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PRODUCTION COSTS AND FINANCIAL FEASIBILITY OF BLACK CHOKEBERRY CULTIVATION IN ROMANIA

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ABSTRACT

In recent years, Aronia melanocarpa (Michx.) Elliott *has attracted increasing attention due to its health benefits, resilience in cultivation, and rising demand in the global "superfood" market. This study investigates the economic profitability of establishing and managing an aronia plantation in Romania, with a focus on a 7-year cash-flow analysis for one hectare scenario between 2023 and 2030. Data were collected through documentary analysis of international market reports, technical project estimates, and economic modeling. Results indicate that although the first two years are financially challenging due to negative cash flow, plantations reach the break-even point in year four, with subsequent annual cash flows exceeding €30,000/ha under favorable yield and pricing conditions.*

INTRODUCTION

In recent years, aronia has become an interesting crop for small producers due to the high demand for "superfood" products, rich in vitamins, nutrients, antioxidants, and with a low caloric index. The plant is quite resistant to diseases and pests, which makes it attractive in sustainable agriculture. Medical research has documented many health benefits of aronia berries (Jurendić and Ščetar, 2021). Extensive biomedical research has highlighted the therapeutic potential of aronia berries, with their high antioxidant activity recognized as the primary mechanism underlying their health-promoting effects. Studies have demonstrated protective roles in the prevention and management of cardiovascular disease, certain cancers (notably colorectal and breast), hepatic dysfunction, and obesity (Kashian, 2016). These findings position aronia not only as a functional food but also as a promising raw material for nutraceutical and pharmaceutical applications.

Parallel to its medical and nutritional significance, the global aronia market has shown consistent expansion over the past decade. Industry reports suggest strong upward trajectories: Straits Research projects revenues rising from USD 598 million in 2024 to USD 1,078 million by 2033, with a compound annual growth rate (CAGR) of 6.7 % (Aronia Berries Market, 2025). Similarly, Aronia Berries Market Size (2025) estimated market revenues at USD 720 million in 2022, forecasting growth to approximately USD 1.34 billion by 2030 (CAGR 7.3 %) as presented in Figure 1. Other analyses, such as those from Maximize Market Research (2025), place the market value at USD 790.2 million in 2024 with an anticipated increase to USD 1.37 billion by 2032, reflecting a

CAGR of 7.1 % between 2025 and 2032. Regionally, North America currently dominates global production and consumption, followed by Asia and Europe.

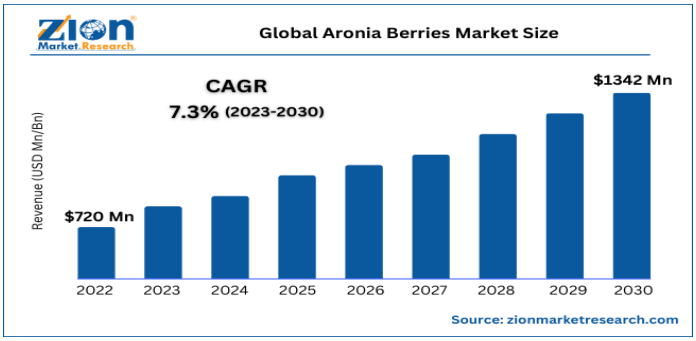

Figure 1. Estimate revenue from 2022-2030 by GABMS

Within Europe, Poland remains the principal hub for raw material supply, with export volumes increasing steadily during 2020–2024. Price dynamics further underscore this trend: aggregated trade data indicate that international export/import prices for fresh aronia rose from approximately USD 2.10/kg in 2023 to USD 3.42/kg in 2024 (Tridge, 2025).

In Romania, aronia has gained traction as a niche crop, with plantations established in regions such as Oltenia, Transylvania, Banat, and Moldova, where edaphoclimatic conditions are favorable for its cultivation.

The research framework was designed to support investment decisions based on objective and verifiable economic criteria. In this context, the study aimed to address the following research questions:

1. What are the production costs and the financial feasibility of an aronia plantation in Romania over the 2023-2030 horizon, under the specified price and yield scenario?

2. To what extent are the results sensitive to ±20 % variations in price, yield, and costs?

MATERIAL AND METHODS

Research Design: The research employed a scenario-based financial modeling approach to evaluate the economic feasibility of *Aronia melanocarpa* (black chokeberry) cultivation under specific conditions of Romania. A 7-year time horizon (2023–2030) was selected to capture both the plantation establishment phase and the transition to full productive capacity.

Data Sources: Baseline data were obtained from official technical documentation prepared for the establishment of aronia plantations under ecological farming systems (2024). These data included detailed cost structures for plantation design, soil preparation, planting material, and annual maintenance operations. To ensure complexity, the baseline estimates were completed by hypothetical comparative data for future years, aligned with market forecasts and accepted methodological standards in agricultural economics (Table 1).

Table 1

Estimate of works and costs

Nr.	Specification	U.M	Unit physic.	Unit/ value	Cost (eur)	Total cost (eur)
1	Design, soil analysis, technical assistance, ground preparation					**1739,00**
1.1	Design, soil analysis, technical assistance	ha	1	€/ha	739,00	739,00
1.2.	Ground preparation	ha	1	€/ha	1000,00	1000,00
2	**Establishment of a fruit tree plantation**	ha	1	€/ha	**1638,39**	**2520,57**
2.1	Soil fertilization and disinfection (complete work)	ha	1	€/ha	1638,00	1638,00
2.2	Complete planting work (staking out, digging holes, shaping, mulching, planting, watering)	no. pl	2263,00	€/plant	0,39	882,57
3.	**Planting material**		2263,00	€/pc	1,64	**3711,32**
4.	**Maintenance expenses Year 1**					**1475,69**
4.1.	***Mechanical works***					**751,64**
	Mechanized weeding and mechanized mowing (4 repetitions)	ha	1	€/ha	175,82	175,82
	Fertilization	ha	1	€/ha	200	200,00
	Mulching vegetation between rows	ha	1	€/ha	175,82	175,82
	6 x Phytosanitary treatments	ha	1	€/ha	200	200,00
4.2.	***Manual work***			€/ha		**193,63**
	Formation cuts	ha	1	€/ha	100,00	100,00
	Planting seedlings to fill gaps	pcs	62	€/pc	0,39	24,18
	Collecting branches and removing them to the edge	ha	1	€/ha	49,45	49,45
	Rodent control	ha	1	€/ha	20,00	20,00
	Harvesting	ha	1	-	-	
4.3.	***Raw materials and supplies***					**530,42**
	Seedlings for filling gaps	pcs	62	€/pc	1,64	101,68
	Fertilization products	ha	1	€/ha	181,31	181,31
	Rodent control	ha	1	€/ha	29,94	29,94
	6 x Phytosanitary treatments	ha	1	€/ha	217,49	217,49
5	**Maintenance costs Year 2 + harvest**	ha	1	€/ha	600,00	**2075,69**
6	**Maintenance costs Year 3 + harvest**	ha	1	€/ha	1500,00	**3875,69**
7	**Maintenance costs Year 4 + harvest**	ha	1	€/ha	2000,00	**4375,69**
8	**Maintenance costs Year 5 + harvest**	ha	1	€/ha	2000,00	**4463,20**
9	**Maintenance costs Year 6 + harvest**	ha	1	€/ha	2000,00	**4552,46**
10	**Maintenance costs Year 7 + harvest**	ha	1	€/ha	2000,00	**4643,50**
	Total general eur (7 ani)					**33432,81**
	Total general ron (7 ani)					**167164,05**
	Total start-up costs euro (2023)					**7970,89**
	Total start-up costs ron (2023)					**39621,70**
	Total maintenance costs euro (7 ani)					**25461,92**
	Total maintenance costs lei (7 ani)					**127309,60**

Source: Technical project for the establishment of fruit farms - Establishment of black chokeberry plantation - *Aronia Melanocarpa* in an ecological system, 2024; INS 2023, MADR 2023;
*Costs without VAT; **exchange rate ECB: 1 euro= 4.97 (18.05.2023); *** average exchange rate 2025-2030 – 5 ron/euro.

Assumptions

The financial model (Table 2, Table 3) was constructed under the following working assumptions:

- Production system: focus on bulk sales of fresh fruit ("farm-gate" prices), without investment in processing or value-added activities;
- Initial investment: € 7,970,89 in 2023 for plantation establishment.
- Working capital: € 1,000 annually, maintained throughout the seven-year analysis to ensure liquidity, needed to cover operational costs and short-term obligations;
- Yield dynamics: progressive yield increase until plantation maturity in year four, with a maximum yield of 12 t/ha under optimal conditions;
- Price dynamics: base selling price set at €3.0/kg in 2024, with an annual increment of 1 % reflecting regional market trends in Central Europe;
- Prices and yields are based on empirical data from agricultural and commercial sources in Romania (INS, 2023; MADR, 2023);
- Cost dynamics: operating and maintenance costs increased by 2 % annually to account for inflation;
- Currency exchange: financial values expressed in euros, with conversions to Romanian lei (RON) based on the European Central Bank exchange rate (1 EUR = 4.97 RON, May 2023) (BNR, 2024), and an assumed average exchange rate of 5 RON/EUR for 2025–2030.

Table 2

Production/yield, selling price

No.	Specification	Base value	Alternative version
1	Time to commercial fruit (maturity)	4 years	3-5 years
2	Production at maturity	12 t/ha	7 t/ha – 14 t/ha
3	Gradual increase of production	Progresiv 0 →12 in-between the years 1-4	Liniar
4	Sale of fresh fruit (bulk)	3 €/kg	Average in Central Europe in 2024

Note: all amounts are "at the farm gate" the price does not include VAT

To assess the investment feasibility, standard financial analysis indicators were used as follow: Net Present Value (NPV); Internal Rate of Return (IRR), and the payback period. (Popa & Voicu, 2021)

The **NPV** was calculated as the difference between the present value of revenues and the present value of costs over the entire analysis period, as follows:

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - I_0 \qquad \sum_{t=1}^{n} \frac{CF_t}{(1+RIR)^t} = I_0$$

where,

CF_t = net cash flow in year *t*,

r = discount rate,

I_0 = initial investment,

n = analysis horizon (7 years).

The Internal Rate of Return (**IRR**) represents the rate that results in a Net Present Value equal to zero. This indicator reflects the project's intrinsic profitability and allows the comparison of the investment's attractiveness relative to other alternatives in the agricultural sector (Rusu & Stoica, 2022).

The **payback period** was determined through the analysis of cumulative cash flows, highlighting the year in which the sum of positive net flows equaled the initial investment (Petrescu, 2023). This indicator provides an intuitive measure of the point at which the investment becomes profitable, making it useful for financing decisions.

The **discount rate** used in the analysis was based on the weighted average cost of capital (WACC) specific to agricultural investments in Romania, estimated in the range of 6–8 % (BNR, 2024; Eurostat, 2023). In the baseline scenario, a value of 6 % was adopted, corresponding to the social discount rate recommended for rural development projects (MADR, 2023). This choice reflects a balance between the return required by the investor and the moderate risk associated with perennial crops.

RESULTS AND DISCUSSIONS

An applied cash-flow analysis was used to simulate the annual liquidity of the plantation. The model tracked total expenditures, gross income, financial results, and net cash flow for each year of the study period. The model thus captured all direct and indirect production costs, excluded VAT distortions, and explicitly acknowledged the annual working capital requirement (Table 3).

The outputs of the model included:

- Annual financial performance (gross income, operating expenses, financial result).
- Cumulative cash flow evolution across the study period.
- Determination of the break-even point (year in which cumulative revenues exceed cumulative costs).

This methodological structure provides a transparent and replicable framework for evaluating the profitability of perennial fruit crops under variable economic conditions.

Table 3

Cash-flow of aronia production

Year	Prod. t/ha	Total expenses (eur)	Gross income* (eur)	Financial result** (eur)	Invest. (eur)	Cash-flow*** (eur)
2023	-	-	-	-	7970,89+1000	-8970,89
2024	1	1475,69	3000	1524,31	1000	524,31
2025	3	2075,69	9000	6924,31	1000	5924,31
2026	7	3875,69	21000	17124,31	1000	16124,31
2027	12	4375,69	36000	31624,31	1000	30624,31
2028	12	4463,20	36360	31896,8	1000	30896,8
2029	12	4552,46	36724	32171,54	1000	31171,54
2030	12	4643,50	37091	32447,5	1000	31447,5
Total		**25461,92**	**179175**	**153713,08**	**15970,89**	**137742,19**

*Note: * Vb = Production *price/kg; ** Rf = Vb - Ch; *** Cash-flow = Rf - I*

Source: own calculations based on the estimated quote, in accordance with the working assumptions

As illustrated in Table 3, the first two years of aronia cultivation represent a critical phase of financial vulnerability, during which external capital or financing mechanisms are required to offset negative cash flow. The transition to profitability occurs once the plantation reaches maturity, corresponding to the break-even point, which in this analysis is achieved in year four. The model indicates a predictable evolution of the investment's profitability. The plantation reaches its maturity by 2026, when the yield reaches 7 t/ha. From 2027 onwards, the plants reach their maximum yielding potential of 12 t/ha, maintaining consistent profitability (Petrescu, 2023).

From year five onward, when the annual cash flow surpasses € 30,000/ha, the enterprise demonstrates a robust profit margin, particularly advantageous for small-scale producers. The cumulative cash flow analysis confirms that the break-even point is reached in year 4 (2026), when the cumulative net revenues exceed the initial investment. Beyond this stage, the project begins to produce substantial positive cash flows, thereby enhancing its medium-term financial viability (Figure 2).

These values confirm the attractiveness of the investment, positioning it above the minimum profitability thresholds for similar agricultural crops (Rusu & Stoica, 2022; Popa & Voicu, 2021).

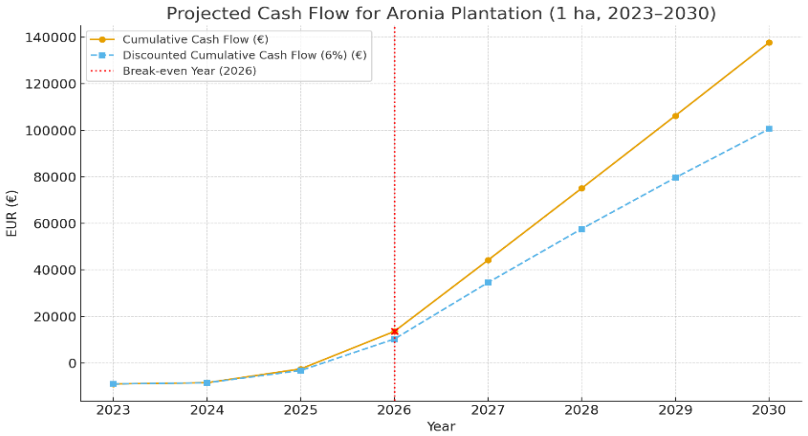

Figure 2. Cumulative cash-flow of *Aronia*

The sensitivity analysis (±20 %), illustrated in Figure 3, indicates a decrease in NPV of approximately 30-35 % under pessimistic scenarios, while the IRR remains above 20 %. This outcome demonstrates the project's moderate resilience (Petrescu, 2023).

This analysis assesses the stability of the project's profitability when subjected to concurrent ±20 % fluctuations in key parameters-namely, price, production, and costs.

Three distinct scenarios were examined analysed as follow:

- Base scenario (solid line) – reflects the original assumptions.
- Optimistic scenario (+20 % price & production, −20 % costs) - shows a faster recovery and higher cumulative profits.
- Pessimistic scenario (-20 % price & production, +20 % costs) - delays the payback period and lowers total returns.

Even under adverse conditions, the cumulative cash flow ultimately turns positive, highlighting the resilience and economic viability of aronia production.

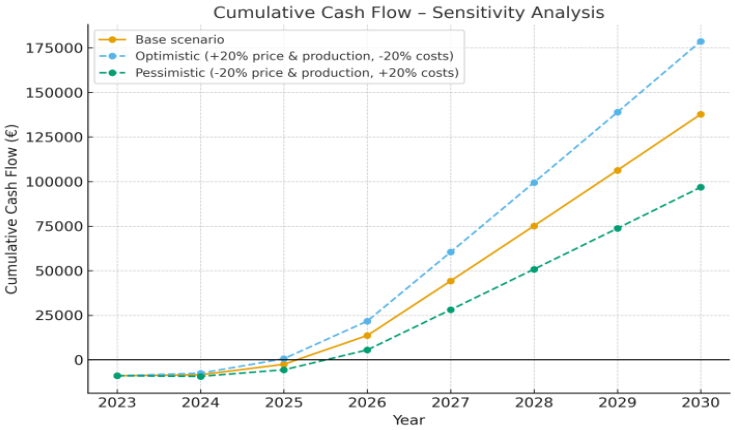

Figure 3. Sensitivity Analysis of *Aronia*

At this stage, the plantation can serve as a stable income-generating activity or provide sufficient financial capacity to support modernization or expansion, including the integration of processing facilities. In the modeled scenario of fresh fruit sales, and assuming an average price of € 2.5–3.0/kg during peak season for high-quality produce (based on regional wholesale and export/import price benchmarks), gross revenues are estimated at € 25,000–30,000/ha (Global Fresh Aronia Berry price 2025).

The advantages of bulk fruit sales include relatively low entry barriers, as no processing infrastructure, advanced packaging systems, or complex certification (e.g., HACCP for juice production) are required. This approach ensures faster cash-flow turnover, avoids capital immobilization in storage, and facilitates easier market access through local distribution channels such as farmers' markets, organic shops, cooperatives, and direct-to-consumer sales.

Nevertheless, significant constraints exist. The market for fresh fruit is smaller than that for processed products (juices, extracts, dietary supplements), primarily due to the astringency of the berries, which limits direct consumer acceptance. Furthermore, price sensitivity remains high, and the perishability of fresh aronia (3–5 days under ambient conditions, extending to a few weeks under refrigeration) imposes logistical challenges in terms of harvesting, sorting, packaging, and rapid sales. Revenues are concentrated within a single harvest period (September–October), which further constrains liquidity planning.

CONCLUSIONS

Aronia cultivation demonstrates strong potential as a profitable and sustainable agricultural enterprise. Although the first years require significant investment and financial resilience, plantations reach the break-even point by year four, after which cash flows stabilize at high and predictable levels. Under optimal agronomic management, the productive lifespan of an aronia plantation may extend for at least 15 additional years beyond the modeled period, ensuring long-term economic sustainability. Well-managed plantations can secure positive profit

margins, although these remain susceptible to seasonal fluctuations, product quality, and contractual arrangements.

For small-scale producers, bulk sales of fresh fruit represent a feasible entry pathway, characterized by lower initial investment and easier market access. However, this strategy is constrained by limited consumer demand, high perishability, and seasonal revenue concentration. Transitioning to on-farm processing has the potential to substantially increase profit margins, but also introduces heightened risks related to sales volatility, cash flow management, and inventory control.

In contrast, investment in processing infrastructure offers higher margins, year-round sales, and access to premium outlets, albeit at the cost of increased financial risk and capital requirements. In Romania, the availability of funding instruments through the CAP Strategic Plan and AFIR's 2025 financing calls (€ 600 million) further enhances the attractiveness of aronia cultivation and processing. Overall, aronia represents a promising crop for diversification, combining resilience, nutritional value, and favorable market dynamics.

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