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The calculation of the economic efficiency of standing timber production – methodological basis and way of counting

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ABSTRACT

In particular, the evaluation of the activities undertaken involves determining whether the project is economically beneficial (whether it brings net benefits). Subsequently, it helps to choose the most profitable variant of the undertaking.
The purpose of this study is to develop methodological assumptions for evaluating the economic efficiency of forest production of basic forest-forming species at different site index classes and to verify them in practice. The research was concerned with the following species: pine and spruce at 100 and 120 years, oak at 140 and 160 years, and beech 120 years, hornbeam 80 years, fir 120 years and birch 80 years, according to site index classes. In addition, for each species, two variants were considered that differed in the way the cost of establishing the stand was determined. The role of evaluation criteria was based on two economic categories: net present value (NPV) and internal rate of return (IRR). The presented evaluation of the profitability of standing timber production was limited to financial analysis, which considers only the income expressed and obtained in monetary units from the sale of timber. The value of 1 hectare of standing timber in each year was calculated as the product of the average timber sale price in PLN/m^3 and the stand value index (m^3/ha) taken from tables prepared by the Forest Research Institute. The highest NPV was shown by fir (9 417-20 627 PLN/ha) and spruce at a harvest age of 100 years (8 309-20 753 PLN/ha). On the other hand, the highest IRR value in variant I was achieved by oak stands with a rotation age of 140 years (2.58), and in variant II by spruce stands with the rotation age of 100 years (2.60). In all examined cases, the economic efficiency of timber production depends on the species, site index classes and rotation age.

KEY WORDS

internal rate of return, net present value, rotation age

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Introduction

The evaluation of economic activity in forestry, as in other areas of productive human activity, requires criteria that reflect the benefits associated with the possibility of different uses of the resources of labor, land and other means of production held, as well as the different relations of the benefits obtained to the inputs incurred (Płotkowski, 1996; Wrzosek, 2008; Rogowski, 2013; Płotkowski *et al.*, 2016).

The first activity for evaluating actions taken is often to determine whether the intended economic venture or program is economically beneficial at all. Only those activities that provide revenues in excess of costs, *i.e.* those with net benefits, are beneficial. If the expected revenues are less than the costs, the venture has no economic justification. In other words, the value of effects should exceed the value of inputs. This is a basic principle for identifying favorable variants of business ventures, especially those having the nature of investments (Pearse, 1990). This is due to the fact that, from an economic point of view, one of the fundamental objectives of economic ventures undertaken is the production of certain material goods and/or services. The implementation of this objective requires the outlay of expenditures, the result of which is referred to as investment. An investment can be considered effective if the revenue from the sale of the products and services produced as a result exceeds the expenditures made.

Due to the volatility of the time value of money, only the real values of individual cost and revenue items at a given moment can be compared. The calculation of such equivalents is possible only with the help of the compound interest calculus, which makes it possible to bring all the monetary values of costs and revenues appearing during the operation of the investment to one arbitrary point in time, which can be, for example, the beginning or end of the investment (Stasiak, 1995). In the case of evaluating, for example, various forest management practices, the most commonly accepted time point is the moment of evaluation, which is simply the present time (Pearse, 1990).

The adoption of an appropriate interest rate is crucial in this type of calculation and depends on the specific case. If, for example, one wants to obtain the real value of a nominal sum of money appearing in the future, which could be compared with other values existing at the present time, then this nominal value is discounted by adopting, as the interest rate, the average inflation rate expected during this period. In contrast, other values of the interest rate are adopted when the discounting technique is used in financial analysis methods leading to the calculation of ratios for evaluating various investment alternatives. This method is also used to assess the financial efficiency of forestry investments, as it allows to take into account the variability over time of the value of money, which is essential due to the long-term nature of these investments (Davis and Johnson, 1987).

In order to choose among the projects under consideration different in terms of their degree of economic utility, we need appropriate criteria. The role of such criteria is most often fulfilled by two economic categories, namely: the NPV and the interest rate of the investment, *i.e.* the rate of return (Stasiak, 1995; Płotkowski *et al.*, 1996; Golej, 2008; Ying *et al.*, 2010; Rogowski, 2013). The NPV is the difference between the value of discounted revenues and discounted costs at the start of the investment at an assumed interest rate (r). In general, the impact of the value and distribution of costs and revenues can be characterized by the statement that the NPV is higher the lower and later the costs appear, and the higher and earlier the revenues appear.

Crucial to the NPV value is the amount of the discount rate. In the case of forestry projects, the real interest rate on long-term loans is assumed. Using such a discount rate to calculate NPV makes it possible to see what the net present value of such a project is. In financial analysis of forestry ventures, a discount rate ranging from 1% all the way up to 7% is most commonly used in Western countries today, with an average of 3-5%, with a 5% rate in force in the UK, for example (Stasiak, 1995).

The NPV value indicates the financial efficiency of a given investment project, which can be accepted in financial terms when the value is positive or at least equal to zero, which in practice means that discounted revenues should exceed or equal discounted costs.

The greater the excess of benefits over costs, the greater the net effects associated with the implementation of a given project. Hence, alternatively beneficial economic projects and programs can be compared and evaluated according to the magnitude of the expected net benefits, or NPV, which in this case acts as a rank reflecting the decision-maker's priority in such a way that a higher NPV means a higher rank, which in turn corresponds to a higher priority (Gunter and Honey, 1984).

The second way of economic evaluation of business ventures usually boils down to the calculation of the discount rate, the so-called internal rate of return (IRR). The IRR equals the discount rate at which the total present value of costs, *i.e.*, the value obtained by discounting them to the present, equals the total present value of revenues. This is the discount rate at which the NPV for a given investment is 0 (Golej, 2008; Rogowski, 2013; Evison, 2018).

The internal rate of return, as a criterion for evaluating investment projects, is used mainly by investors seeking to maximize income within their financial resources. It eliminates the need to adopt an interest rate in advance. An additional advantage of the internal rate of return as a selection criterion is simplicity; most people understand that the higher the rate of return on the outlay spent, the more favorable the capital investment (Pearce, 1983).

The purpose of this study is to develop methodological assumptions for evaluating the economic efficiency of forest production of basic forest-forming species at different site index classes and to verify them in practice.

Material and methods

In this study, the starting point in calculating the internal rate of return (IRR) is the value of the stand at two points in time, *i.e.*, the value at the rotation age u (M_u) and at the age i (M_i), up to which the basic costs of establishing and maintaining the stand are incurred.

Value of the stand [PLN/ha] at the rotation age u (M_u) was determined according to the formula [1]:

$$M_u = W_s \cdot C \qquad [1]$$

where:

- W_s – value of the stand given in conversion factors m^3/ha (by sale value), read in the age of cutting by valuation classes (Tablice, 2013).
- C – average selling price of wood raw material in PLN/m^3 (Komunikat, 2020).
- u – rotation age.

In turn, the method of calculating the value of a stand of trees [PLN/ha] at age i (M_i) is presented in the formula [2]:

$$M_i = W_{ki} \cdot C \qquad [2]$$

where:

W_{ki} – value of the stand given in conversion factors m^3/ha (according to cost outlay), read at age i according to valuation classes (Tablice, 2013).

C – as above,

i – the age up to which the basic costs of establishing and maintaining a tree stand are incurred.

Establishment and maintenance of a tree stand is associated with costs. We consider the costs of establishing and maintaining a tree stand as capital expenditures. The costs associated with the establishment of a stand cover the initial life of the stand, basically up to the age at which usable sorties appear. Hence, it is necessary to discount all costs to the year of crop establishment.

In the study, the stand value (M_i) for each of the selected species, within the framework of site index classes, was determined in two ways: i, which contributed to the separation of two variants of IRR calculations, namely:

– Variant I – uses the value of the stand of trees determined according to the costs incurred at the age of 20 years (M_{20}), for the species and site index classes,
– Variant II – differentiates the age i, at which the value of the stand according to the costs incurred (M_i) is determined, taking as the upper limit the last age given in the table before the moment of appearance of the large timber. Hence, in this variant stand values (M_i) determined for different ages by species and site index classes will be taken into account.

Further, having the value of the stands at two time moments (M_i, M_u), it is possible to proceed to calculate, the updated value (brought to the moment of crop establishment) of the cost of establishing and maintaining the stand to the age i, that is, the initial value (M_0) and IRR, which is presented by the following formulas [3-5]:

$$M_0 = \frac{M_i}{(1+IRR)^i} \qquad [3]$$

where the IRR is also expected to meet the following condition (formula 4):

$$M_u = M_0 \cdot (1 + IRR)^u \qquad [4]$$

At this stage, it is extremely important to determine the appropriate discount rate. The logic of proceeding and determining the IRR value for only one example is presented using the method of successive approximations. An accurately determined interest rate is the rate at which all the discounted costs of establishing and maintaining stands up (M_i) to the beginning of the rotation age (M_0) and then prolonged to the end of the rotation age, give exactly the value of the stand (M_u). The course of calculation of IRR is shown schematically in Figure 1. Due to the labor intensity of this method, the remaining IRR values were determined using the formula 5.

$$IRR = 100 \cdot \left(\sqrt[u]{\frac{M_u}{M_0}} - 1 \right) \qquad [5]$$

On the other hand, the method of calculating the net present value (NPV) in PLN/ha is presented by the formula [6]:

$$NPV = \frac{M_u}{(1+p)^u}$$

where:

p – interest rate adopted in [%]

The range of calculations made is illustrated in Figure 2.

Results

Example of IRR and NPV calculations for variant I (stand establishment costs are for a 20-year period).

Pine tree, age at cutting of 100 years, I site index.

The value of the stand in m^3 of wood raw material:

$$Wk_{20} – 86.6\ m^3/ha$$
$$Ws_{100} – 396.7\ m^3/ha$$

Average current selling price of wood raw material (2020):

$$C – 196.84\ PLN/m^3$$

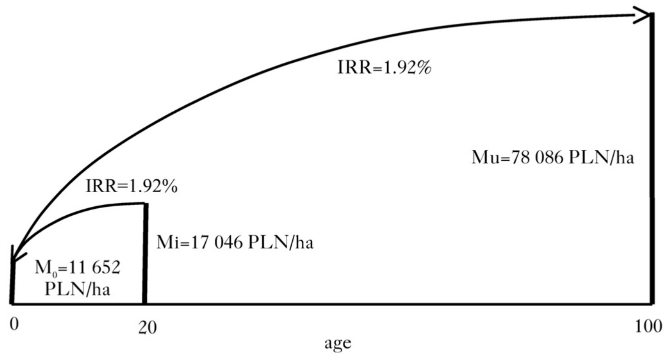

Fig. 1.
Scheme of IRR calculations

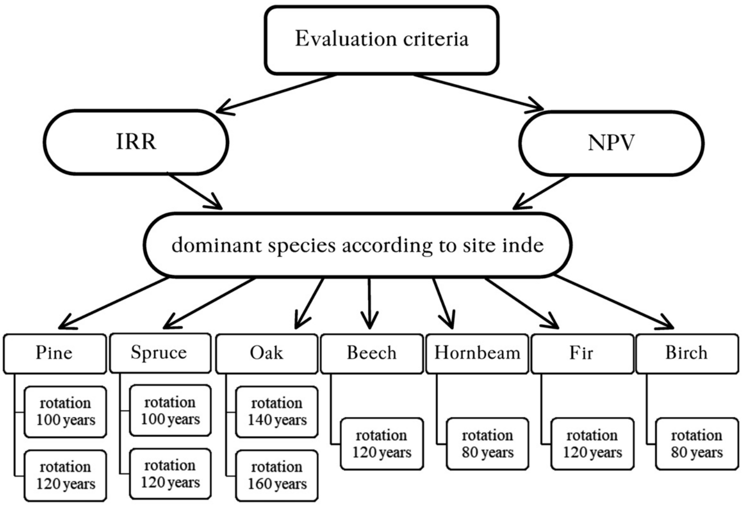

Fig. 2.
The range of IRR and NPV calculations according to species and site index classes

Determination of the value of 1 ha of forest stand, with a standing crop index of Z=1, at the age of 20 years (M_{20}) and at the age of 100 years (M_{100}):

$$M_{20} = 86.6\ m^3/ha \cdot 196.84\ PLN/m^3 = 17\,046\ PLN/ha$$
$$M_{100} = 396.7\ m^3/ha \cdot 196.84\ PLN/m^3 = 78\,086\ PLN/ha$$

Calculation, using the method of successive approximations, of the present value (brought at the time of crop establishment) of the cost of establishing and maintaining a stand of trees up to the age of 20 years, *i.e.* the initial value (M_0) and internal rate of return (IRR):

$$M_0 = \frac{17\,046\ \mathrm{PLN/ha}}{(1+IRR)^{20}}$$

where IRR is also to meet the following condition:

$$78\,086\ \mathrm{PLN/ha} = M_0 \cdot (1 + IRR)^{100}$$

Results of determining the internal rate of return (IRR) and present value of costs (M_0), by the method of successive approximations is shown in Table 1.

To check the above calculations, we use the formula 5, according to which IRR will be:

$$IRR = 100 \cdot \left(\sqrt[100]{\frac{78\,086\ \mathrm{PLN/ha}}{11\ 652\ \mathrm{PLN/ha}}} - 1 \right) = 1.92056\%$$

On the other hand, the net present value (NPV) for a pine tree of I site index, the rotation age of 100 years and an assumed inflation rate of p=2% will be:

$$NPV = \frac{78\,086\ \mathrm{PLN/ha}}{(1+0.02)^{100}} = 10\,779\ \mathrm{PLN/ha}$$

Example of internal rate of return (IRR) calculation for variant II (stand establishment costs cover a different period of time, depending on the valuation).

Pine tree, the rotation age of 100 years, I site index.

The value of the stand in m^3 of wood raw material:

$$Wk_{40} - 121.3\ m^3/ha,$$
$$Ws_{100} - 396.7\ m^3/ha.$$

Average current selling price of wood raw material (2020):

$$C - 196.84\ PLN/m^3.$$

Table 1.

Internal Rate of Return (IRR) and present value of costs (M_0) – variant I

IRR [%]	M_0 [PLN/ha]	M_{100} [PLN/ha]
1.91776	11 658	77 915
1.91832	11 657	77 949
1.91888	11 656	77 983
1.91944	11 654	78 018
1.92000	11 653	78 052
1.92056	**11 652**	**78 086**
1.92112	11 651	78 121
1.92168	11 649	78 155
1.92224	11 648	78 189
1.92280	11 647	78 224

Determination of the value of 1 ha of forest stand, with standing crop index Z=1, at the age of 40 years (M_{40}) and at the age of 100 years (M_{100}):

$$M_{40} = 121.3 \text{ m}^3\text{/ha} \cdot 166.84 \text{ PLN/m}^3 = 23\,877 \text{ PLN/ha},$$
$$M_{100} = 396.7 \text{ m}^3\text{/ha} \cdot 196.84 \text{ PLN/m}^3 = 78\,086 \text{ PLN/ha}.$$

Calculation, using the method of successive approximations, of the present value (brought at the time of crop establishment) of the cost of establishing and maintaining a stand of trees to the age of 40 years, *i.e.* the initial value (M_0) and the internal rate of return (IRR):

$$M_0 = \frac{23\,877 \text{ PLN/ha}}{(1+IRR)^{40}}$$

where IRR is also to meet the following condition:

$$78\,086 \text{ PLN/ha} = M_0 \cdot (1 + IRR)^{100}$$

Results of determining the internal rate of return (IRR) and present value of costs (M_0), by the method of successive approximations is shown in Table 2.

To check the above calculations, we use the formula 5, according to which IRR will be:

$$IRR = 100 \cdot \left(\sqrt[100]{\frac{78\,086 \text{ PLN/ha}}{10\ 837 \text{ PLN/ha}}} - 1 \right) = 1.99449\%$$

The data in Table 3 shows that the highest IRR is achieved by oak developed at the rotation age of 140 years. The average value in this case is 2.58%. This means that every 100 PLN of expenses incurred in establishing an oak stand yields 2.58 PLN of net income per year for the entire period of the oak rotation age. The value of the IRR for each species varies depending on the site index classes. Thus, in the case in question concerning oak, the IRR value varies from 2.28% in I site index, to 2.92% for IV site index. In general, it can be said that higher IRR values are obtained at relatively lower rotation ages. The content of all IRR values included in the table is characterized by the commentary presented above.

The economic content of the calculated IRRs in Table 4 is the same as for Table 3. It seems that the data of Table 4 (variant II) better reflects the economic reality. Worth noting is the high profitability of spruce (2.60%), fir (2.57%) and beech (2.52%).

An example of the calculation of NPV values is provided in Table 5. The calculations show that the updated value of all future income (brought at the time of stand establishment) varies depending on the species, site index classes and rotation age. The highest NPV values are recorded for coniferous species, especially spruce and fir.

Table 2.

Internal Rate of Return (IRR) and present value of costs (M_0) – variant II

IRR [%]	M_0 [PLN/ha]	M_{100} [PLN/ha]
1.99204	10 847	77 974
1.99253	10 845	77 997
1.99302	10 843	78 019
1.99351	10 841	78 042
1.99400	10 839	78 064
1.99449	**10 837**	**78 086**
1.99498	10 835	78 109
1.99547	10 833	78 132
1.99596	10 831	78 154
1.99645	10 829	78 177

Table 3.

Internal Rate of Return (IRR) according to species and site index classes (variant I)

Species	Rotation	Site index classes [%]				
		I	II	III	IV	On average*
Pine	100	1.92	1.99	1.91	1.86	1.85
	120	1.64	1.64	1.58	1.59	1.57
Spruce	100	2.40	2.39	2.35	2.14	2.19
	120	2.02	1.95	1.92	1.79	1.82
Fir	120	2.35	2.35	2.29	2.09	2.23
Oak	140	2.28	2.45	2.66	2.92	2.58
	160	1.98	2.16	2.33	2.59	2.27
Beech	120	1.85	1.96	1.70	1.51	1.64
Hornbeam	80	2.14	1.92	1.70	1.61	1.77
Birch	80	1.66	1.55	1.43	1.40	1.51

* The average also includes the site index classes Ia and V if they occur with species

Table 4.

Internal Rate of Return (IRR) according to species and site index classes (variant II)

Species	Rotation	Site index classes [%]				
		I	II	III	IV	On average*
Pine	100	1.99	2.06	2.05	2.12	2.00
	120	1.63	1.58	1.53	1.55	1.55
Spruce	100	2.69	2.75	2.82	2.69	2.60
	120	2.14	2.06	2.06	1.95	1.94
Fir	120	2.56	2.61	2.65	2.47	2.57
Oak	140	2.04	2.09	2.03	2.43	2.15
	160	1.69	1.76	1.60	1.92	1.74
Beech	120	2.45	2.74	2.45	2.52	2.52
Hornbeam	80	2.08	1.75	1.58	1.49	1.66
Birch	80	1.58	1.49	1.35	1.31	1.43

* The average also includes the site index classes Ia and V if they occur with species

Table 5.

Net present value (NPV) in [PLN/ha] according to site index classes with the assumed interest rate *p=2%*

Species	Rotation	Site index classes [%]			
		I	II	III	IV
Pine	100	10 779	8 689	6 771	5 160
	120	8 076	6 166	4 802	3 834
Spruce	100	20 753	16 601	12 324	8 309
	120	15 502	11 669	8 693	6 034
Fir	120	20 627	16 433	12 927	9 417
Oak	140	14 114	11 165	8 201	5 178
	160	9 895	8 234	5 918	3 977
Beech	120	12 554	10 497	7 093	4 579
Hornbeam	80	15 487	10 937	6 569	3 395
Birch	80	10 408	8 793	7 287	6 246

Discussion

The subject of the publication are problems that are a classic direction of cost-benefit analysis in forest management. Current scientific research directions in this field focus, firstly, on the problem of cost-benefit analysis in forest policy and environmental protection policy (Albers and Robinson, 2007; Burnett *et al.*, 2007). Secondly, they relate to the choice of the discount rate (Brukas *et al.*, 2001; Hepburn and Koundouri, 2007). According to Chudy *et al.*, (2020), key components affecting forestry investments are expected assets returns, portfolio diversification and inflation hedging. In the last forty years, not only small landowners but also institutional investors are interested in forest investments.

The paper presents the results of a study on the formation of the level of efficiency (profitability) of forest production of seven basic forest-forming species. Calculations were made using two economic criteria commonly applied in assessing investment efficiency, *i.e.*, the present value of future income (NPV) and the so-called internal rate of return (IRR). For each species, two variants were considered, characterized by a different way of determining the cost of establishing a stand.

The study (calculations) shows that the highest level of production efficiency measured by the NPV is shown by coniferous species, especially spruce and fir. However, in all the cases studied, the NPV varies not only with species, but also with site index classes and age of cutting. Higher values are obtained for lower age of cutting.

The results of the evaluation of the efficiency of standing timber production measured by IRR (internal rate of return) are different. In the case of variant I stands, oak stands have the highest IRR value. Indeed, the average IRR value in these stands reaches 2.58%, which exceeds the values of this index obtained for fir (2.23%) and spruce (2.19%) at rotation age. In the case of variant II, the highest IRR value is shown by spruce, fir and beech stands (within 2.50%). Attention is drawn to the high IRR value for oak stands, with 2.15% at a lower age of cutting amounting to 140 years.

Data available in the literature (Chudy *et al.*, 2020; Cubbage *et al.*, 2020) show that the IRR for forest investments ranges from 0.0% (Loblolly pine in the US) to 31.5% for eucalyptus in China. Data collected by Ying (Ying *et al.*, 2010) on the projected financial performance of plantation management for five species in Fujian shows that Chinese fir (rotation age 15) offers the lowest IRR (19.85%), but a respectable NPV value. In turn, the IRR for Masson pine (rotation 31 years) is 34.84%. In this case, the high NPV results from the large revenues generated due to thinning. In the Experimental Center of Tropical Forests – typical state-owned forest farm in South China – Masson pine achieves IRR 10% (Zhang, 2019). According to Siry *et al.* (2001), loblolly pine has an IRR of 9-12% in the US. Research conducted by Beljan *et al.* (2020) shows that multi-aged European beech forests have the highest internal rate of return (8.45%) and are the only one which would meet the expectations of a financially rational investor (multi-aged sessile oak forests – 6.92% and understocks European beech-fir forests – 7.17%). In turn, the lowest IRR value is characteristic for even-aged sessile oak forests (3.64%). Cubbage *et al.* (2020) reported that internal rates of returns for the slower growing species in northern Europe is about 3% to 7%, while Brukas and Weber (2009) reported that IRR for Scots pine in Scandinavia is 2.1%, in Germany 0,6% and in Latvia 3.8%. Whereas for Norway spruce in Scandinavia 3.5%, in Germany 2.7% and in Latvia 4.7%. According to Bis (2009), IRR in Poland for pine is around 3% for I site index and 2.6% for II (Lithuania 3.1%) and for spruce around 4.6% for I site index and 4.2% for II (Lithuania 3.5%).

The presented assessment of the profitability of standing timber production is limited to a financial analysis, which considers only revenues expressed and obtained in monetary units from timber sales. The account ignores the value of non-productive benefits and services derived from the forest. Their value in many cases can be many times higher than the revenue derived from timber production. However, the problem lies in valuing them in monetary units, which is a problem in itself.

Conclussions

The NPV provides a good guide for proceeding wherever alternative ways of using some fixed resource, such as a specific area of land, for example, are at stake, and the decision-maker is interested in finding the way that provides the highest income. The category in question provides a good basis for choosing among mutually exclusive ways of managing resources, if there are no constraints on other inputs such as those related to the cost of establishing a tree stand.

The main problem in calculating the IRR is the appropriate determination of the stand value.

The use of species with a higher IRR can improve sustainable forest management and the provision of ecosystem services.

Internal rate of return for specific economic projects poses many serious problems and can lead to misleading conclusions. It is only appropriate for economic intentions that require a one-time expenditure of inputs with subsequent receipt of income. In the case of some ventures, income is received quite early, which in turn entails additional costs later, which favors a higher discount rate more. In addition, calculations of the internal rate of return become extremely complicated when there are both income and losses associated with a given venture scattered irregularly over time.

The tested methodology showing specific results can and should be used in forest policy. The authors see its application in the forest management principles, in particular in the selection of the main forest tree species in more fertile habitats. The use can also be seen in the calculation of losses due to premature felling.

Authors' contributions

S.P. – conceptualization, methodology, the literature review, formal analysis, material collection, investigation, writing – original draft preparation; L.P. – conceptualization, methodology, investigation, manuscript review and editing.

Conflict of interest

The authors declare the absence of potential conflicts of interest.

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STRESZCZENIE

Ocena ekonomicznej efektywności produkcji drewna na pniu

Ocena działalności gospodarczej w leśnictwie, podobnie jak w innych dziedzinach aktywności produkcyjnej człowieka, wymaga kryteriów odzwierciedlających korzyści związane z możliwością różnego użycia posiadanych zasobów pracy, ziemi i innych środków produkcji oraz z różnymi relacjami uzyskiwanych korzyści do ponoszonych nakładów (Płotkowski 1996; Wrzosek 2008; Rogowski 2013; Płotkowski i in. 2016). Pierwszą czynnością dotyczącą oceny podejmowanych działań jest stwierdzenie, czy zamierzone przedsięwzięcie lub program gospodarczy są w ogóle korzystne z ekonomicznego punktu widzenia. Natomiast aby dokonać wyboru spośród rozpatrywanych przedsięwzięć, różnych pod względem stopnia ich użyteczności gospodarczej, potrzeba odpowiednich kryteriów. Ich rolę pełnią najczęściej 2 kategorie ekonomiczne: wartość bieżąca netto (NPV) oraz wewnętrzna stopa zwrotu z inwestycji (IRR) (Stasiak 1995; Płotkowski i in. 1996; Golej 2008; Yingi in. 2010; Rogowski 2013).

Celem niniejszej pracy jest stworzenie założeń metodycznych oceny ekonomicznej efektywności produkcji leśnej podstawowych gatunków lasotwórczych na różnych bonitacjach i ich praktyczna weryfikacja. Rolę kryterium oceny pełniły 2 kategorie ekonomiczne: NPV oraz IRR. Przebieg wyliczeń IRR przedstawia rycina 1. Badania objęły następujące gatunki (ryc. 2): So i Św przy kolei rębu 100 i 120 lat, Db przy kolei rębu 140 i 160 lat, Bk 120 lat, Gb 80 lat, Jd 120 lat i Brz 80 lat. Dodatkowo dla każdego gatunku rozpatrzono 2 warianty różniące się sposobem określenia kosztów założenia drzewostanu. W wariancie I wykorzystano wartość drzewostanu określoną według wyłożonych kosztów w wieku 20 lat, natomiast w wariancie II przyjęto różny wiek, w zależności od momentu pojawienia się grubizny. Przedstawiona ocena rentowności produkcji drewna na pniu ograniczyła się do analizy finansowej, która uwzględnia tylko przychody wyrażane i uzyskiwane w jednostkach pieniężnych ze sprzedaży drewna. Wartość 1 ha drzewostanu w poszczególnych latach została wyliczona jako iloczyn przeciętnej ceny sprzedaży surowca drzewnego w zł/m^3 oraz wskaźnika wartości drzewostanu (m^3/ha) na podstawie tablic opracowanych przez Instytut Badawczy Leśnictwa.

Przykład określenia IRR metodą kolejnych przybliżeń dla wariantu I przedstawia tabela 1, a dla wariantu II – tabela 2. Z przeprowadzonych badań wynika, że w przypadku IRR w wariancie I (tab. 3) najwyższą wartością charakteryzują się drzewostany dębowe przy kolei rębu 140 lat (przeciętnie 2,58%), jodła (2,23%) i świerk (2,19%). Natomiast w przypadku wariantu II (tab. 4) najwyższą wartość IRR wykazują drzewostany świerkowe (2,6%), jodłowe (2,57%) oraz bukowe (2,52%). Z kolei najwyższy poziom efektywności produkcji mierzony wartością NPV wykazują gatunki iglaste, w tym zwłaszcza świerk (8309 zł/ha) i jodła (9417 zł/ha) (tab. 5). We wszystkich badanych przypadkach wartość NPV zmienia się nie tylko w zależności od gatunku, ale również bonitacji oraz wieku rębności. Wyższe wartości uzyskuje się w przypadku niższych kolei rębu.