ECONOMIC EFFICIENCY OF INVESTMENTS IN THE GROWING OF MEDICINAL HERBS AND SPICES

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ARTICLE INFO

Original Article

Received: *26 August 2023*

Accepted: *20 October 2023*

doi:10.59267/ekoPolj240113N

UDC 338.246.027:633.8

Keywords:

Medicinal herbs, spices, investments, crossover rate.

***JEL**: Q01, Q14, D25*

ABSTRACT

Medicinal herbs are important for human nutrition and industrial processing. The main goal of research is assessment of economic effectiveness of investments in seedlings production and establishment of plantation under mentioned crops. Analysis involves data from the coal mine complex in Pljevlja (Montenegro), while implies dynamic methods such are Net Present Value, (Modified) Internal Rate of Return, and Payback Period. Although research results favored the seedlings production, determined crossover rate indicates some opposite conclusions. Inconsistency in conclusions according to Net Present Value and Internal Rate of Return occurs only for certain range of discount rate. Research also implies sensitive analysis of crossover rate according to changes in volume of invested assets. So, management could make appropriate decisions towards the investments in medicinal plants production. Derived results suppose that investment in production of medicinal herbs seedlings is economically more effective for all discount rates above the crossover rate (6.08%).

Introduction

Medicinal plants (herbs) and spices have been used in human nutrition and medicine since prehistoric times (Sam, 2019; Sachan et al., 2018). Nowadays, they are used as fresh or processed in human diet and medicine, as a compound of animal feed, or raw material in several sectors of industry (i.e. cosmetics and perfumery, pharmacology, food and feed industry, cookery, light chemical industry, etc.), (Jackson, Snowdon, 1990;

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Mirzaei Aghsaghali, 2012; Wiart, 2012; Živković et al., 2019; Saranraj, Sivasakthi, 2014). They are grown as domesticated varieties in organized industrial production or picked in a wild form in nature (Dhar et al., 2000; Jeločnik et al., 2012). Depending on plant species, they could be successfully grown all over the world, both in open field or greenhouse, in soil or hydroponic (Maggini et al., 2011; Hakimi et al., 2022; Luković et al, 2023). They could be consumed as fresh or processed (dried and milled as powder, in form of oils, tinctures, etc.), (Balentine et al., 1999). They could be used as the whole plants or just as the part of a plant (e.g. radix, leaves, stalk, flower, seeds, fruits, etc.), (Dragland et al., 2003, Done et al., 2012; Botezatu & Andrei, 2012)).

There are a lot of benefits linked to the growing and further use of the medicinal herbs and spices. Above all, they have therapeutic and healing effects towards the most of diseases and misfunctioning in human organism, they are taste and quality enhancer in food products, they are precious compounds within the cosmetics and pharmacy preparations, etc. (Abdel Aziz et al., 2016; Dini, 2018; Jabeen et al., 2022). During their life cycle, they are able to synthesize a number of chemical compounds useful in protection and curing against several diseases and pathogens, such are cardiovascular and neurological issues, diabetes, cancer, arthritis, dementia, etc. (Andrei et al., 2014; Preethi et al., 2010; Chaudhari et al., 2021; Mayekar et al., 2021).

Global market of the mentioned plants is constantly growing affected by an increase in demand (Inoue et al., 2019). Current market worldwide is worth over the 170 mld USD, while it has annual growth over the 3.5% in the last several years (FMI, 2023). Although the growing of medicinal herbs and spices is profitable, some estimations show that the most of profit is concentrated in processing and retail, while, for example, plant collectors take less than 7% of market price of final product (Schippmann et al., 2002). It has to be mentioned that the value of plants and products entering into the global trade is not ultimate, as the large part is naturally consumed or sold on black market (in grey zone), (Farnsworth, Soejarto, 1991).

In line with the health benefits they carry on, medicinal herbs and spices fully correspond to nature, good life habits and sustainable development (Van Wyk, Prinsloo, 2018). Besides the fact that their production brings the income to farmers and rural communities affecting the poverty alleviation processes, the premise of their healthiness drives the growers to act entirely with the principles of good agricultural practice, protecting the local environment and landscapes (Shinwari, 2010; Wondimu et al., 2007).

It is not so rare that medicinal herbs and spices or some other crops are grown on areas that formerly were used for certain form of mining (Pruvot et al., 2006; Dutta, Maharia, 2012; Vaculik et al., 2013; Blanco et al., 2022). In these cases, the environment of the previous mine pits has to be entirely remediated and re-cultivated, or simply ecologically cleaned and brought to primal purpose – agriculture (Ignatyeva et al., 2020; Tichy, Mejstrik, 1996). At this moment, mentioned crops become protectors of rural communities of further mainly soil and water degradation, while they bring certain economic and social benefits too. Of course, investing in such a production has

some costs, usually higher than production in regular conditions (on real agricultural land). So, investment requires deeper techno-economic preparation for decision making process in order to avoid potential failures. From the aspect of economic assessment of planned investment benefits, commonly used dynamic methods are the ones of investment effectiveness evaluation, such are NPV, IRR, PBP (Miletić & Radić, 2022; Kodir et al., 2017; Jeločnik, Subić, 2020; Ergina et al., 2020; Dončić et al.,2022; Pantić et al., 2022; Subić et al., 2021).

The main paper's goal is to present the evaluation of economic effectiveness of investments in seedlings production and establishment of plantation under the medicinal herbs and spices, while making an adequate investment decision towards the available investment alternatives. Paper presents the certain selection mechanism based on calculation of crossover rate's value, towards the choosing the optimal investment alternative by decision maker.

Research was based on the following hypothesis:

H1: Investments in growing of medicinal herbs (in seedlings production and its plantation growing) is economically justified.

H2: Use of the Net Present Value and Internal Rate of Return could lead to different conclusions in investment analysis, i.e. to favoring of different investments (in seedlings production, or plantation growing).

H3: Deviations from initial (expected) level of investment and net cash flow could have large impact to selection between available investment alternatives in medicinal herbs production.

Methodological Framework

The data from the public coal mine enterprise in Pljevlja (Montenegro) are used in the research as data source, as well as available scientific and professional literature focused on seedlings growing and plantation production of medicinal herbs and spices. All data and derived results are presented by adequate tables and Figures. All values are given in EUR.

For the assessment of economic effectiveness of investments, the discounting methods are used, such are the Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP), (Subić et al., 2020). Besides, the investments are also assessed by the Modified Internal Rate of Return (MIRR), whose level, unlike classic IRR, depends on the level of discount rate (Barry, Robison, 2014).

When comparing investments, i.e. considering which investment is more economically acceptable, different levels of discount rates were used, while, based on that, the level of crossover rate was determined (the level of the discount rate at which NPVs of compared investments are mutually equal), (Park, Matunhire, 2011). The value of crossover rate is determined according to the differential net cash flow of reconsidered investments, by calculating its internal interest rate (Noe et al., 2003). In addition, it

was analyzed how the level of crossover rate is affected by the variations in level of initial investments and the net cash flow from investment.

Results with Discussion

As a part of sustainable maintaining of the abandoned coal mining pits area (at 100 ha), after finishing the remediation and re-cultivation processes, management of the public coal mine enterprise strives to establish certain lines of agricultural production. Final decision has been focused on the sector of medicinal herbs and spices production (Coal mine enterprise AD Pljevlja, 2023a, b.).

In line with that, there are two investments that could be realized, i.e. investment in machinery and equipment for crops growing with establishing of plantation of certain plant species (with the application of modern technological solutions), or investment in crops' seedlings production facilities (contemporary greenhouses) and required equipment and machines. Enterprise management has to decide which of the two offered investments has to be financed, according to economic effects they produce.

Medicinal herbs and spices that will be grown in the final selection involve the following crops: Lavender Grosso and English Lavender, Sage, Thyme, Hyssop, Oregano, Winter Savory, Sweet Wormwood, Lovage, and Parsley. All plants will be grown as a long-term plantation, as well as perennial or annual crops. It was assessed that these are the plants that possess large market potential with constantly increasing demand and selling prices at the regional markets (as fresh raw material or processed products).

Initial value of investment in crops' seedling production is 87,309 EUR. This investment includes the purchase of two greenhouses with a steel structure (single-aisle greenhouses, 10 m wide, with 3.5 m high flat sides, and the overall height of 5.5 m in the ridge), as well as the supporting equipment in greenhouse production, i.e. 28 tables for a greenhouse (2 m x 8.5 m x 1 m). Investment in crops growing (establishment of organic plantation system) includes the purchase of required equipment and machinery (tractors, trailers, sprayers, water tanks, plows, planters, chisel plows, medicinal plant pickers, diggers, turner plows, tillers, harrows and seedbeds maker), establishment of long-term plantations (Lavender Grosso and English Lavender) and other (investment works), whereby the initial investment amounts 256,927 EUR (*Table 1*.). An economic effect of use of the appropriate machinery in medical herbs production is discussed by Ivanović et al. (2007).

Table 1. Overall investment in organic crops growing or seedlings production (in EUR)

No.	Element	Seedlings production		Plants growing	
		Total investment	Share in total investment (%)	Total investment	Share in total investment (%)
I	**Fixed assets**	**79,372**	**90.91**	**233,570**	**90.91**
1.	Facilities	39,578	45.33	-	-
2.	Equipment and mechanization	39,794	45.58	196,800	76.60

No.	Element	Seedlings production		Plants growing	
		Total investment	Share in total investment (%)	Total investment	Share in total investment (%)
3.	Long-term plantations	-	-	33,650	13.10
4.	Other			3,120	1.12
II	**PWC**	**7,937**	**9.09**	**23,357**	**9.09**
Total (I+II)		**87,309**	**100.00**	**256,927**	**100.00**

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

The financing scheme (available sources) for planned investments are identical, i.e. in both cases the largest part of investment will be financed with own (corporative) assets (fixed assets), while the permanent working capital (PWC) will be financed from a short-term loan (*Table 2*.).

Table 2. Financing sources for realization of investment alternatives (in EUR)

No.	Element	Seedlings production		Plants growing	
		Total investment	Share in total investment (%)	Total investment	Share in total investment (%)
I	**Own assets**	**79,372**	**90.91**	**233,570**	**90.91**
1.	Fixed assets	79,372	90.91	233,570	90.91
II	**Other sources**	**7,937**	**9.09**	**23,357**	**9.09**
1.	PWC	7,937	9.09	23,357	9.09
Total (I+II)		**87,309**	**100.00**	**256,927**	**100.00**

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

After determining all incomes and expenses incurred during the investment's exploitation, the net profit (income statements) for seedlings production (*Table 3*.) and medicinal herbs and spices growing (*Table 4*.) was defined. It has to be noted that, according to current regulations in Montenegro, the income tax rate is 9% for amounts up to 100,000 EUR, while for amounts over 100,000 EUR tax covers 9,000 EUR + 12% on the amount over 100,000 EUR. Generally, in both investments (except in the initial year of plantation establishment) there is an achieved positive net profit in entire period of investments exploitation.

In line with data from the income statements, the economic flow for both investments is performed, while in the last year of investments' use (10th year) the salvage value of the investments is also presented (*Table 5. and 6*.). It is visible that, at the second alternative, the economic flow is negative in the first and sixth year of exploitation, as a result of plantation reestablishment after five years of using.

Table 3. Income statement in seedlings production (in EUR)

No.	Element	Years									
		I	II	III	IV	V	VI	VII	VIII	IX	X
I	**Total incomes**	**155,930**	**155,930**	**155,930**	**155,930**	**155,930**	**149,200**	**149,200**	**149,200**	**149,200**	**149,200**
1.	Sale incomes	155,930	155,930	155,930	155,930	155,930	149,200	149,200	149,200	149,200	149,200
II	**Total expenditures (1+2)**	**151,508**	**151,296**	**151,296**	**151,296**	**151,296**	**135,777**	**135,777**	**135,777**	**135,777**	**135,777**
1.	Business expenditures	151,296	151,296	151,296	151,296	151,296	135,777	135,777	135,777	135,777	135,777
1.1.	Material costs	17,576	17,576	17,576	17,576	17,576	15,946	15,946	15,946	15,946	15,946
1.2.	Non-material costs without depreciation and interest	125,783	125,783	125,783	125,783	125,783	111,894	111,894	111,894	111,894	111,894
1.3.	Depreciation	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937	7,937
2.	Financial expenditures	212	0	0	0	0	0	0	0	0	0
2.1.	Interest	212	0	0	0	0	0	0	0	0	0
III	**Gross profit (I-II)**	**4,422**	**4,634**	**4,634**	**4,634**	**4,634**	**13,423**	**13,423**	**13,423**	**13,423**	**13,423**
IV	**Income tax**	398	417	417	417	417	1,208	1,208	1,208	1,208	1,208
V	**Net profit (III-IV)**	**4,024**	**4,217**	**4,217**	**4,217**	**4,217**	**12,215**	**12,215**	**12,215**	**12,215**	**12,215**

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

Table 4. Income statement in plantation crops growing (in EUR)

No.	Element	Years									
		I	II	III	IV	V	VI	VII	VIII	IX	X
I	**Total incomes**	**67,763**	**177,828**	**218,768**	**245,975**	**272,664**	**202,298**	**264,060**	**272,664**	**272,664**	**272,664**
1.	Sale incomes	67,763	177,828	218,768	245,975	272,664	202,298	264,060	272,664	272,664	272,664
II	**Total expenditures (1+2)**	**306,844**	**162,735**	**176,269**	**175,738**	**173,988**	**251,971**	**166,661**	**165,036**	**171,107**	**163,756**
1.	Business expenditures	306,220	162,735	176,269	175,738	173,988	251,971	166,661	165,036	171,107	163,756
1.1.	Material costs	242,731	85,325	85,899	95,383	86,403	185,554	96,352	86,305	86,305	86,305
1.2.	Non-material costs without depreciation and interest	43,810	57,730	70,690	60,675	67,906	46,736	50,629	59,052	65,123	57,771
1.3.	Depreciation	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680	19,680
2.	Financial expenditures	623	0	0	0	0	0	0	0	0	0
2.1.	Interest	623	0	0	0	0	0	0	0	0	0
III	**Gross profit (I-II)**	**-239,081**	**15,094**	**42,499**	**70,237**	**98,676**	**-49,673**	**97,400**	**107,628**	**101,557**	**108,908**
IV	**Income tax**	0	1,358	3,825	6,321	8,881	0	8,766	9,915	9,187	10,069
V	**Net profit (III-IV)**	**-239,081**	**13,735**	**38,674**	**63,916**	**89,795**	**-49,673**	**88,634**	**97,712**	**92,370**	**98,839**

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

Table 5. Economic flow in seedlings production (in EUR)

No.	Element	Zero moment	Years									
			I	II	III	IV	V	VI	VII	VIII	IX	X
I	**Total inflow (1+2)**	**0.0**	**155,929.7**	**155,929.7**	**155,929.7**	**155.929,7**	**155.929,7**	**149.199,7**	**149.199,7**	**149.199,7**	**149.199,7**	**157.136,9**
1.	Total income	0.0	155,929.7	155,929.7	155,929.7	155.929,7	155.929,7	149.199,7	149.199,7	149.199,7	149.199,7	149.199,7
2.	Salvage value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7,937.1
	2.1. Fixed assets	0.0										0.0
	2.2. PWC	0.0										7.937,1
II	**Total outflow (3+4+5)**	**87,308.7**	**143,756.8**	**143,775.8**	**143,775.8**	**143.775,8**	**143.775,8**	**129.047,8**	**129.047,8**	**129.047,8**	**129.047,8**	**129.047,8**
3.	Investment	87,308.7										
	3.1. In fixed assets	79,371.6										
	3.2. In PWC	7,937.1										
4.	Costs without depreciation and interest	0.0	143,358.8	143,358.8	143,358.8	143.358,8	143.358,8	127.839,8	127.839,8	127.839,8	127.839,8	127.839,8
5.	Income tax	0.0	397.9	417.0	417.0	417,0	417,0	1.208,0	1.208,0	1.208,0	1.208,0	1.208,0
III	**Net cash flow (I-II)**	**-87,308.7**	**12,172.9**	**12,153.8**	**12,153.8**	**12.153,8**	**12.153,8**	**20.151,8**	**20.151,8**	**20.151,8**	**20.151,8**	**28.089,0**

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

Table 6. Economic flow in plantation crops growing (in EUR)

No.	Element	Zero moment	Years									
			I	II	III	IV	V	VI	VII	VIII	IX	X
I	**Total inflow (1+2)**	**0.0**	**67,762.8**	**177,828.3**	**218,768.1**	**245,975.2**	**272,664.2**	**202,297.9**	**264,060.4**	**272,664.2**	**272,664.2**	**296,021.2**
1.	Total income	0.0	67,762.8	177,828.3	218,768.1	245,975.2	272,664.2	202,297.9	264,060.4	272,664.2	272,664.2	272,664.2
2.	Salvage value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23,357.0
	2.1. Fixed assets	0.0										0.0
	2.2. PWC	0.0										23,357.0
II	**Total outflow (3+4+5)**	**256,927.0**	**286,540.4**	**144.413.0**	**160,413.8**	**162,379.2**	**163,189.0**	**232,290.5**	**155,746.7**	**155,271.7**	**160,614.1**	**154,145.0**
3.	Investment	256,927.0										
	3.1. In fixed assets	233,570.0										
	3.2. In PWC	23,357.0										
4.	Costs without depreciation and interest	0.0	286,540.4	143.054.6	156,588.9	156,057.8	154,308.1	232,290.5	146,980.8	145,356.4	151,427.3	144,076.0
5.	Income tax	0.0	0.0	1,358.4	3,824.9	6,321.3	8,880.8	0.0	8,765.9	9,915.3	9,186.8	10,068.9
III	**Net cash flow (I-II)**	**-256,927.0**	**-218,777.6**	**33,415.3**	**58,354.2**	**83,596.0**	**109,475.2**	**-29,992.6**	**108,313.7**	**117,392.5**	**112,050.1**	**141,876.2**

Source: Coal mine enterprise AD Pljevlja, 2023a, b.

The economic analysis starts from the assumption that investments in seedling production and plantation production are observed as independent and mutually competitive investments. Respectively, there is a question - If the investor had to select only one of considered investments, which investment would be more acceptable? Based on the presented economic flows for both investment alternatives, adequate assessment indicators are determined (*Table 7*.).

Table 7. Comparing the elements of investment analysis related to seedlings production and establishment of selected crops growing

Indicators	Investment	
	Seedlings production	Plantation establishment
Investment (EUR)	87,308.76	256,927.00
NPV (EUR)	25,488.89	6,119.05
IRR (%)	12.07	7.24
MIRR (%)	9.78	7.14
PBP (years)	7.98	9.92
Discount rate (%)	7.00	7.00

Source: Authors' calculations according to data from Coal mine enterprise AD Pljevlja, 2023a, b.

Previously performed analyzes showed that both investments are economically justified according to the all observed indicators (net present value - NPV, internal rate of return - IRR, modified internal rate of return – MIRR, or payback period - PBP). This is a reason why the comparision of required financial assets for investments has to be done, as well as the economic effects derived from the observed investments exploitation (*Table 7*.). Initially used discount rate reflects current value of the available external capital at the regional market.

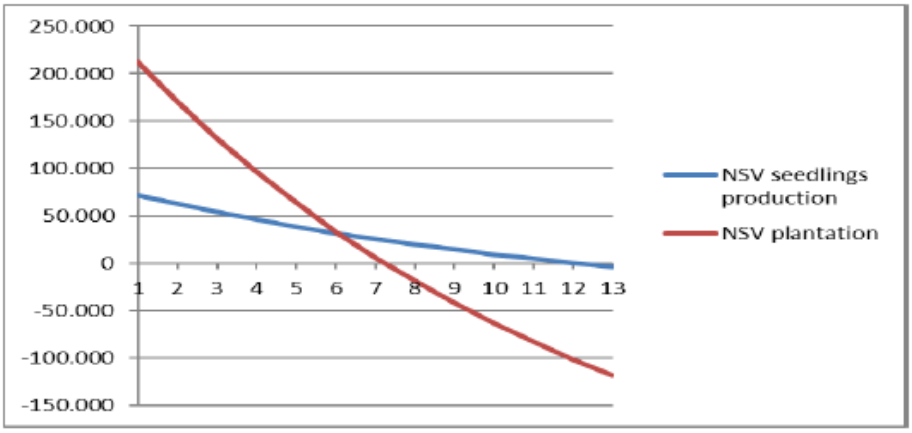
It is obvious that, for the observed period, the investment in seedlings production is economically more acceptable, as it requires smaller investment, while its NPV, IRR and MIRR are higher than the same indicators for the establishment of plantation. At same time, its PBP is quite shorter.

Meanwhile, it has to be considered that the amount of NPV (including the results and conclusions of the performed analysis) is strongly affected by the level of discount rate. While the IRR is constant (regardless the height of discount rate), it is known that the value of NPV is decreasing by the rise of discount rate (Gogić, 2014). In order to investigate the abovementioned at defined investments, their NPV for discount rates from the range 1-13% (*Figure 1*.) is determined. Used upper limit for discount rate of 13% is determined according to the fact that IRR for investment in seedlings production is 12.07%, i.e. the NPV values for all discount rates higher than 12.07% will be negative.

It can be noticed that, for a certain discount rate (i.e. crossover rate), both observed investments have the same amount of NPV. If the discount rate is higher or lower than the fixed one (in this case 6.08%), preference should be given only to one of the observed investments (Bierman, Smidt, 2007). Therefore, it is possible that for a certain

range of discount rates (higher than the crossover rate), NPV and IRR could lead to the same conclusion, while for another range of discount rates (lower than the crossover rate), NPV and IRR could give contradictory results and conclusions (Ivanović, 2013).

Figure 1. NPV for various discount rates (in EUR, %)



Source: According to the authors' calculations.

The crossover rate could be determined as the IRR of diferential net cash flow of the observed investments (Ivanović, Marković, 2018; Ren, 2022). By applynig this approach, it is determined that the crossover rate is 6.08%. In other words, if the discount rate is higher than the crossover rate, the investment in the seedlings production is economically more acceptable according to both criteria (NPV and IRR). Contrary to that, if the discount rate is lower than the crossover rate, NPV of plants growing in plantation is higher, while the investment in the seedlings production has higher IRR. During the conduction of this analysis, the attention should be paid to the fact that the crossover rate is changing by itself depending on the variation of different factors included in the calculation. So, the influence of the change in amount of initial investments (in zero moment) on the value of crossover rate was examined, while the same procedure was carried out for the amount of net income from the economic flow (net cash flow), (*Table 8*.).

Table 8. Variation of crossover rate

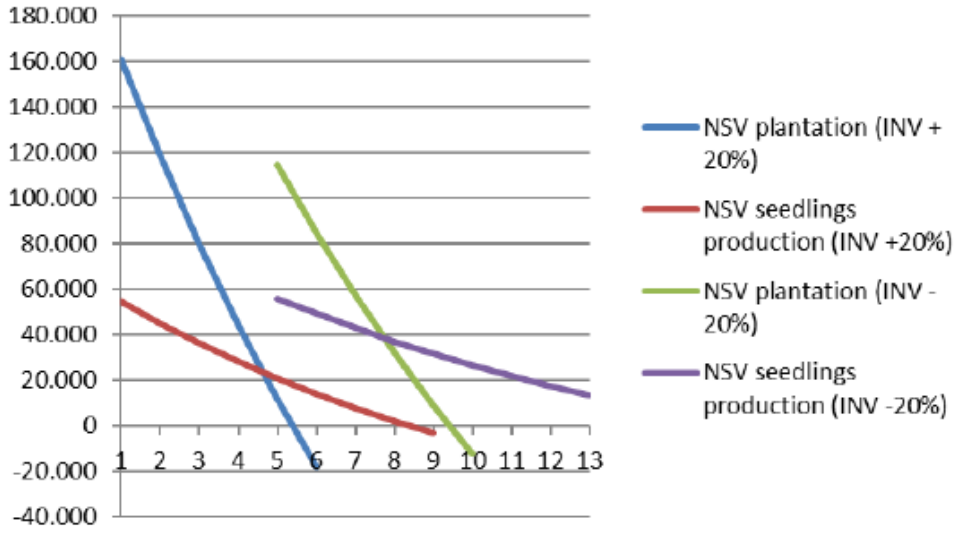
Change in investment value	New crossover rate	Change in net cash flows	New crossover rate
-20%	7.74%	-20%	4.29%
-10%	6.88%	-10%	5.25%
0%	6.08%	0%	6.08%
+10%	5.33%	+10%	6.81%
+20%	4.63%	+20%	7.45%

Source: According to the authors' calculations.

Change in the amount of initial investment and net cash flow in a favorable direction for the investor (i.e. decrease in investment value and increase in net cash flow) leads to an increase in the level of crossover rate. At the same time, the decrease in investments volume causes a slightly higher growth of the crossover rate than the growth of net cash flow. Completely opposite conclusions could be drawn in case of unfavorable business conditions, such as the growth in the level of investment and decrease in net cash flow value.

In order to get a better insight into the consequences that would occur due to positive or negative variations in the volume of initial investment (zero moment) for 20%, it is not enough just to calculate the corresponding crossover rates, but also the NPV (for different levels of the discount rate), as well as the IRR in the observed cases (*Figure 2*.).

Figure 2. Change in indicator value in line to different volume of investment (in EUR, %)



Source: According to the authors' calculations.

In relation to the results derived from the basic assumptions (shown in previous *Figure 1*.), in case of investment growth for 20%, there has come to an expected decrease in the NPV, but also the IRR (at this moment it amounts 5.39% for investment in crops growing at established plantation, while it was reduced to 8.40% in case of investment in seedlings production). On the other hand, the decrease in initial investment for 20% will cause an increase in the NPV and the IRR (for investment in plants growing at the plantation it will grow to 9.42%, while for investment in seedlings production it will increase to even 17.04%).

The results derived towards the trend of crossover rate compared to available business conditions could help investors to make a profound decision about an adequate selection between mutually exclusive investments (especially considering the investor preferences regarding the use of NPV and/or IRR in the process of making business decisions).

The initial hypotesis are proven by the results of the reserch.

Conclusions

The performed analysis points out that the investment in seedlings of medicinal plants and spices production is more economically effective than the investment in their plantation growing. This conclusion refers to the application of projected discount rate of 7%, that cause all parameters more favorable in seedlings production (including IRR, whose value does not depend on the level of discount rate). This conclusion could be made for all levels of discount rate above the crossover rate, which, according to initial data, amounts 6.08%. On the other hand, for discount rates lower than the crossover rate, the value of NPV leads to favoring one investment, while the use of IRR leads to favoring the other investment.

Additionally, the fact that certain parameters (such are the amounts of investment and cash flow) may deviate from their expected (initial) values has been considered, leading to a change in values of all indicators of investment analysis (including the change in crossover rate). The abovementioned additionally complicates the decision-making process. Nevertheless, the final decision related to investing (the selection of more acceptable investment) cannot be based only on the indicators of economic analysis, but also on the procurement and sales market analysis, whose impact is also important in making investment decision.

Acknowledgements

Paper is a part of research financed by the MSTDI RS, agreed in decision no. 451-03-47/2023-01/200009 from 3.2.2023.

Conflict of interests

The authors declare no conflict of interest.

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