



ECONOMIC EFFICIENCY OF INVESTMENTS IN THE BLUEBERRY ORCHARD ESTABLISHMENT

Branka Kalanović¹-Bulatović¹, Bojan Dimitrijević*, Zoran Rajić¹, Raša Milanov¹, Dušan Milić², Sreten Jelić and Dragić Živković

University of Belgrade, Faculty of Agriculture, Belgrade, Serbia.

¹Department of Public Health and Sanitary Inspection, Ministry of Health, Republic of Serbia.

²University of Novi Sad, Faculty of Agriculture, Novi Sad, Serbia.

Abstract

Investments in the new orchard establishment are characterized by a number of specific features resulting from the biological nature of cultivated fruit crops. The timeline of the investment and the orchard exploitation, the amount of investment, and the revenue and expenditure are crucial when making decisions regarding an investment and assessing its effectiveness. Blueberry plants in commercial orchards may last for decades and, compared to most other fruit crops, have a relatively low maintenance costs. However, when it comes to investments in the plantation establishment, blueberries are one of the most expensive fruit crops. This paper analyses the economic efficiency of investment in an establishment of one hectare of blueberry plantation on a family farm. Static and dynamic performance indicators were used to calculate the economic feasibility of the investment. All the conducted analyses and assessments indicate that the total investment in blueberry orchard establishment is economically viable.

Key words : Economic Efficiency, Investments, Blueberry, Orchard.

1. Introduction

European blueberry or Common bilberry (*Vaccinium myrtillus* L.) is widespread throughout the world, while in our country it can be found on mountain clearings and heights of Kopaonik, Golija, Javor, Tara, Stara planina, Vlasina [Nikolić and Milivojević (2010)]. A total amount of blueberry that is bought equals several dozen tons per annum, while a large proportion of blueberry is used by households. This makes it impossible to determine a total scope of production thereof. Areas planted with European blueberry in Serbia are being spontaneously expanding, while, on the other hand, irresponsible pickers are ruthlessly destroying them by using combs and scythes. The latter is directly endangering European blueberry and thus calls for limited picking thereof and implementation of the respective legislation [Ministry of Natural Resources, Mining and Spatial Planning of Republic of Serbia (2012)].

Cultivated highbush blueberry (*Vaccinium corymbosum* L.) is scarcely spread in Serbia the area of cultivation varies between 70 and 75 hectares. The largest area of cultivation is located in Western Serbia (“Agropartner”, Lučani). In Serbia, people have limited experience in growing highbush blueberry. Since 1970s several attempts were made to start the production of this fruit variety. Although growing conditions were relatively favourable and most of the achieved results were satisfactory, the producer’s interest remained unexpectedly negligible [Petrović, Leposavić and Veljković (2007)].

Given that exploitation period of plantation-bred blueberry is 15-20 years, and that orchard cultivation requires large investments, it is necessary to undertake, prior to making investments, a detailed analysis of all conditions of importance to achieving cost-effective production.

Blueberry production is characterised by a high-level merchantability over 95% of picked fruits that are either processed or fresh are placed on the market (world and home market). Blueberry export (mostly in a frozen condition) is mainly directed to the most developed European countries and the USA. These markets require high quality of the blueberry fruit and products. Therefore, one of the necessary conditions for the development of primary production of this type of fruit is production, storage and delivery capacity building.

2. Materials and methods

Scope of this paper aims at the analysis of economic efficiency of investments in establishment of one hectare of blueberry orchard in family-owned holdings.

Purpose of the investment is to enable production of blueberry fruits (partly for table use and partly for processing) to be placed on home and foreign markets and thus enabling holdings to make foreign currency income.

Investment calculation methods, dynamic (multi-period), and statistical (single-period) methods were used in order to determine and assess the economic efficiency of investments.

Dynamic calculation methods

All dynamic methods to be used are based on the comparison between the amount of inflow (b_1, b_2, \dots, b_n) and the amount of outflow for the procurement and use of investment facility discounted during a specific accounting period.

When assessing possible levels of cost-effectiveness of perennial orchards (blueberry production) inflow amount is calculated on the basis of expected average yield, while outflow will depend on the applied production technology and therefore, it is not possible to give a precise estimate of expected inflow and outflow. In this case the capital value shall be determined on the basis of average values.

$$C_{00} = \left[b \frac{(1+i)^n - 1}{(1+i)^n i} + \frac{Bn}{(1+i)^n} \right] - \left[\left[a \frac{(1+i)^n - 1}{(1+i)^n i} + A_0 \right] \right]$$

In this way, a slightly smaller amount of capital value, *i.e.* slightly less optimistic result, will be obtained when assessing economic efficiency of the investment.

Internal interest rate method

Internal interest rate (i_e) is calculated by using the following equation :

$$\sum_{k=1}^a b_k (a+i)^{-k} + B(1+i)^{-n} = \sum_{k=1}^n a_k (1+i)^{-k} + A_0$$

This method defines cost-effectiveness of the investment as the level of effective rate as regards the invested financial resources. It is the interest rate the investment capital value of which equals zero ($C_0 = 0$), *i.e.* the investment capital value will remain positive as long as the calculable interest rate is lower than the internal interest rate ($i_e \geq i$).

With statistical methods investment calculations of economic efficiency assessment are made on the basis of inflow and outflow for one part of the investment period (usually one year period), where the time factor is of no relevant importance. Statistical methods to be used comprise efficiency and profitability methods.

Data originating from different sources were used in order to produce this research paper. Basic data on the blueberry production were obtained from the *Association of Cultivated Blueberry Breeders*, Belanovica and from UP "Moba", Ljig. Data obtained from the documentation of the family-owned holding were used to design work and material consumption plans needed for the production.

3. Results and discussion

Starting assumptions related to the establishment of highbush blueberry perennial orchard:

1. Orchard is one hectare in area.
2. Tree architecture contains 2,222 seedlings with 3×1.5 meters spacing.
3. Average yield is estimated to be about 9 tons when an intensive farming system is used.
4. Orchard establishment time period is three years.
5. Exploitation period of the orchard is 20 years.
6. Analysis of the investment that involves costs of pure orchard establishment over a three year period.

Basic assumptions for orchard establishment

Investment period in case of orchard establishment varies between 3 and 6 years, while the biggest investment is made in case of the preparation of soil and orchard establishment [Milić, Kalanović and Trmčić (2009)]. In the period between year 3 and year 6, the yield gets higher and from year 7 onwards the orchard enters into full bearing period as shown in Figure 1.

Material basis relates to agricultural land where the orchard will be established. The amount of intermediate goods spent and scope of work performed will depend on the technology of orchard establishing, nurturing and maintenance.

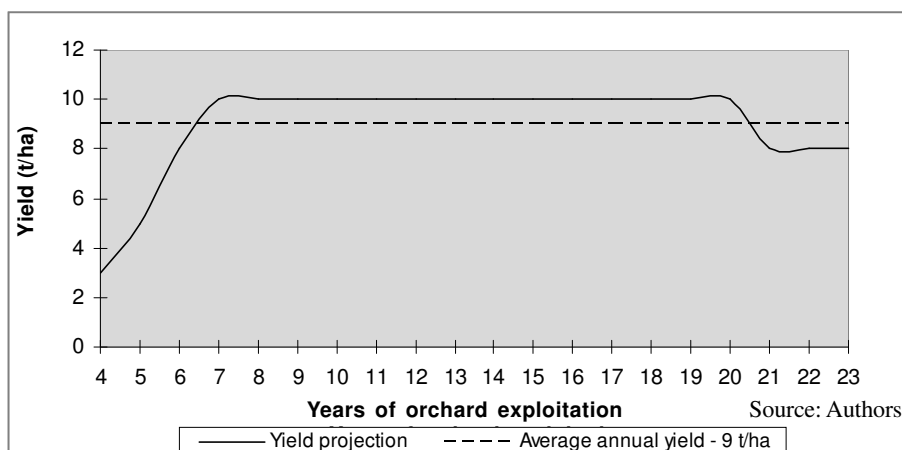


Fig. 1 : Projection of expected blueberry yield levels during exploitation of the orchard.

The needed amount of material and scope of work during the period of establishing and nurturing of blueberry is presented in Tables 1, 2 and 3.

Table 1 : Intermediate goods.

No.	Material	Unit of measurement	Norm-quantity per hectare		
			I	II	III
1.	Seedlings	pcs.	2.222	-	-
2.	Manure	tons	60	15	15
3.	Mineral fertilisers NPK	kg	600	500	500
4.	Mineral fertilisers KAN	kg	100	100	100
5.	Fill-in seedlings	pcs.	-	100	-
6.	Sawdust	kg	10	10	10
7.	Marking pegs	pcs.	2.222	-	-
8.	Drip irrigation system	set	1	-	-
9.	Fence around the orchard	set	1	-	-
10.	Straw, maize stalks, mulching agents	tons	10	10	10
11.	Pesticides	kg	4	7	7
12.	Peat	bale (300 l)	150	-	-

Table 2 : Machine works.

No.	Type of works	Unit of measurement	Scope of work		
			I	II	III
1.	Pedological and agrochemical analysis of soil	Sample	2	-	-
2.	Transport of manure	hour/tractor	10	3	3
3.	Ploughing	hour/tractor	5	-	-
4.	Tillage	hour/tractor	4	-	-
5.	Pit digging	hour/tractor	9	1	-
6.	Transport of seedlings, peat, mineral fertilisers	hour/tractor	3	-	-
7.	Spraying	hour/tractor	3	6*3	6*3
8.	Row crop work (mowing)	hour/tractor	10	6*4	6*4

Table 2 shows that the number of tractor hours is the same during the planting year and two year nurturing period.

Table 3 : Manpower.

No.	Type of works	Unit of measurement	Number of working days		
			I	II	III
1.	Preparation of land	Working day	3	-	-
2.	Loading (unloading) of manure	Working day	5	2	2
3.	Preparation of the substrate (manure-sawdust)	Working day	10	1	-
4.	Manure spreading	Working day	8	2	2
5.	Preparation of the mulching substrate	Working day	-	5	5
6.	Row marking and hole edges	Working day	7	-	-
7.	Preparation of seedlings for planting	Working day	2	1	-
8.	Planting	Working day	10	1	-
9.	Irrigation	Working day	8	10	10
10.	Spreading of mineral fertilisers (three times)	Working day	3	2	2
11.	Weeding and row space raking	Working day	30	35	35
12.	Placement of poisonous baits	Working day	-	4	4
13.	Pruning	Working day	-	3	8
14.	Harvesting	Working day	-	20	40
	Total	Working day	83	86	108

A total of 83 working days were spent during the blueberry planting year, whereas 36.14% thereof was spent for weeding and raking. During the first nurturing year 41% out of 86 working days was spent on weeding and raking, while most of the days were spent on blueberry picking during nurturing year 2.

Economic and financial analysis

An insight into operating costs can be gained by assessing all inputs and outputs, while a projection of balance sheet and project financial and economic flow could be made since they present a starting point for evaluating the efficiency of the project [Rodić, Vukelić and Andrić (2007)]. The analysis shall be made for the orchard which is 1 hectare in area.

Breeding or starting value of these orchards shall be defined as the volume of investments made, *i.e.* costs to be incurred during establishment period, and the said value is formed on the basis of two groups of costs :

1. costs (investments) incurred once in the period of orchard establishment: include costs related to planning, cleaning, levelling and breaker ploughing of the land. Furthermore, this group includes costs of row and planting location marking, planting preparatory activities, planting hole digging, costs related to seedling arrangements, marking pegs, drip irrigation system, plantation fences, anti-hail network.
2. Breeding costs during certain years of orchard establishment : - include costs of filling in empty spots with fill-in seedlings, cultivation, fertilisation, nurturing and protection and fruit picking and transport-related costs (during small-scale yield

years). Small-scale yield is the yield that is produced during orchard establishment period.

Planned estimate of establishment of highbush blueberry orchard

When providing estimate the assumption was that the investment period would last for three years, while in year 4 there would be an intersection of cost and production value lines. Small-scale yield value in year 2 and 3 was deducted from the total costs. The orchard is one hectare in area with 3×1.5 m plant spacing (2,222 seedlings per hectare).

Estimated value of blueberry orchard establishment

I Year 1 costs

Tables 4, 5 and 6 show the costs incurred in year 1 of orchard establishment.

Table 4 : Material-related costs in year 1 of orchard establishment.

No.	Type of material	Unit of measurement	Quantity	Price per unit of meas. (•)	Amount
1.	Seedlings	pcs.	2.222	5	11.110
2.	Manure	tons	60	30	1.800
3.	Mineral fertilisers NPK	kg	600	0,31	186
4.	Mineral fertilisers KAN	kg	100	0,50	50
5.	Peat*	bale (300 l)	150	12	1.800
6.	Sawdust	kg	10	21,6	216
7.	Marking pegs	pcs.	2.222	-	100
8.	Drip irrigation system	set	1	2.000	2.000
9.	Fence around the orchard	set	1	1.000	1.000
10.	Straw, maize stalks, mulching agents	tons	10	30	300
11.	Pesticides	kg	4	90	360
	Total	-	-	-	18.922

*Unit of measurement was bale (300 l). 20 l/seedling is needed, i.e. one bale per 15 seedlings. 150 bales the price of which is 12 • is needed for 1 hectare area (2,222 seedlings).

Table 5 indicates that the highest costs related to the purchase of seedlings, while a major item of material-related costs is drip irrigation system.

Table 5 : Service costs in year 1 of orchard establishment.

No.	Type of works	Unit of measurement	Quantity	Price per unit of meas. (•)	Amount
1.	Pedological and agrochemical analysis of soil	sample	2	35	70
2.	Transport of manure	hour/tractor	10	25	250
3.	Ploughing	hour/tractor	5	25	125
4.	Tillage	hour/tractor	4	35	140
5.	Pit digging	hour/tractor	9	23	207
6.	Transport of seedlings, peat, mineral fertilisers	hour/tractor	4	25	100
7.	Spraying	hour/tractor	3	25	75
8.	Row crop work (mowing)	hour/tractor	10	25	250
	Total	-	-	-	1.217

The major part of service costs structure is made up of inter-row cultivation costs and manure transportation costs.

Table 6 : Labour costs in year 1 of orchard establishment.

No.	Type of works	Unit of measurement	Quantity	Price per unit of meas. (•)	Amount
1.	Land preparation	Working day	3	15	45
2.	Loading (unloading) of the manure	Working day	5	15	75
3.	Preparation of substrates (manure-sawdust)	Working day	10	15	150
4.	Manure spreading	Working day	8	15	120
5.	Row direction marking	Working day	7	15	105
6.	Preparation of seedlings for planting	Working day	2	15	30
7.	Planting	Working day	10	15	150
8.	Irrigation	Working day	8	15	120
9.	Spreading of mineral fertilisers	Working day	3	15	45
10.	Weeding and row space raking	Working day	30	15	450
	Total	-	-	-	1.290

The major part of labour costs structure is made up of the costs related to weeding and row space raking.

II Year 2 costs

Tables 7, 8 and 9 show the costs incurred in year 2 of orchard establishment.

Table 7 : Material-related costs in year 2 of orchard establishment.

No.	Type of material	Unit of measurement	Quantity	Price per unit of meas. (•)	Amount
1.	Manure	tons	15	20	300
2.	Mineral fertilisers NPK	kg	500	0,31	155
3.	Mineral fertilisers KAN	kg	100	0,50	50
4.	Fill-in seedlings	pcs.	100	5	500
5.	Sawdust and other mulching agents	tons	10	21,6	216
6.	Pesticides and poisonous baits	kg	7	90	630
	Total	-	-	-	1.851

Pesticide and bait-related costs and costs of fill-in seedling purchase are the highest costs incurred in this year.

Table 8 : Service-related costs in year 2 of orchard establishment.

No.	Type of works	Unit of measurement	Quantity	Price per unit of meas. (•)	Amount
1.	Transport of manure	hour/tractor	3	25	75
2.	Spraying	hour/tractor	6x3	25	450
3.	Row crop work	hour/tractor	6x4	25	600
4.	Provision of irrigation water*	hour/tractor	-	-	500
	Total	-	-	-	1.625

*Costs depend on the absence of a drip irrigation system. The said costs can be higher and will, in that case, depend on the agro-ecological conditions. The said costs cannot altogether be lower even when the system was put in place.

Table 9 : Labour costs in year 2 of orchard establishment.

No.	Type of works	Unit of measurement	Quantity	Price per unit of meas. (•)	Amount
1.	Manure loading and spreading	Working day	5	15	75
2.	Preparation of mulching substrates	Working day	5	15	75
3.	Hoeing, weeding and mulching	Working day	35	15	525
4.	Placement of poisonous baits	Working day	4	15	60
5.	Irrigation	Working day	10	15	150
6.	Harvesting	Working day	20	15	300
	Total	-	-	-	1.185

Due to yield being produced in year 2, picking costs are incurred.

I Year 1 costs: $18,922 + 1,217 + 1,290 = 21,429 \bullet$

II Year 2 costs: $1,851 + 1,625 + 1,185 = 4,661 \bullet$

III Year 3 costs*: year 2 costs $4,661 + 300 \bullet = 4,961 \bullet$

*Increase in costs occurred due to the increase in picking costs (due to increased yield).

Total costs of establishment of one hectare of blueberry orchard amount to $I+II+III=31,051 \bullet$.

Small-scale yield value in years 2 and 3 amounts to $4,000 \bullet (2,500 \text{ kg/h} \times 1.6 \bullet)$.

A yield of 800 kg/h is planned in year 2, while this amount will be 1.700 in year 3, which amounts to the said 2.500 kg/h.

Net investments in case of orchard establishment = total costs–small-scale yield value.

Net investment = $31,051 - 4,000 = 27,051 \bullet$.

Costs related to establishment of one hectare of perennial blueberry orchard (breeding value of the orchard)

Following the aforementioned breeding value of the orchard can be presented in a tabular form, *i.e.* total costs in years 1, 2 and 3 (orchard establishment years) and a small-scale yield value occurring in years 2 and 3 of orchard establishment, whereby necessary investments can be computed.

Table 10 : Costs related to the establishment of one hectare of perennial blueberry orchard, small-scale yield value and necessary investments.

No.	Cost types	I	II	III	Total
1.	Material costs	18.922	1.851	1.851	22.624
2.	Machine works	1.217	1.625	1.625	4.467
3.	Labour	1.290	1.185	1.485	3.960
4.	Other costs (2% out of total costs)	429	93	99	621
5.	Total (1+2+3+4)	21.858	4.754	5.060	31.672
6.	Small-scale yield value	-	1.280*	2.720**	4.000
7.	Necessary investments (5-6)	21.858	3.474	2.340	27.672

*In year 2 the yield is 800 kg/ha, the price is 1.6 •/kg which amounts to $800 \times 1.6 = 1,280$

** In year 3 the yield is 1,700 t/ha, the price is 1.6 •/kg which amounts to $1,700 \times 1.6 = 2,720$

Operating costs

Costs related to regular orchard maintenance : Calculation of costs of regular orchard maintenance was made by means of normative necessary intermediate goods, machine works and labour for regular blueberry orchard maintenance [Kalanović¹, Dimitrijević¹ and Ivanović¹ (2011)].

Table 11 shows annual costs of intermediate goods that are part of operating costs.

Table 11 : Annual costs of intermediate goods.

No.	Material	Unit of measurement	Norm-quantity per hectare	Price (•)	Total
1.	Manure*	tons	10	30	300
2.	Mineral fertilisers NPK	kg	500	0,25	125
3.	Mineral fertilisers KAN	kg	200	0,20	40
4.	Pesticides	kg	50	10	500
5.	Cardboard packaging material 0,3 κΓ	pcs.	25.000	0,05	1.250
Total					2.215

*30 tons of manure every three years.

Cardboard packaging material makes the production much more expensive during the period of regular orchard maintenance. Cardboard packaging material-related costs are higher than all other intermediate goods-related costs.

Table 12 shows annual machine work costs that are part of operating costs.

Table 12 : Annual machine work costs.

No.	Machine works	Unit of measurement	Scope of work	Price (•)	Total
1.	Transport and spreading of mineral fertilisers		0,2	100	20
2.	Transport of protective agents		0,1	100	10
3.	Fruit atomiser spraying		3	100	300
4.	Weed control by means of herbicides (four times)	tractor days	0,3	100	30
5.	Cultivation		1,5	100	150
6.	Packaging material and fruit transport		3	100	300
7.	Other works		1	100	100
Total					910

The scope of activities is twice as large with fruit atomiser spraying and with packaging material and fruit transport and therefore the costs are higher than in case of other machine works.

Dynamic assessment of the project

Dynamic methods for determination of economic efficiency of investments are characterised by the application which includes all inflow periods, *i.e.* when inflow is obtained during the planned investment period. In other words, dynamic methods application is based on the determination of a series of inflow arising from investments and a series of outflow

for the design and use of the investment project. The said outflow and inflow occur at various points of investment period and it is not possible simply to add or subtract them due to interest impact, *i.e.* it is not possible to compare them. Therefore, all outflow and inflow incurred at certain points (years) of the investment period shall be determined in one (same) accounting period and by their compounding, if they were incurred in an earlier period, *i.e.* by discounting, if they were incurred after the accounting period [Andrić, Vasiljević and Sredojević (2005)].

Establishment-related cost, *i.e.* investments were made during orchard establishment. Since year 4 the costs are being incurred in the period of orchard exploitation. A small-scale yield will be produced even in year 2. For the first four years costs will be higher than the income. Higher yield will be produced since year 5 as income becomes higher, while costs are currently lower than income. Net inflow is calculated when outflow amount is deducted from inflow amount. For the first four years net inflow will be negative, while the said inflow will become positive since year 5.

Inflow and outflow discounting was carried out.

The assumption was that the calculable interest rate equals $i = 12\%$.

Capital value of the investment was computed to amount to 15,139.75 •.

Capital value of the investment (net present value) $kvi > 0$, which means that it is positive.

Investment internal interest rate amounts to $isp = 17.11\%$.

It should amount to $isp > i$, which is the case here- $17.11\% > 12\%$.

The conclusion is that the investment in establishment of perennial blueberry orchard is economically justifiable.

Statistical and economical indicators

With statistical methods of investment calculation the assessment of economical efficiency of the investment shall be made on the basis of the inflow and outflow for one part of the investment period (usually for one year period). Therefore, these methods are named single period methods. The time factor related to these methods is of no relevant importance. The following well-known statistical methods are used:

Efficiency = production value/production costs

Year 7 example : efficiency = $16,000/6,305.1 = 2.54$

$E > 1$ – production is economical.

In order to be able to monitor the efficiency of blueberry production year 7 was taken as an example. Since, efficiency coefficient in year 7 amounts to 2.54 (*i.e.* $E > 1$), it can be concluded that business operation was efficient in the said year.

Cost-effectiveness = (profit/production value) $\times 100$.

Year 7 example : cost-effectiveness = $(9,694.9/16,000) \times 100 = 60.6\%$.

Indicator of production cost-effectiveness rate was also computed for year 7 and

production value participation in the profit amounts to 60.6%, which makes the production cost-effective.

A conclusion can be made on the basis of statistical economic indicators that the investment in perennial blueberry orchard is economically justifiable.

4. Conclusion

The paper analyses the economic viability of an investment in one hectare of blueberry plantation establishment on a family farm.

The investment in the orchard establishment has been made by the family farm. It should be noted that the family farm mostly uses its own work force and the occasional seasonal workers.

The initial value of the orchard is equal to the amount of the investment in plantation establishment *i.e.* all expenses arising once in the period of orchard establishment as well as during the first few years of cultivation. The required investment for this orchard establishment equals 21858 • in the first, 3474 • and 2340 • in the third year, which totals 26672 •.

Dynamic and static performance indicators were used to calculate the economic feasibility of the investment. The calculated dynamic performance indicators of the project show that the investment is economically justified as the capital investment value of • 15139.75 is desirable and the internal rate of return on investment (17.11%) was higher than the calculated interest rate (12%). Static performance indicators show that the period of plantation exploitation was cost effective ($E > 1$), and the production profitable.

The conducted analyses and assessments indicate that the total investment in blueberry orchard establishment is economically justified.

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