

Sustainable performance evaluation of forestry enterprises in the context of carbon neutrality

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Abstract. Highly polluting and energy-consuming enterprises are generally considered to be a key concern for achieving sustainability, but the sustainability of forestry enterprises is not to be underestimated. Enterprise development can only be considered stable if the economic, environmental and social development of the enterprise is addressed simultaneously. To properly and comprehensively evaluate the sustainable development of forestry enterprises, there should be a corresponding performance evaluation. Constructing a sustainable performance evaluation model for forestry enterprises can not only help enterprises to develop in a balanced way in the three dimensions of finance, environment and society, but also provide directions and suggestions for their future operations. In this paper, we construct a six-dimensional SBSC, combining the three methods of DEMATEL, ANP and VIKOR. The paper also evaluates the case of a specific forestry company, J, to identify the problems of the case company and to propose corresponding improvement measures for its sustainable development strategy in order to achieve the necessary level of expectations.

Keywords: Carbon Neutral; Forestry Business; Sustainable Performance; MCDM.

1. Introduction

As the concept of sustainable development continues to take hold, people are becoming aware of the importance of co-development between environmental protection, social development and economic growth. Forests cover 40% of the land surface and account for 90% and 70% of the biomass and primary productivity of terrestrial ecosystems respectively [1,2]. The rational use of forest resources is of great value for sustainable development. In the face of limited forest resources, a stable and effective sustainable development can be achieved by managing forestry activities and regulating the production experience of forestry enterprises [3,4]. From an economic point of view, the primary objective of the establishment of a business is economic profit, and this is also the case for forestry enterprises. One scholar investigated community-based natural resource enterprises (mainly ecotourism and NTFPs) and found that only seven out of 37 were profitable. According to other studies [5], better financial performance also means that there are surplus resources to invest in sustainability activities and initiatives. This means that an increase in the finances of forestry companies not only promotes further growth, but also provides better support for environmental protection and social responsibility, thus contributing to sustainable development. On the one hand, forestry companies can continue to develop traditional industries such as economic forestry and timber processing, as well as try to develop new industries such as bio-carbon sinks, relying on the "green mountains". On the other hand, forestry enterprises have long production cycles, high investment and operational risks, and the uncertainty of climate and environment can affect the production of forestry, thus affecting the operation and efficiency of forestry enterprises. From a social perspective, forestry enterprises should pay more attention to the value of forest resources to society and try to take more social responsibility while seeking economic benefits.

The evaluation of the sustainable performance of enterprises is mostly found in highly polluting enterprises such as electricity and pharmaceuticals. The public focus on polluting enterprises, trying to reduce pollution emissions and improve sustainability by 'cutting costs'. However, the ability of environmentally friendly enterprises such as forestry companies to 'cut back' on emissions has been overlooked. Furthermore, sustainable management of forestry is more often found in forests than in forestry companies. Sustainable forestry, which is often discussed at UN conferences on environment

and sustainability, is considered one of the most important focal points of sustainable development [6]. To ensure sustainable development, a management approach based on the principles of sustainability is needed. Implementing forest management into specific companies can better promote forest management and thus reduce the costs of conservation and use of forest resources. Currently, most of the tools used to evaluate the sustainable performance of forests are financial data, and financial indicators do not provide a comprehensive picture of the environmental and social aspects of the enterprise. Some scholars have calculated a net present value (NPV) based on a 30-year projected rotation and an 8% interest rate, adjusted to the specific management practices of natural forests in Mexico, to analyse the financial performance of forest management [7]. Other studies have examined forest area, tree species and inventories to assess market participation [8]. Therefore, incorporating non-financial indicators such as social and environmental aspects of forestry enterprises into manageable and constructing sustainable performance evaluation models can effectively facilitate more accurate decision-making with stakeholders. Sustainable performance evaluation models are mostly constructed using the Balanced Scorecard (BSC). However, during continuous development, it has been found that the SBSC, based on the triple bottom line and the BSC, better focuses on the environmental and social aspects of a company and is more suitable for use in sustainable performance evaluation studies of forestry companies. Given that the core of achieving sustainable development is to maintain a balance between the various dimensions, this requires all sectors to work together. Highly polluting and energy-intensive industries are inevitably the focus of attention in the process of achieving sustainable development. But the contribution of forestry companies to sustainable development cannot be underestimated. Forestry enterprises need to do a better job of fulfilling their social responsibilities and earn themselves a good reputation and reputation. At the same time, the carbon sinks of forestry enterprises can be sold as assets of the enterprise, which not only improve the environment but also bring more revenue to the enterprise. Therefore, if the three main dimensions of forestry enterprises - economic, environmental and social - can be evaluated in a reasonable manner, the sustainability of forestry enterprises can be effectively evaluated.

2. Literature Review

2.1 Sustainable performance evaluation of forestry enterprises

Early definitions of sustainable development published in the 18th century applied to forestry [9], and medieval sources already emphasised the importance of long-term forest use [10]. Eleven per cent of the world's forests are protected forests and four per cent are intensive timber producing forests, while the remaining 85 per cent are not, and the importance of focusing on these has not been emphasised [11]. This suggests that managing forest resources through forestry enterprises that give them economic value beyond their environmental value, while providing value to society at large, can contribute to the sustainable development of forests, as well as to the sustainable development of forestry enterprises. The security of forest conservation activities relies on the ability to protect the quality of the forest ecosystems operated by the enterprises [12]. Therefore, evaluating the sustainable performance of forestry enterprises can not only effectively safeguard the rational use of forest resources, but also promote better development and contribute more to society. Some people question that investing in environmental protection will increase the burden on enterprises and reduce their profitability. However, in the long run and from a sustainable perspective, investing in environmental protection can increase the visibility of the company and attract more customers, thus generating more revenue. The same can be said for active corporate social responsibility. Generally speaking, the evaluation of sustainable corporate performance should take into account all three aspects - financial, environmental and social - at the same time [13,14], as well as the linkages between these three aspects [15]. Compared to the BSC, the SBSC incorporates social and environmental influences into the study of enterprise development from a sustainable perspective [16], which can be more effective in evaluating enterprises. At present, there is no complete index system and model for evaluating

sustainable performance of forestry enterprises. Sustainable performance evaluation of forestry enterprises has become increasingly important, however, despite the recognition of the importance of measuring and assessing sustainability, and the positive trend of developing and implementing related methodologies. Research on issues related to the evaluation of sustainable performance in forestry enterprises is still relatively uncommon. Research on the sustainable development of forestry enterprises not only provides better assistance for the development of enterprises, but also contributes to the long-term goals of the country.

2.2 Sustainable Balanced Scorecard and its application

The Sustainable Balanced Scorecard (SBSC) is an evolution of the traditional Balanced Scorecard (BSC). Given that sustainability is a systematic concept [17], an assessment that considers only one or two categories of the triple bottom line is not sufficient for a comprehensive assessment of sustainability. The ordinary balanced scorecard no longer meets the requirements of corporate sustainability [18,19]. Therefore, some scholars have tried to develop some extended balanced scorecards based on theories related to the triple bottom line and social responsibility, and attempted to take into account the economic, social and environmental aspects to better assess enterprises. Some scholars have proposed adding a non-market perspective to the balanced scorecard, which includes environmental and social dimensions, to assess the sustainability of a company more comprehensively, and this approach is known as the Sustainable Balanced Scorecard (SBSC) [21-23]. the SBSC approach to sustainable performance evaluation model contains five dimensions: internal processes, environment/society, learning and growth, finance, and customers. the SBSC effectively overcomes the shortcomings of the traditional balanced scorecard which neglects the environmental and social dimensions. The triple bottom line requires a balance of trade-offs between environmental, economic and social components, as well as additional consideration of time frames and evaluator perspectives [24]. Some scholars have also looked at CSR to highlight the linkages between the three dimensions [25,26]. The three dimensions - economic sustainability, environmental sustainability and social sustainability - are interdependent and influence each other. For example, the issue of rational distribution of benefits and equitable access to resources remains a fundamental component of the economic and social aspects of sustainable development; rapid economic growth can lead to depletion of natural resources, pollution of water and atmosphere, abnormal climate change and loss of biodiversity in the transformation of natural resources that meet the basic needs of everyday life. SBSC as a multidimensional performance measurement and management control tool, it can address a range of management needs regarding corporate sustainability issues, i.e. assisting companies in the process of implementing sustainability strategies, facilitating sustainability management standards and decision-making, supporting regulatory data requirements, and meeting stakeholder information needs [26].

2.3 Review of the literature

Although there has been in-depth research on the sustainability of forests, and the performance evaluation of forestry enterprises. In October 2018, the UN Intergovernmental Panel on Climate Change (IPCC) called on countries to take action to limit warming to 1.5 degrees Celsius. On this basis, the future of forestry enterprises is full of opportunities: on the one hand, forestry enterprises are relatively carbon rich, and may even have a situation where their absorption exceeds their emissions. As a result, carbon sinks can be turned into a bio-asset providing more revenue for forestry companies. On the other hand, the company's commitment to social responsibility can bring reputation and credibility to the company. The way in which forests and human society interact with forests is linked to specific sustainable development goals [27]. Sustainable development in forestry enterprises not only brings long-lasting benefits to the enterprise, but also makes a significant contribution to society and the environment. By planting trees, forestry companies can effectively absorb carbon dioxide from the air, supporting the reduction of carbon emissions and contributing to the country's goal of 'carbon peaking' and 'carbon neutrality'. And as wood use continues to increase,

forestry companies are cutting down trees, which, if not considered sustainable, will eventually outstrip their income. Achieving sustainable development requires an economic, social and environmental approach, and these are the three areas that forestry companies need to focus on in their development.

In forestry, the idea of sustainable forest management (SFM) has been an adopted principle since the eighth century [28]. Initially the definition of sustainable forestry was presented with an emphasis on the sustainability of timber production only [29]. In the course of its continuous development, the SFM concept developed several levels of frameworks [30]. These frameworks consist of a number of criteria and indicators (C&I) that are necessary for management and evaluation [31]. C&I is the most scientific framework that can be used as a basis for policy decisions (Hall, 2001). However, there is currently no full international consensus on SFM and C&I, but rather a basic framework has been developed for reference in different countries and regions [30,32-35]. In terms of forestry enterprise performance evaluation, some scholars have studied and compared modern methods of evaluating company performance and concluded that there is a need for a multi-criteria indicator evaluation method [36]. Others have proposed a ratio model of economic development and environmental indicators using non-financial reporting data of enterprises [37]. [38] developed criteria for the conformity of forestry enterprise activities to strategic tasks and objectives, identifying environmental, economic and social sustainability. Sustainable performance evaluation models for forestry enterprises not only help the enterprises to develop better, but also contribute significantly to the rational use of forest resources and the protection of the environment.

3. An integrated sustainability performance assessment model for forestry enterprises under the carbon neutrality target

The traditional BSC does not reflect all dimensions of forestry enterprises, so this paper adds two dimensions, environmental and social, to build a six-dimensional framework for evaluating the sustainable performance of forestry enterprises. This paper uses a questionnaire survey to determine the secondary indicators for sustainable performance evaluation of forestry enterprises. Based on the previous literature and the analysis and screening of the importance of the influencing factors, it was finally determined that Company J constructs an indicator system for sustainable performance evaluation, as shown in Table 1.

Table 1. Constructing an indicator system for sustainable performance evaluation

Primary Indicators	Secondary indicators
Finance (C1)	Profit margin on sales (C11)
	Weighted average return on net assets (C12)
Customers (C2)	Customer satisfaction (C21)
	Customer relationship (C22)
Internal Processes (C3)	Rate of increase in R&D investment (C31)
	Resource utilisation (C32)
Learning and Growth (C4)	Employee Satisfaction (C41)
	Employee Training (C42)
Society (C5)	Effectiveness of precise poverty alleviation (C51)
	Rate of increase in forest product production (C52)
Environment (C6)	Rate of increase in forest area (C61)
	Rate of increase in timber harvesting (C62)

This paper uses a hybrid MCDM approach to evaluate the sustainable performance of forestry enterprises. The specific methods are as follows.

1. The specific steps of the DEMATEL method are as follows.
 - (1) Obtain an average score matrix based on expert scoring.

$$Z = \begin{Bmatrix} Z_{11} & \cdots & Z_{1j} & \cdots & Z_{1n} \\ \vdots & & \vdots & & \vdots \\ Z_{i1} & \cdots & Z_{ij} & \cdots & Z_{in} \\ \vdots & & \vdots & & \vdots \\ Z_{ni} & \cdots & Z_{nj} & \cdots & Z_{nn} \end{Bmatrix}$$

(2) The direct impact matrix $D = Z / Z_{\max}$

(3) The total impact relationship matrix T is the sum of the terms resulting in. $T = \{t_{ij}\}$

2. The specific steps of ANP are as follows.

(1) Normalize the full impact matrix

(2) Weighted supermatrix

3 VIKOR method implementation steps are as follows.

(1) Set the scoring criteria to 1-10, and set "10" as the desired value.

(2) Find the best value S and the worst value R, and calculate the composite index Q.

(3) Arrange all the data in ascending order by Q, S and R. Q indicates the difference between the actual value and the ideal value.

The specific process is as follows.

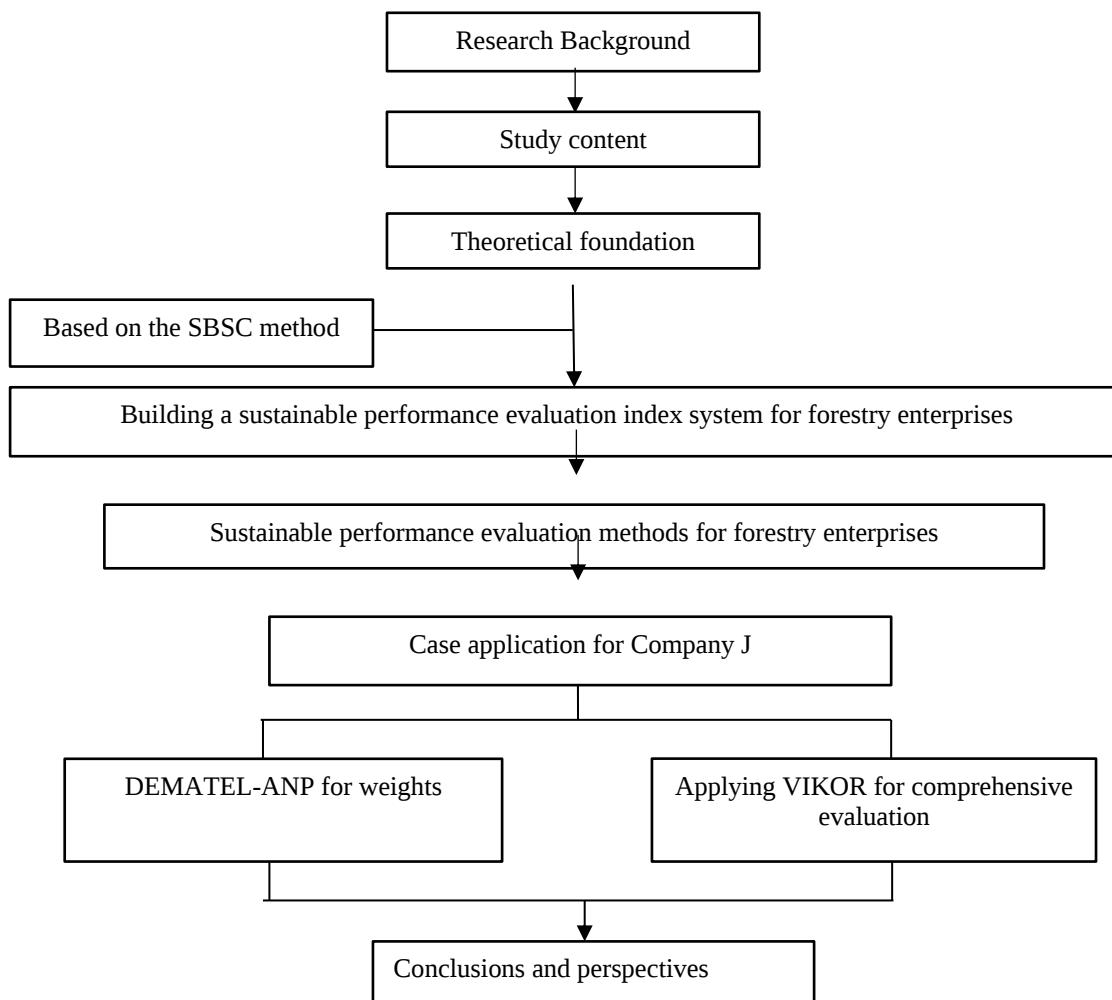


Figure 1. Research flow chart

4. A case study of sustainable development performance of a Chinese forestry company

4.1 A brief description of J Forestry Enterprises

J Forestry Enterprise is a leading enterprise in Yunnan Province in forestry industrialisation, agricultural industrialisation and national key poverty alleviation. 2020, the company's business is mainly divided into two parts, one is forestry plantation business: the company continues to promote forestry plantation management and care work, and promotes forest economic plantation and agricultural plantation related business research; the second is forest products processing: mainly produces products such as artificial boards, rosin, as well as finished oil and chemical fuels, which are produced by The forestry industry in which the J forestry enterprises operate has a wide range of businesses and products, and is an important part of the national economy, playing an important role in maintaining national ecological security, promoting employment for farmers, boosting their incomes and prospering the rural economy.

4.2 Analysis of sustainable performance evaluation of J forestry enterprises based on a hybrid MCDM approach

The mean score matrix, the direct impact matrix, and the total relationship impact matrix were obtained in turn through the questionnaire and the DEMATEL method. The final relationships between the dimensions and the degree of influence of the indicators were obtained, as shown in Table 2.

Table 2. Relationship between dimensions and the degree of influence of indicators

Indicator	Degree of Influence	Influencedness	Centrality	Degree of cause	Ranking
Finance (C1)	4.604	4.476	9.080	0.129	
Profit margin on sales (C11)	1.557	1.585	3.142	-0.027	2
Weighted average return on net assets (C12)	1.534	1.507	3.041	0.027	1
Customers (C2)	4.171	4.212	8.383	-0.041	
Customer satisfaction (C21)	1.318	1.301	2.619	0.017	1
Customer relationship (C22)	1.296	1.313	2.609	-0.017	2
Internal Processes (C3)	4.149	4.327	8.476	-0.179	
Rate of increase in R&D investment (C31)	1.447	1.344	2.791	0.103	1
Resource utilisation (C32)	1.249	1.352	2.601	-0.103	2
Learning and Growth (C4)	4.290	4.075	8.365	0.216	
Employee Satisfaction (C41)	1.315	1.209	2.524	0.106	1
Employee Training (C42)	1.301	1.406	2.707	-0.106	2
Society (C5)	4.568	4.343	8.911	0.225	
Effectiveness of precise poverty alleviation (C51)	1.429	1.478	2.907	-0.049	2
Rate of increase in forest product production (C52)	1.516	1.467	2.983	0.049	1
Environment (C6)	3.825	4.174	7.999	-0.349	
Rate of increase in forest area (C61)	1.152	1.206	2.357	-0.054	1
Rate of increase in timber harvesting (C62)	1.282	1.228	2.510	0.054	2

Combining the DEMATEL and ANP methods gives the DANP impact weights for each criterion (Table 3).

Table 3. DANP impact weights for each criterion

Indicator	C11	C12	C21	C22	C31	C32	C41	C42	C51	C52	C61	C62
	0.023	0.021	0.021	0.021	0.021	0.021	0.019	0.021	0.021	0.021	0.020	0.021

Data based on the weighting of each indicator in each dimension and the corresponding questionnaire. The final performance evaluation based on the VIKOR method was obtained. This is shown in Table 4.

Table 4. Performance evaluation based on the VIKOR method

			Overall	
	Local weights	Overall weighting	Performance Score	Gap value
Finance (C1)	0.175		5.934	0.407
Profit margin on sales (C11)	0.517	0.023	7.174	0.283
Weighted average return on net assets (C12)	0.483	0.021	4.609	0.539
Customers (C2)	0.165		5.296	0.470
Customer satisfaction (C21)	0.498	0.021	7.087	0.291
Customer relationship (C22)	0.502	0.021	3.522	0.648
Internal Processes (C3)	0.169		8.756	0.124
Rate of increase in R&D investment (C31)	0.498	0.021	9.957	0.004
Resource utilisation (C32)	0.502	0.021	7.565	0.243
Learning and Growth (C4)	0.159		6.611	0.339
Employee Satisfaction (C41)	0.466	0.019	7.261	0.274
Employee Training (C42)	0.534	0.021	6.043	0.396
Society (C5)	0.170		6.151	0.385
Effectiveness of precise poverty alleviation (C51)	0.502	0.021	5.826	0.417
Rate of increase in forest product production (C52)	0.498	0.021	6.478	0.352
Environment (C6)	0.163		7.135	0.286
Rate of increase in forest area (C61)	0.495	0.020	8.696	0.130
Rate of increase in timber harvesting (C62)	0.505	0.021	5.609	0.439
Overall Performance Score			6.646	
Overall Gap Value				0.335

4.3 Analysis and discussion

Based on the above data and, it can be learned that Company J should focus on customer relations (C22: 0.648), weighted average return on net assets (C12: 0.539) and the rate of increase in timber harvesting (C62: 0.439) if it wants to achieve sustainable growth. The paper makes the following recommendations.

The first is to improve customer relations. The object of a company's service is its customers, and optimising customer relations can help the company to better understand market trends and improve its effectiveness, thus promoting environmental protection and social responsibility. Reaching the goal of sustainable corporate development. Secondly, the weighted average return on net assets

should not be underestimated as well. The weighted average return on net assets emphasises the results of profit earned from net assets during the operating period, which helps the relevant stakeholders of the company to make a correct judgment of the company's future profitability. Enhances the company's ability to generate profits per unit of net assets and increase efficiency. Higher returns with less investment. Finally, attention needs to be paid to the rate of increase in timber harvesting. Given the enormous role of forests for the environment and society, companies should increase the planting of trees in the process of cutting down trees for production at the same time, while trying to improve production technology and reduce waste in the process of timber production and processing, which in turn will help to mitigate the increasing rate of timber harvesting.

5. Conclusion and outlook

This paper provides some contribution to the literature on performance evaluation of forestry enterprises. Sustainable performance evaluation of forestry enterprises is always neglected and there is little previous research in the literature. This paper combines DEMATEL with ANP and VIKOR to assess the sustainability performance of forestry enterprises. The network of influences between sustainability performance criteria of forestry enterprises can be illustrated, and key factors of sustainability performance of forestry enterprises and their weights are proposed. It makes the results of sustainable performance evaluation of forestry enterprises more accurate and realistic.

Of course, there are some limitations in this paper. Firstly, the indicators must be constantly updated and optimised in the process of enterprise development and research. Also, the data obtained by the questionnaire is somewhat subjective, which may make the results biased. Finally, the case enterprises do not represent all forestry enterprises with certain specificity, so research and generalisation can be carried out according to different types of forestry enterprises to promote a more practical model.

Acknowledgements

This work was supported by the Postgraduate Research & Practice Innovation Program of Jiangsu Province [SJCX21_0156]. And the paper is primarily based on research at Nanjing University of Technology. Thanks to the many teachers who provided valuable comments and feedback on earlier versions of this paper, and to the anonymous reviewers for their helpful comments.

References

- [1] Korner, C., Asshoff R., Bignucolo O., Hättenschwiler S., Keel S.G., Perláez-Riedl S., Pepin S., Siegwolf R.T.W., Zotz G. 2005. Carbon flux and growth in mature deciduous forest trees exposed to elevated CO₂. *Science* 309, 1360-1362.
- [2] Nemani, R.R., Keeling C.D., Hashimoto H., Jolly W.M., Piper S.C., Tucker C.J., Myneni R.B., Running S.W. 2003. Climate driven increases in global terrestrial net primary production from 1982 to 1999. *Science* 300,1560-1563.
- [3] MARINELLI A., CASINI L. Aspects of the turkey oak management in Italy. In *Prospettive di valorizzazione delle cerrete dell'Italia Centro Meridionale*, Regione Basilicata, 1989 [In Italian].
- [4] KUvAN Y., EROL S.Y., YILDIRIM H.T. Forest Managers' Perception of the Foremost Forestry Issues, Problems and Forest Functions in Turkey. *Polish Journal of Environmental Studies* 20 (2), 393, 2010.
- [5] WADDOCK S.A., GRAVES S.B. The corporate social performance-financial performance link. *Strategic Management Journal*, 18 (4), 303, 1997.
- [6] Atmiş, E., & Çil, A. (2013). Sustainable Forestry in Turkey. *Journal of Sustainable Forestry*, 32(4), 354–364. <https://doi.org/10.1080/10549811.2013.767210>
- [7] Cubbage, F., Davis, R. R., Frey, G. E., & Chandrasekharan Behr, D. (2013a). Financial and economic evaluation guidelines for community forestry projects in Latin America. Washington, DC: Program on Forests (PROFOR). Retrieved from

http://www.profor.info/sites/profor.info/files/docs/Financial%20and%20Economic%20Evaluation%20Guidelines%20for%20Community%20Forestry%20Projects%20in%20Latin%20America_0.pdf

- [8] Forster, R. A., Guemes-Ricalde, F. J. F., & Zapata, J. L. (2014). Market insertion of forest communities in southeastern Mexico: The relevance of forest endowment and organization. Retrieved from <http://eujournal.org/index.php/esj/article/viewFile/4824/4527>
- [9] Carlowitz, H.C. von Sylvicultura Oeconomica. In Sylvicultura Oeconomica; Anweisung zur wilden Baum-Zucht: Leipzig, Germany, 1732; ISBN 9783941300569.
- [10] Günther, E. Ökologieorientiertes Management: Um-(weltorientiert) Denken in der BWL; UTB GmbH: Stuttgart, Germany, 2008; ISBN 9783825283834. (In Deutsch)
- [11] Lindenmayer, D.B.; Franklin, J.F.; Löhmy, A.; Baker, S.C.; Bauhus, J.; Beese, W.; Brodie, A.; Kiehl, B.; Kouki, J.; Pastur, G.M.; et al. A major shift to the retention approach for forestry can help resolve some global forest sustainability issues. *Conserv. Lett.* 2012, 5, 421–431. [CrossRef]
- [12] Cherchyk L. 2016. Konceptual`ni osnovy` formuvannya sy`stemy` socioekologoekonomichnoyi bezpeky [Conceptual basis for the formation system of Socioecological and economic security], *Economic Forum*, 2, 167-175. http://nbuv.gov.ua/UJRN/ecfor_2016_2_27
- [13] Cagno, E., Neri, A., Howard, M., Brenna, G., Trianni, A., 2019. Industrial sustainability performance measurement systems: a novel framework. *J. Clean. Prod.* 230, 1354–1375. doi:10.1016/j.jclepro.2019.05.021.
- [14] Cagno, E., Neri, A., Trianni, A., 2018. Broadening to sustainability the perspective of industrial decision-makers on the energy efficiency measures adoption: some empirical evidence. *Energy Effic* 11, 1193–1210. doi:10.1007/s12053-018-9621-0.
- [15] Gualandris, J., Klassen, R.D., Vachon, S., Kalchschmidt, M., 2015. Sustainable evaluation and verification in supply chains: aligning and leveraging accountability to stakeholders. *J. Oper. Manag.* 38, 1–13. doi:10.1016/j.jom.2015.06.002.
- [16] Rabbani, A., Zamani, M., Yazdani-Chamzini, A., & Zavadskas E., K. Proposing a new integrated model based on sustainability balanced scorecard (SBSC) and MCDM approaches by using linguistic variables for the performance evaluation of oil producing companies[J]. *Expert Systems With Applications*, 2014, 41(16).
- [17] Von Wirén-Lehr, S. Sustainability in agriculture—an evaluation of principal goal-oriented concepts to close the gap between theory and practice. *Agr. Ecosyst. Environ.* 2001, 84, 115–129.
- [18] Horváth & Partners . *Balanced Scorecard v praxi*. Praha: Profess Consulting, 2002, xiv, 386 s. ISBN 80-725-9018-9.40, 103e108. <https://doi.org/10.1016/j.procir.2016.01.067>.
- [19] Kožená, M., Štříteská, M., Svoboda, O. Dynamic Balanced Scorecard: model for Sustainable Regional Development. In: *WSEAS TRANSACTIONS on ENVIRONMENT and DEVELOPMEN*. Volume 7, 2011, p. 211-221, ISSN 17905079.
- [20] Figge, F., Hahn, T., Schaltegger, S., & Wagner, M. (2002a). The sustainability balanced scorecard—Linking sustainability management to business strategy. *Business Strategy and the Environment*, 11(5), 269–284.
- [21] Figge, F., Hahn, T., Schaltegger, S., & Wagner, M. The sustainability balanced scorecard—A tool for value-oriented sustainability management in strategy focused organisations. [J]. *ERP environment: Shipley*, 2001, 83-90.
- [22] Figge, F., Hahn, T., Schaltegger, S., & Wagner, M. The sustainability balanced scorecard lining sustainability management to business strategy[J]. *Bus. Strategy Environ*, 2002, 11:269-284.
- [23] Santiago-Brown, I.; Jerram, C.; Metcalfe, A.; Collins, C. What does sustainability mean? Knowledge gleaned from applying mixed methods research to wine grape growing. *J. Mixed Methods Res.* 2014, doi:10.1177/1558689814534919.
- [24] Schaltegger, S., & Burritt, R. L. (2005). Corporate Sustainability. In H. Folmer & T. Tietenberg (Eds.), *The international yearbook of environmental and resource economics 2005/2006: A Survey of Current Issues* (pp. 185–222). Cheltenham, UK: Edward Elgar.

- [25] Schaltegger, S., & Burritt, R. L. (2005). Corporate Sustainability. In H. Folmer & T. Tietenberg (Eds.), *The international yearbook of environmental and resource economics 2005/2006: A Survey of Current Issues* (pp. 185–222). Cheltenham, UK: Edward Elgar.
- [26] Katila, P.; de Jong, W.; Galloway, G.; Pokorny, B.; Pacheco, P. *Harnessing Community and Smallholder Forestry for Sustainable Development Goals*; IUFRO-WFSE: Helsinki, Finland, 2017.
- [27] Wiersum, K. F. (1995). 200 years of sustainability in forestry: Lessons from history. *Environmental Management*, 19(3), 321–329.
- [28] Santos, A., Carvalho, A., Barbosa-Póvoa, A. P., Marques, A., & Amorim, P. (2019b). Assessment and optimization of sustainable forest wood supply chains – a systematic literature review. *Forest Policy and Economics*, 105, 112–135. <https://doi.org/10.1016/j.forpol.2019.05.026>
- [29] Jafari, A., Sadeghi Kaji, H., Azadi, H., Gebrehiwot, K., Aghamir, F., and Van Passel, S. (2018). Assessing the sustainability of community forest management: A case study from Iran, *Forest Policy and Economics*, 96(July 2017), 1–8. <https://doi.org/10.1016/j.forpol.2018.08.001>
- [30] Martín-Fernández, S., & Martínez-Falero, E. (2018). Sustainability assessment in forest management based on individual preferences. *Journal of Environmental Management*, 206, 482–489. <https://doi.org/10.1016/j.jenvman.2017.10.057>
- [31] Mohammadi, Z., & Limaie, S. (2018). Multiple criteria decision- making approaches for forest sustainability (case study: Iranian caspian forests). *Forest Research*, 07(01), 1–7. <https://doi.org/10.4172/2168-9776.1000215>
- [32] Mohammadi, Z., & Limaie, S. (2018). Multiple criteria decision- making approaches for forest sustainability (case study: Iranian caspian forests). *Forest Research*, 07(01), 1–7. <https://doi.org/10.4172/2168-9776.1000215>
- [33] Ness, E., Piirsalu, U., Anderberg, S., & Olsson, L. (2007). Categorising tools for sustainability assessment. *Ecological Economics*, 60(3), 498–508.
- [34] Reynolds, K. M., Thomson, A. J., Köhl, M., Shannon, M. A., Ray, D., & Rennolls, K. (2007). *Sustainable forestry from monitoring and modelling to knowledge management & policy science* (p. 527). CAB International.
- [35] Hilkevics, S., Semakina, V. 2019. The classification and comparison of business ratios analysis methods. *Insights into Regional Development*, 1(1), 48-57. [http://doi.org/10.9770/IRD.2019.1.1\(4\)](http://doi.org/10.9770/IRD.2019.1.1(4))
- [36] Bogdanov, V., Ilysheva N., Baldesku E., Zakirov U. 2016. A model of the correlation between economic development and environmental performance based on the company's non-financial reporting data, *The Economy of the Region*, 12(1), 93-104. <https://doi.org/10.17059/2016-1-7>
- [37] Artyushok, V. S. 2012. Kryteri y vidpovidnosti diyal'nosti lisogospodars'ky'x pidpry'yemstv strategichnij cili v umovax stalogo rozvy'tku [Criteria forestry enterprises of strategic objectives in terms of sustainable development], *Scientific Proceedings of the National University «Ostroh Academy»: Economy*. 19, 95-98. http://nbuv.gov.ua/UJRN/Nznuoa_2012_19_22.