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# Economic Assessment of Sea Buckthorn Cultivation and Processing in Conditions of Intensive Production

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**Abstract:** *The cultivation of medicinal plants is a current topic of growing importance. In Europe, but also the world, the demand for high-quality food is constantly growing. Sea buckthorn can be considered a functional food, which is an intermediate step between classic foods and medicines. Sea buckthorn contains a high content of vitamin C, which makes it an ideal helper in the treatment of flu or angina; thanks to the high content of vitamin B, it heals burns, has antiseptic effects, consumption of products from this medicinal plant ensures prevention in the treatment of cardiovascular diseases and cancer, supports digestion, detoxifies the body, purifies and supports the activity of the kidneys and urinary system, reduces high cholesterol, improves memory, has anti-inflammatory effects. In the contribution, we focus on the economic assessment of the cultivation and processing of this superfood in an intensive cultivation method. We modeled two alternatives: "Alternative A" - frozen fruits, "Alternative B" - 100% sea buckthorn juice. Based on the performed analysis, the second alternative is more economically efficient, given that the payback period is before the seventh vegetation year, the internal rate of return is at the level of 35.67% and the net present value reaches the level of 1,379,316 €. In the contribution, we also evaluated the intensity of production based on the resulting indicators (revenues, costs, management result per hectare, average profitability of revenues and costs) with conventional crops grown in the corn production area (wheat, barley, corn). We found that the values of all indicators were more favorable for sea buckthorn.*

## 1. INTRODUCTION

Sea buckthorn (*Hippophae rhamnoides* L., SBT) is being used as a folk medicine for its diverse medicinal properties. Flavonoids are generally considered the main bioactive and characteristic ingredients in SBT (Liu et al. 2021). Sea buckthorn (*Hippophae rhamnoides* L.), an ancient plant widely found in China, Mongolia, Russia, and northern Europe containing yellow or orange, fleshy, juicy, and soft berries, has gained increasing attention from scientists and consumers. It has a long history as a traditional Chinese herbal medicine, owing to its diverse phytochemical components and excellent antioxidant potential for improving the health of individuals suffering from chronic diseases (Ma et al., 2021). Sea buckthorn (*Hippophae rhamnoides* L., SBT) belongs to the Elaeagnaceae family and is a thorny, deciduous, dioecious shrub, which grows in cold-temp areas and arid regions, and is naturally distributed in Asia, Europe and North America. It has been used historically as a folk medicine to treat circulatory diseases, skin damage, metabolic disorders and digestive diseases in traditional Chinese medicinal prescriptions, being formally documented in the Chinese Pharmacopoeia in 1977 (Olas, 2018; Suryakumar & Gupta, 2011).

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Sea buckthorn (SB) has been indicated to have hypoglycemic potential, but its effects on glucose in people with impaired glucose regulation (IGR) are still unclear (Ren et al., 2021). At present, increasing attention on the possible positive effects of SB berries for glycemic control was also noted. Several animal studies have shown the positive effects of SB protein/fruit oil extract on reducing blood glucose, as well as alleviating insulin resistance. (Gao et al., 2017; Yuan et. al., 2016; Zhang et al., 2010). In human trials, for example, compared with strawberries, SB decreased and delayed insulin response and improved glycemic profile following a sucrose-containing berry meal (Mortensen et al., 2018).

Sea buckthorn (*Hippophae rhamnoides* L.), which has been categorized as a "medicine food homology" fruit by China's National Health Commission for both nutritional and medicinal purposes, has nearly 200 kinds of nutritive and bioactive compounds such as polyunsaturated fatty acids, carotenoids, sugar alcohols, superoxide dismutase and phytosterols. Significant bioactivity, including cardiovascular improvement, antidiabetic and anti-obesity activity, have highlighted the application of sea buckthorn (Wang et al., 2021). Sea-buckthorn is an ancient plant with modern advantages, due to its nutritional and medicinal value. It is cold resistant, and native to Europe and Asia. All parts of sea-buckthorn, *e.g.* berries, leaves, and seed or pulp oils, contain many bioactive compounds. They are a rich source of natural antioxidants, such as tocopherols, carotenoids, flavonoids; they also contain proteins, vitamins, minerals, lipids (mainly unsaturated fatty acids), sugars, organic acids and phytosterols. Sea-buckthorn extracts have therefore many beneficial properties, mainly antioxidative, anticancer, anti-inflammatory, antibacterial and tissue protective (Cho et al., 2017; Guo et al., 2017; Suryakumar & Gupta 2011; Zhang et al., 2018; Zargar et al., 2020; Ji et. al., 2020). Recent clinical studies have also shown that consumption of extract from sea-buckthorn berries leads to an increase in the number of selected types of stem cells (progenitor, endothelial and lymphocytoid mesenchymal stem cells) in circulating blood. This, in turn, may affect the repair and regeneration processes in damaged tissues, as well as the suppression of inflammation (Drapeau et al., 2019).

Sea buckthorn and its derived products (oil; alcoholic extracts), rich in flavonoids and essential fatty acids, are among these healthcare products. Specifically, sea buckthorn and its derivatives are reported to have antioxidant and antitumor activity in dysplastic skin cells. (Dudau et al., 2021). Sea buckthorn (Elaeagnus rhamnoides L.) is a unique medicinal and aromatic plant, frequently used as part of various pharmaceutical treatments, some of which are related to skincare. Sea-buckthorn-derived alcoholic extracts and seed oil were tested for antioxidant, antitumor and regenerative properties (Gegotek et al., 2018; Olas et al., 2018).

The processing of sea buckthorn berries for juice extraction leads to a large amount of residues, accounting for 20% of the total fruit weight, consisting of pulp, seed and skin which are known to be rich in carotenoids, polyphenols, fatty acids and sterols (Rösch et al., 2004; Dulf et al., 2012; Radenkovs et al., 2018). To reduce waste, sea buckthorn pomace is generally utilized as animal feed or for the extraction of biologically active compounds, providing beneficial food constituents, antioxidants, and cosmetics products (Périno-Issartier et al., 2011). Other food applications targeted the addition of sea buckthorn pomace to bread and other bakery products in order to increase their nutritive value (Lougas et al., 2005; Kant et al., 2012) and the direct enrichment of edible oils with sea buckthorn carotenoids (Chemat et al., 2012).

## 2. MATERIAL AND METHODOLOGY

The goal of our research is an economic assessment of the simulation of operating inputs and outputs of a sea buckthorn plantation with an intensive cultivation method in the conditions of the Slovak Republic. The source of data for the simulation of the economic efficiency model of the cultivation of the medicinal plant selected by us was primary data from growers who are engaged in the cultivation of this medicinal plant. The missing data, especially of a production nature, which the growers were not willing to provide us, were obtained mainly from the professional literature by Valíček and Havelka (2008) and Bajer (2014).

Expected assumptions of research results:

1. The finalization of the total production in the form of sea buckthorn juice is more economically advantageous compared to the processing of the total harvest in the form of frozen fruits;
2. The resulting indicators evaluating the economic level of our model (total yields, costs, farming economic result per hectare, average profitability of costs and yields) will achieve more favorable economic results compared to the cultivation of conventional crops in the corn production area (wheat, barley, corn).

The plantation modeled by us has the character of an intensive cultivation method. Intensive agriculture is characterized by increasing the yield of the land using mechanization, chemical agents and the irrigation system. It does not require a large area of land, so it focuses on maximizing a specific, albeit smaller, area. In this method of cultivation, a whole range of preparations and modern methods are used to keep the soil as productive as possible. Compared to extensive agriculture, it represents a change in approach to crop cultivation, soil care, and thus to agriculture.

The reasons for choosing the mentioned medicinal plant are:

- the mentioned crop does not have sufficient economic evaluation (justification) in the Slovak Republic or in the world - in the scientific databases accessible to us, there is a minimum of contributions that would relate to the economy of medicinal plants in general, or specifically to sea buckthorn;
- with sea buckthorn, there are enough articles from an agrotechnical, production, medical or chemical point of view, but not from an economic point of view;
- it was not our intention to focus on the economic evaluation of plantation cultivation of conventional medicinal plants on arable land (echinacea, chamomile, calendula);
- almost the entire territory of the Slovak Republic has suitable conditions for growing this crop;
  it is a perennial medicinal plant;
- fruit tree or fruit bush;
- contains a large amount of substances beneficial to health;
- final products from this medicinal plant are increasingly popular among end consumers.

The sea buckthorn plantation fulfills the legal conditions for its inclusion in the category of long-term tangible assets. It will be depreciated in the fourth depreciation group with a depreciation period of 12 years.

## 2.1. Procedure for Determining Investment Expenses

Investment expenses will be determined in the amount of own costs for planting and tending the plantation until the first year of fertility, which is the fourth year after planting for sea buckthorn.

The economic evaluation was carried out through static and dynamic methods of evaluating investment projects:

1. Use of static methods:
   a. **average profitability of revenues** – the indicator compares the average economic result of the project before taxation and the average revenues that will be produced during the lifetime of the project (Gurčík et al., 2012);
   b. **average profitability of costs** – the indicator compares the average economic result from the project before taxation and the average operating costs incurred during the life of the project (Gurčík et al., 2012). We use the pre-tax farming result for subsequent comparison with conventional crops (wheat, barley, corn);
   c. **return period of invested funds** – is the time during which the funds invested in the project will be returned. It is the period that elapses from the investment expenditure to the time when the accumulated revenues from the project cover this expenditure (Krištofík et al., 2009).
2. Use of dynamic methods:
   a. **Net present value** – can be defined as the difference between the discounted cash income from the investment and the capital expenditure. An interpretation of the various possible net present value outcomes is as follows:
      - NPV > 0 – the discounted cash income exceeds the capital expenditure, the investment project is acceptable for the company,
      - NPV < 0 – the discounted cash income is less than the capital expenditure, the investment project is not acceptable for the company,
      - NPV = 0 – the investment project is indifferent from the point of view of the company (Bielik & Turčeková, 2013).
   b. **Internal rate of return** – can be defined as the interest rate at which the present value of the cash income from the investment equals the capital expenditure. We can also define it as an interest rate at which the net present value is equal to zero (Bielik et al., 2018).
   c. **Discounting as part of dynamic investment calculations** – the discount rate plays an important role in the calculation of dynamic indicators, the amount of which depends on the cost of own equity. This cost should evaluate the fact that the investor used the capital for a specific project and thereby got rid of the possibility to invest the free funds in other investment opportunities (Kislingerová, 2001). Over the last 15 years, the average return on government bonds is at the level of 3.5%. For projects with higher risk, the discount rate can be up to 5% higher than the average cost of own equity. Investments in agriculture are among the projects with a higher risk. Based on the above, the discount rate in our project was set at 8%.
   d. **Analysis of sensitivity factors -** Sensitivity analysis consists of monitoring the impact of a change in some determinants on a change in the net present value (Krištofik et al., 2009). In the paper, we examine the impact of an increase in operating costs and a decrease in revenues on the net present value.

### 2.2. Break-Even Point Analysis

To determine the Break-even point represents for the enterprise the important information because it defines the minimum amount of products that the enterprise needs to produce to cover its fixed and variable costs. Knowing the Break-even point allows an enterprise to properly estimate the revenues necessary to ensure profits (Majerčáková & Majerčák, 2015).

## 3. RESULTS

The input parameters of our model are shown in Table 1. Cultivation of sea buckthorn in the Slovak Republic is rather an exception, it is not a widespread crop. Sea buckthorn is a unique cultural crop grown in Slovakia. Before we proceeded to the actual creation of the model, we personally visited several entities that are dedicated to the cultivation of this interesting crop, which contains a large number of substances beneficial to health, but in the mosaic of input data, we lacked data of a production nature, which either our respondents were not willing to provide us or provided them to us, and through subsequent cross-checking, we found that they are false or unreliable data. We sorted the collected data into data that is probably correct and data that is irrelevant. That's why we supplemented these missing data from the professional literature. We chose the varieties that are most planted under the conditions of the Slovak Republic. When growing this crop, it is necessary to consider its basic biological peculiarities. This includes a dioeciousness, demanding light, the need for sufficient air flow, water-protected land with enough organic matter and mineral substances.

Dioeciousness means that without the presence of a male, or a female plant does not pollinate the flower, which would prevent the harvest. In our model, we consider growing the Pollmix and Leikora varieties, which achieve the best production values in our conditions. On one hectare, approximately 90% of the female plants will be planted and the rest will be male plants. In the project, we calculate with the alternative that the business entity has the land at its disposal, i.e., j. without the cost of its procurement. The model compiled by us points to the individual work steps necessary for planting and tending the plantation, harvesting, and processing the crop, as well as the disposal of the plantation. Input prices of material assets, which are unavoidable during cultivation, or processing of this crop (mower, fencing, drip irrigation, freezer box, sorter) were determined based on consultation with potential suppliers of these capital inputs. We received information about the amount of labor costs directly from the growers. Personnel costs for harvesting were set at the level of 7 €/hour (net). Material costs (e.g., fertilization, electric shears needed for harvesting, etc.) were set based on a market survey carried out by us.

In the economic assessment, we assumed the finalization of the production in 2 forms:
- "Alternative A" - we plan to sell frozen sea buckthorn,
- "Alternative B" - 100% sea buckthorn juice.

The technological-economic project assumes 12 production years with an average annual yield of 9.50 kg per bush, i.e. j. 11 t/ha. The first production year is the fourth year after planting. This year we expect a yield of 0.60 kg per bush, while we assume that it will reach the maximum yield in the fifth to seventh production year (13.3 kg). After this period, the planned yield per hectare decreases slightly every year. The average annual yield in the eighth to twelfth production year per bush is 11.5 kg.

**Table 1.** Model input parameters

| **Item** | **Data** |
|---|---|
| Area (ha) | 10 |
| Variety (types) | Leikora, Pollmix |
| No. of plants (ha) | 1 281 |
| No. of female plants (ha) – Leikora | 1 159 |
| No. of male plants (ha) – Pollmix | 122 |
| Mower | yes |
| Fencing | yes |
| Irrigation system | yes |
| Freezer box | yes |
| Sorter machine | yes |
| Building (for storage of unsold or unprocessed crops) | yes |
| Method of harvest | by hand using electric scissors |
| Sea buckthorn yield | 52 % |
| Selling price of berries (frozen sea buckthorn) | 7 €/kg |
| Selling price of juice | 22 €/l |

**Source:** Own processing

Our plantation model has an area of 10 hectares; to ensure the annual harvest, it is necessary to plan to plant 5 hectares in the first year, then 5 hectares in the following year. The reason for this is the fact that during harvesting, whole branches are cut, including the fruits (due to the sharp thorns on the branches), which will affect the productivity of the plant. The cut branches and the fruits are still in the field and placed in containers that go to the freezer box, where they are frozen for 48 hours at a temperature of -15 $^{0}$C. Subsequently, the fruits frozen in this way are easily separated from the twigs. The fruits go to the sorting line, where they are separated from the leaves and in this condition, they can either be further stored in another freezer box at a temperature of -18 $^{o}$C (like other small fruits) or they can be processed into a whole range of products. The yield of sea buckthorn is 52%, which means that we get approximately half a liter of juice from 1 kg of fruit. In the model, we assume the price of frozen fruit at the level of 7 €/kg, while we plan an annual price increase of 5% until the sixth year of production. This price increase was determined based on the current development of the price increase of this crop. The price of the juice was also determined based on market research. In the first year, we expect a price of 22 €/l, but the price of juice has grown significantly more slowly in the last period, and that is the reason why we expect only a 1% annual price increase.

Table 3 shows our planned operating costs that will arise during the production period of the sea buckthorn plantation, as well as the share of individual cost components in the total costs. Fixed costs include those whose volume does not change depending on the scale of production (mowing costs, fertilization costs, sorting machine maintenance costs, depreciation, operation of the freezer, liquidation of the plantation at the end of its life). During the life of the plantation, we will depreciate not only the plantation itself, but also the mower (reinvestment in the 4th production year), the fence, the irrigation system (reinvestment in the 4th production year) and the building (from the 1st production year) that will serve as a warehouse for storage not yet sold, or unprocessed crops from the plantation, a freezer box (from the first year of production) and a sorter (from the first year of production). Among the variable costs are the costs of manual harvest from the plantation, as well as other harvesting costs, among which we include the work of the tractor, the cost of transporting the fruit from the plantation, as well as the cost of procuring electric shears with which the crop is cut from the branches. Harvesting will be done by cutting branches. This alternative was chosen due to the fact that mechanized harvesting with a harvester (adapted for cutting branches) would be disadvantageous due to high investment costs and poor utilization of the harvester considering that this harvester can cut 4-8 ha per day, and we calculate with harvesting in one year on an area of 5 hectares. There is also an alternative with vibrating mechanized technology. In Romania, they tested vibrating harvesters very successfully with the Moldova variety. The harvesting speed was 29-30 bushels per hour, which represented a harvest of approximately 800-900 kg of fruit (Bajer, 2014). However, this method does not seem to be effective due to the fact that there is a high loss of fruit, meaning that such a mechanized harvest would have to be followed by pruning of the branches as well. When we compare both alternatives, we find that the share of variable costs is higher in "Alternative B", which is related to the additional costs of pressing and packaging juices.

In Table 2 we see the quantification of investment expenses for the establishment of 10 hectares of sea buckthorn plantation within the first year of fertility, which in the case of this medicinal plant is the fourth year from the establishment of the plantation. At the beginning of the growing season, an investment in the procurement of a mower, fencing and an irrigation system is necessary. Together, these costs make up more than 50% of the total investment expenses. As for the plantation itself, the most expensive item is the planting itself, the share of which is almost 24% of the total investment expenses. Among other costs, we include the costs of preparing the plantation itself before planting, fertilizing the soil in the year of planting, as well as the costs of care until the first production year, which includes mowing, fertilizing and cutting bushes. Fertilization is ensured by both organic (manure) and inorganic (superphosphate, potassium sulphate, ammonium nitrate) fertilizers.

**Table 2.** Quantification of investment expenses up to the first production year (in Eur)

| Item | Costs per 10 ha | Percentage share |
|---|---|---|
| Procurement of a mower | 4 000 | 1.45 |
| Procurement of fencing | 19 200 | 6.94 |
| Procurement of an irrigation system | 127 500 | 46.06 |
| Preparatory work | 10 000 | 3.61 |
| Soil fertilization | 13 072 | 4.72 |
| Planting a plantation | 65 406 | 23.63 |
| Treatment costs | 37 633 | 13.60 |
| **Total** | **276 811** | **100 %** |

**Source:** Own processing

From the comparison of the alternatives modelled by us, it is clear that the implementation of "Alternative B" is more economically efficient (Table 4). The internal rate of return for this alternative is 35.67%, the payback period is before the seventh vegetation year, the net present value of the investment is at the level of 1,379,316 €. The average break-even point is at the level of 14,524 kg, or 9,481 l. Based on the above, the research assumption was confirmed that the finalization of the production in the form of 100% sea buckthorn juice is economically more interesting for the business entity compared to the finalization of the harvest in the form of frozen sea buckthorn.

Furthermore, we analyzed how an increase in operating costs by 10% or a decrease in revenues by 10% will influence the net present value (Table 5). The results of the analysis show that a more significant impact in the modeled alternatives is the decrease in revenues compared to the increase in operating costs. This impact is more significant with "Alternative B", in absolute terms we record a decrease of 261,056 € or 34%.

**Table 3.** The amount of total costs in € during the production period of the sea buckthorn plantation and their share in the total costs

| Type of costs/Alternative | A (€) | A (%) | B (€) | B (%) |
|---|---|---|---|---|
| **Fixed costs** | **1 055 967** | **28.74** | **1 055 967** | **22.7** |
| Mowing costs | 46 484 | 1.27 | 46 484 | 1 |
| Costs of fertilization | 29 078 | 0.79 | 29 078 | 0.63 |
| Maintenance costs | 12 400 | 0.34 | 12 400 | 0.27 |
| Depreciation | 392 761 | 10.69 | 292 761 | 8.44 |
| Freezer operation | 563 308 | 15.33 | 563 308 | 12.11 |
| Disposal of plantation | 11 936 | 0.32 | 11 936 | 0.26 |
| **Variable costs** | **2 617 806** | **71.26** | **3 595 281** | **77.3** |
| Personnel costs for annual fruit collection | 378 514 | 10.30 | 378 514 | 8.14 |
| Other costs of harvest | 2 051 315 | 55.84 | 2 051 315 | 44,1 |
| Cleaning | 187 977 | 5.12 | 187 977 | 4.04 |
| Cost for pressing juices | 0 | 0 | 195 496 | 4.2 |
| Cost per bottle | 0 | 0 | 781 979 | 16.81 |
| **Costs** | **3 673 772** | **100** | **4 651 247** | **100** |

**Source:** Own processing

**Table 4.** Resulting indicators of the economic efficiency of the investment - sea buckthorn (intensive cultivation method)

| Indicator/alternatives | A | B |
|---|---|---|
| Payback period (in years) | 7,59 | 6,75 |
| Average profitability of revenues (%) | 36,19 | 42,31 |
| Average cost profitability (%) | 56,72 | 73,35 |
| Net present values (€) | 767 080 | 1 379 316 |
| Internal rate of return (%) | 26.41 | 35.67 |
| Break-even point | 14 524 kg | 9 481 l |

**Source:** Own processing

**Table 5.** Analysis of the sensitivity of factors to changes in the net present value - sea buckthorn (intensive cultivation method)

| Alternatives | A | | B | |
|---|---|---|---|---|
| 10% increase in operating costs | -184 348 € | -24% | -228 525 € | -17% |
| 10% decrease in revenue | -261 056 € | -34% | -366 457 € | -27% |

**Source:** Own processing

When performing any business activity, the primary goal is to achieve profit, maximize production and increase competitiveness in the market. Agricultural production, which tries to generate a positive economic result, is no exception. In general, the operating result represents the difference between revenues and costs. The amount of total revenues is also affected by subsidies that are paid in Slovakia through the Agricultural Payment Agency. Since we were unable to obtain information on the amount of subsidies provided to sea buckthorn growers, in Table 6 we present a comparison of selected economic indicators without taking into account subsidies. The source of data for conventional crops was the publication Cost of Agricultural Products published by the National Agricultural and Food Centre of the Slovak Republic. When comparing individual crops, we can see that of the conventional crops, corn achieves the most economically favorable values. The result of wheat management reached the value of -26 €, which was reflected in the negative profitability of revenues as well as costs. With sea buckthorn, we see much more interesting economic values compared to commonly grown crops. When comparing the economic indicators between the alternatives modelled by us, we again see more interesting values for “Alternative B”.

**Table 6.** Comparison of selected economic indicators between sea buckthorn and selected conventional crops (intensive cultivation method vs. corn production area)

| Alternative | Wheat | Maize | Barley | Sea buckthorn | |
|---|---|---|---|---|---|
| | | | | A | B |
| Revenues per hectare (€) | 804 | 995 | 770 | 95 959 | 134 379 |
| Costs per hectare (€) | 831 | 971 | 757 | 64 230 | 77 521 |
| Profit per hectare (€) | -26 | 24 | 13 | 34 730 | 56 858 |
| Return on costs ( %) | -3.18 | 2.47 | 1.78 | 56.72 | 73.35 |
| Return on revenues ( %) | -3.28 | 4.41 | 1.75 | 36.19 | 42.31 |

**Source:** Own processing

From the data presented in Table 6, it is clear that the first research assumption has been confirmed, which means that the cultivation of sea buckthorn with an intensive cultivation method is economically more interesting compared to the cultivation of conventional crops selected by us in the corn production area.

## 4. FUTURE RESEARCH DIRECTIONS

International trade with sea buckthorn has developed within the last ten years with great success. More and more not only berries but also semi-products are marketed, and trade channels become more complex. There is a great demand for assuring quality and defining distinct parameters for products from sea buckthorn. In 2013 International Sea Buckthorn Association (ISA) launched a working group to propose sea buckthorn standards. The first draft documents presented in 2014 indicate that there are tremendous differences in understanding what standardization means. In general, standardization means the unification of dimensions, types and procedures. In production, it is used to unify products (typification) or/and define common sets of parameters (properties) (Morsel, 2015).

Sea buckthorn is a plant-producing fruit containing high levels of complex nutrients that competes within a developed market of internationally traded natural nutraceutical products. It has been grown as an agricultural crop in Europe since the 1970s. This is part of a global production that is largely Asian-centered, where investment in processing development and facilities has grown significantly since the year 2000. Health-conscious consumers in Europe spend €9 billion a year on nutritional supplements. Sea buckthorn as a crop is expanding in some EU member states, but cost structures and technical difficulties relating to harvesting need to be answered for production to grow (Eagle, 2015).

Erdos and Szollosi (2018) focus on the business management-related advantages and disadvantages of sea buckthorn production and processing based on economic analyses. It is the main objective of the authors to identify the expected economic findings in a high-standard plantation with different average yields. A deterministic model calculation was performed based on technological processes, using the primary data collected from enterprises dealing with sea buckthorn production. The calculation is based on the assumption of a 10-hectare plantation with intensive production technology (high soil quality (golden crown value: 32 GC per ha), irrigation, high plant density per hectare). The cost and income relations and the long-term return of the plantation were examined in the case of different average yields (12 t/ha, 18 t/ha and 24 t/ha). Under the economic circumstances of 2016, the planting cost of an intensive plantation is around 4-4.1 million HUF/ha. In the years following the fruit-bearing stage, direct production costs are between 2.5-3.9 million HUF/ha, depending on the given average yield. On the contrary, 5.6-11.1 million HUF/ha revenue can be reached based on the current market prices, resulting in a gross margin of 3.1-7.1 million HUF/ha. Under the modelled circumstances, return is realized on the plantation's costs in 6-8 years. The net present value (NPVr=3.24%) calculated for the 15-year-long life cycle of the 10-hectare plantation is between 151-466 million HUF, while the internal rate of return (IRR) is between 23-45%. From the business management aspect, the advantage of sea buckthorn production is that it provides better income and return at a planting cost that is similar to that of other small fruits and berries. At the same time, the disadvantage of sea buckthorn production is the fact that yields are harvested every two years due to the technological characteristics of harvesting. The negative impact of this bi-yearly yield on liquidity can be eliminated with the so-called delayed planting.

In the economic evaluation of the cultivation of sea buckthorn, we started with the authentic documents of a specific farm operating in the territory of Slovakia. In the work, we evaluated basic economic indicators such as sales, costs, profit as well as selected ratio indicators of economic efficiency for the period 2012-2016. The profit from a hectare of plantation for the period 2012-2016 ranges from 600 € to 9,584 €, depending on harvest and realization price of production. It is assumed that at the time of full productivity of the plantation, an average yield of 15 kg per bush will be achieved and it is realistic that the profit from 1 hectare will be at a level exceeding the value of 30,000 €. When comparing the economic results of growing conventional crops such as cereals, root crops, but also oilseeds, the profit achieved when growing sea buckthorn is commercially interesting. And this even though building a plantation requires considerable investment expenses. The economic effect can also be increased by finalizing sea buckthorn fruits under farm conditions (Gurčík et al., 2019). A topic for further research can be the economic evaluation of the cultivation and processing of sea buckthorn using other varieties, given that we have several dozen varieties of this medicinal plant, or the economic evaluation of the plantation cultivation and processing of other medicinal plants that are interesting for the consumer in terms of health benefits (arrow rose, goji).

## 5. CONCLUSION

The scientific contribution aimed to evaluate the economic efficiency model of growing and processing sea buckthorn using an intensive cultivation method. In the paper, we present the finalization of the production in two forms: "Alternative A" - frozen fruits, "Alternative B" - 100% sea buckthorn juice. Based on the performed analysis, the most economically acceptable option for the grower is the implementation of "Alternative B". With this alternative, the payback period was before the seventh growing year, the internal rate of return was 35.67% and the net present value was 1,379,316 €. The results of the sensitivity analysis showed that in both modeled alternatives, the net present value was more affected by the decrease in yields, which are affected by the variability of the harvest and the unit price per kilogram, respectively.

Both formulated research assumptions were confirmed:

1. The finalization of the total production in the form of sea buckthorn juice is more economically advantageous in comparison with the processing of the total harvest in the form of frozen fruits;
2. The economic indicators chosen by us (total revenues, costs, farming result per hectare, average profitability of costs and revenues) will achieve economically more interesting values compared to conventional crops grown in the corn production area (wheat, barley, corn).

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