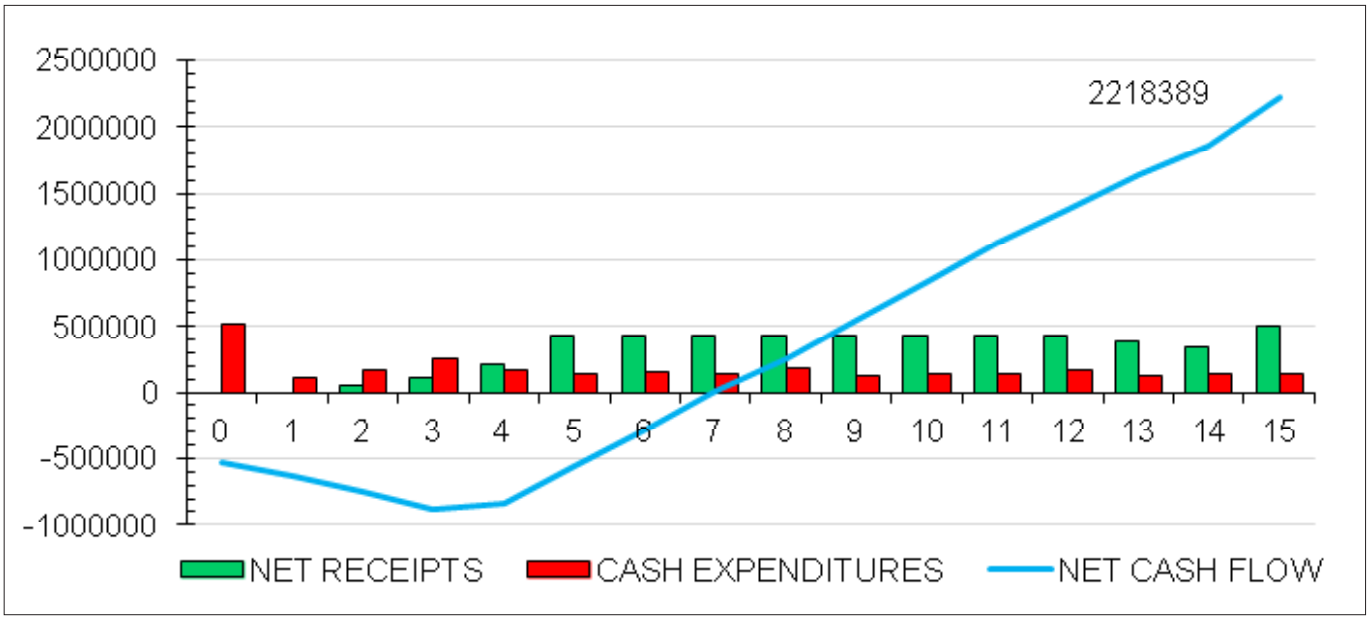

Figure 1: Cumulative 15 years net cash flow of apple orchard project (€)

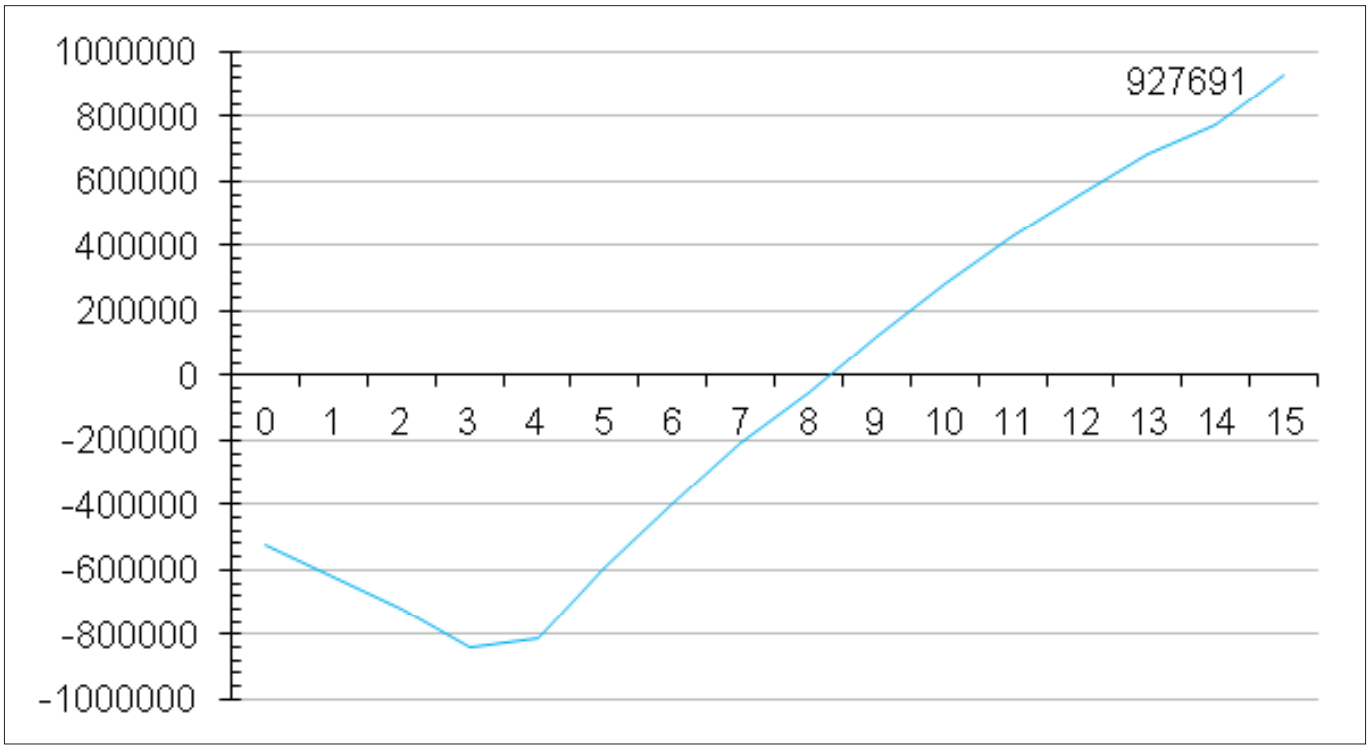

Figure 2: Net present value of apple orchard project (n =15 years; discount rate = 6%; in €)

family farms can be very profitable under Serbian production conditions, but only if it includes comprehensive agricultural techniques. Badiu et. al. (2015) found in the case of Romania that the investment cost for super-intensive apple orchards is 50,574 €/ha, which is close to the investment cost in this case study. The values of CB investment indicators are higher in Romania than in BiH (NPV=114,047 €/ha, IRR= 22.18% and DPP=4.17 years), which is due to the higher proportion of first class apples. Much more realistic and closer to the results in BiH are the results for the case of investment in intensive apple orchards in the Czech Republic (Sojkova and Adamičkova, 2011), which gave NPV=8,148 €/ha, IRR=14.24% and DPP=7.15 years (with similar assumptions, useful life 15 years, investment 30,390 €/ha). Appati (2009) compared the financial impact of investments in 1 ha apple orchards in Hungary and Germany. NPV was expressed in HUF (no exchange rate to convert to €), IRR was 15.3% in Hungary and 9.9% in Germany, useful life was 8 years in Hungary and 9 years in Germany.

The results obtained in the studied case in B&H are not far from those obtained in the Central European countries. This confirms that the natural conditions and the market conditions are similar, considering that the research in B&H is more recent, when the input and labor costs have increased, so the calculated parameters are lower than they would have been five or ten years ago.

CONCLUSIONS

One of the fundamental characteristics of agriculture is the great variability of yields, due mainly to climatic, biological and human factors. For this reason, income in agriculture is not constant and stable, which makes this production very risky. If it is possible to control the production process and influencing factors as much as possible, it is possible to reduce the business risk, which is the goal of any production. In the apple production studied here, the influence of variable factors is minimized by incorporating an irrigation system, hail protection, and a frost protection system into the investment. Modern methods of pruning, fertilization and pesticide application are also incorporated into the production process under the supervision of competent and professional experts. All these measures result in high yields and stable incomes, and the risk of errors in planning and assuming future income and expenses is minimized. The applied cost-benefit method answers the most important question regarding any investment, whether it is financially feasible or not. The first result of the evaluation of the investments studied is that 43,540 €/ha of total investment in fixed assets is required during the life of the orchard, and 870,800 € of total investment for 20 hectares. The input costs increase in the initial years and amount to about 47,112 € after the fourth year, except in the years when the irrigation hoses are replaced, which increases these costs to 62,625 €.

The income in apple production comes from four sources: First grade apples, second grade apples, subsidies per kilogram of apple, and fuel subsidies. In the analysis, it was assumed that 60% of the apples produced belong to the first class and the rest to the second class. In the first years the income is very low, in the fifth year the orchard is fully productive and brings a maximum income of 429,485 € per year, until in the 13th year the yield starts to decrease and therefore the income decreases. Income from the sale of first class apples has the largest share of total income (77%), followed by subsidies per kilogram with about 13%, followed by the sale of second class apples (10%) and subsidies for fuel with less than 1%. The total income from fruit production is €5,054,705 and the expenditure is € 2,836,316. It can be concluded that this project is very profitable, because at the end of the period the net cash flow is 2,218,389 €. Assuming a discount rate of 6%, the net present value is €927,691, which is also very acceptable given the rather high discount rate and the 15-year period for project implementation. The undiscounted payback period is 7.973 years and the discounted payback period is 9.313 years. The goal of any project is to increase the internal rate of return, and in this case it is high (16.13%), which encourages the investor. Such a high internal rate of return was achieved because the planned orchard is very intensive (irrigation system, hail protection, frost protection, protection from other pests by fencing). The price and yield of apples are high and stable. All agrotechnical and pomotechnical measures are practiced. Fixed assets are used optimally based on economies of scale.

Based on the calculated net cash flow value, net present value, discounted and undiscounted payback period, and internal rate of return, it is concluded that all these values are acceptable and favorable to the investor. The investment in an apple orchard in the Republic of Srpska is feasible and reasonable. Of course, despite all the calculated indicators, the limitations of investing in such projects are certainly the high initial investment costs for high-intensity plantations, especially for agricultural producers of RS, who lack capital for such investments due to low accumulation rates in agriculture.

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Primerjalna analiza skupnih stroškov in prihodkov nasadov jabolk v Republiki Srbski

IZVLEČEK

Z raziskavo smo želeli analizirati finančni učinek investicije v nasade jabolk v Republiki Srbski. V ta namen je bila uporabljena metoda Cost - Benefit analize (CBA). Podatki o investicijskih stroških nasadov, letni stroški proizvodnje, količine pridelka in letni prihodki so bili zbrani na podlagi nestrukturirane ankete. Anketa je bil izvedena neposredno v praksi, v sadjarskem podjetju "Agroimpex Nova". Nekateri vhodni podatki so bili pridobljeni v obstoječi strokovni literaturi. Osnovna sredstva, materialni stroški, storitve, plače, krediti in stroški amortizacije so strukturirani in ocenjeni za 15-letno obdobje. Podobno velja za prihodke. Kot najpomembnejši parametri analize so v raziskavi ocenjeni naslednji kazalniki: obdobje vračila investicijskega vložka, neto sedanja vrednost (NPV) in interna stopnja donosa (IRR). Rezultati kažejo, da je višina investicije v nasade jabolk 2.836.316 €, neto prihodki za 15 let trajanja projekta pa lahko dosežejo vrednost 5.054.705 €. Vrednost letnega denarnega toka je ocenjena na 2.218.389 €. Vrednost NPV, ob predpostavljeni 6 % diskontni stopnji, znaša 927.691 €. Ocenjena neto sedanja vrednost na hektar znaša 46.385 €. Nediskontirana doba povratka investicije dosega vrednost 7.973 let. Vračilna doba z upoštevano 6 % diskontno stopnjo je daljša in sicer 9,313 let. Interna stopnja donosa doseže vrednost 16,13 %. Glede na rezultate analize, lahko sklepamo, da je naložba v nasad jablan v Republiki Srbski finančno izvedljiva in iz vidika investitorjev zanimiva naložba.

Ključne besede: primerjalna analiza stroškov in koristi, nasadi jabolk, Republika Srbska