Agronomy Research **17**(3), 771–782, 2019
https://doi.org/10.15159/AR.19.131

Bioenergy in agricultural companies: financial performance assessment

M. Nurmet[1,2,*], M. Mõtte[1], K. Lemsalu[1] and J. Lehtsaar[1]

[1]Estonian University of Life Sciences, Institute of Economics and Social Sciences, F. R. Kreutzwald street 1, EE51006 Tartu, Estonia
[2]University of Tartu, Faculty of Economics, Department of Accounting and Finance, J. Liiv street 4, EE50409 Tartu, Estonia
[*]Correspondence: maire.nurmet@emu.ee

Abstract. The target of increasing the use of renewable energy in rural areas has initiated the investments in bioenergy. The purpose of this paper is to assess the financial performance of Estonian agricultural companies that have invested in bioenergy solutions. An investment in bioenergy is attractive to the company if the results obtained by it enable benefits to the investors. In the context of the study of financial performance of agricultural companies that have undertaken bioenergy investments, the key performance indicators based on DuPont identity are analysed from the perspective of formulating and implementing a company's financial decisions. The data of financial statements of the analysed companies are from Estonian Agricultural Registers and Information Board (ARIB) and Commercial Register. The study reports the financial performance results of Estonian agricultural companies using renewable resources and producing bioenergy: whether they achieved higher efficiency and profitability or change in financial structure. The Estonian agricultural companies that have invested in bioenergy solutions may need to control their financial performance by improving profitability and controlling financial leverage.

Key words: agricultural companies' performance, bioenergy investment, DuPont identity, renewable energy.

INTRODUCTION

Bioenergy investments to agricultural companies contribute to the renewable energy target, objectives of rural development and Europe 2020 strategy for smart, sustainable and inclusive growth. The EU Renewable Energy Directive (2009/28/EC) requires Member States to develop plans to achieve the renewable energy target (Renewable Energy Directive (2009/28/EC). The National Renewable Energy Action Plan show a large commitment to biomass. The input of biomass in the EU planned by the Member States for 2020 bases mainly on wood and crops. National Development Plan of the Energy Sector until 2030 states that by 2030 the share of renewable energy accounts for 50% of final consumption of domestic electricity and 80% of the heat generated in Estonia (National Development Plan of the Energy Sector until 2030, 2017).

Wind and biomass are the most important resources of renewables in Estonia (Republic of Estonia, 2017).

According to the EU regulation No 1305/2013 Article 5 on support for rural development by the European Agricultural Fund for Rural Development defines the EU priorities for rural development. The objectives of rural development, which contribute to the Europe 2020 strategy for smart, sustainable and inclusive growth, will be achievable through the priorities for rural development. These priorities reflect the relevant thematic objectives: promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors. The focus is on efficiency in water use in agriculture; efficiency in energy use in agriculture and food processing; the supply and use of renewable sources of energy, by-products, wastes and residues and of other non-food raw material for the purposes of the bio-economy. The tasks include reducing greenhouse gases and ammonia emissions from agriculture and fostering carbon conservation and sequestration in agriculture and forestry (Regulation (EU) No 1305/2013).

The increasing efficiency of energy use in agriculture and food processing is achievable by promoting bioenergy investments in agricultural companies. Agricultural companies in Estonia have the supported possibility to invest in biomass production equipment, and bioenergy production facilities. A major part of the investments was financed according to The Estonian Rural Development Plan (ERDP) 2007—2013 Measure 3.1.3. – Investments into the production of bioenergy national resources (Estonian Rural Development Plan 2007–2013. 2008). Bioenergy investments are mostly capital-intensive, but implementation of these sustainable environmental investments in company level facilitates the supply and use of renewable sources of energy for the purposes of the bio-economy and will lead agricultural companies to greater social benefits and increased efficiency to in the longer period. The question by incorporating sustainable bio-based solutions in company level is whether it improves its financial performance.

The relationship between responsible behaviour of companies, environmental responsibility and financial performance has been widely debated subject in recent years. The environmental responsibility improves reputation and corporate image in the long run and will influence financial performance. (Adams, 2002; Oh et al., 2017). Bioenergy investments pursue environmental objectives in addition to profitability.

The financial performance of agricultural companies, which have invested in bioenergy solutions, is under the consideration in this paper. The purpose is to find out what change has occurred in the efficiency, the profitability, and the financial structure of Estonian agricultural companies that have invested in biomass production equipment, and bioenergy production facilities in 2009–2015, having used financing from the ERDP 2007–2013 Measure 3.1.3. The financial ratios are a valuable tool in understanding financial performance. The DuPont analysis is used to determine how the key performance indicators have changed after the implementation of bioenergy investments. According to the model, financial profitability ratio is decomposed into three separate components: efficiency, profitability, and leverage ratios (Grashuis, 2018).

The motivation for examining the financial performance of agricultural companies that have invested in biomass production equipment and bioenergy production facilities arise from the fact that the economic performance of agricultural companies, which contribute to achievement of the goals of EU to the renewable energy have not been systematically examined in Estonia. Several international studies have examined problems close to overall performance of agricultural companies (Ahrendsen & Katchova, 2012; Zorn et al., 2018), effect of corporate social responsibility on financial performance (Lassala et al., 2017), financial issues of bioenergy production (Hall & Howe, 2012; Bikar et al., 2018), whether the adoption of sustainable energy systems improves corporate financial performance and efficiency (Abulfotuh, 2007; Martí-Ballester, 2017).

As such, the agricultural companies that have invested in biomass production equipment and bioenergy production facilities have impact leading to greater environmental stability. Financially well-performed companies that are environmentally responsible should have a possibility at least to maintain their current competitive position. Even though being capital-intensive, bioenergy investments should enable agricultural companies through the increased financial performance to increment financial resources in the long run.

MATERIALS AND METHODS

The bioenergy investments, financing decisions and profitability: literature review

Bioenergy investments have increased due to new investment support policy in the EU. Bioenergy production as a part of bio-based business is a commercial activity that uses renewable biological resources and technologies to replace fossil fuels (Schmidt et al., 2012). The option to develop a sustainable bio-based economy is with the support the development of technologies, facilities and infrastructure for the biomass production. Bioenergy usage helps to improve agricultural productivity, reduce losses in agriculture and food wastage. Bioenergy production technology enables to use the remaining agricultural residues and refuses for energy purposes, and leads technically and economically to the use of all parts of the crop.

Bioenergy as a renewable energy option has been progressive as a promising option well suited to the food supply chain given the biological nature of its products (Hall & Howe, 2012; Jensen & Govindan 2014). Bioenergy production using biomass converting technologies may use various types of biomass: agricultural residues, forest residues, bio-energy crops on degraded land, especially perennial crops, aquatic biomass. Bioenergy is obtainable by combusting solid, liquid or gas fuels made from biomass, which may or may not have undergone some form of conversion process (Fig. 1). The technologies used for converting biomass to biofuels and bioenergy, especially biomass production equipment and bioenergy production facilities, are developing rapidly.

The cost of biomass is the most important cost element of all forms of bioenergy use. In order to remain competitive in energy markets, the food and agricultural prices cannot rise faster than energy prices for agriculture. Barring massive subsidies for bioenergy, the need to maintain competitiveness should create an endogenous brake on food prices (Schmidhuber, 2006). The fluctuations in biomass and fuel prices complicate the financial evaluation of the implementation of bioenergy technology for using biomass resources to substitute fossil fuels (Jensen & Govindan, 2014). Financial and environmental assessment of bioenergy application has indicated that it is possible to realize financial benefits in terms of additional profits and cost savings, but that challenging conditions can be problematic from a company perspective and provide challenges for the promotion of bioenergy investments. (Jensen & Govindan 2014). The analyses of whether the adoption of sustainable energy systems, which use renewable energy sources, improves corporate financial performance have shown that the adoption of sustainable energy systems help to improve short-term corporate financial performance (return on assets) due to the level of implementation of sustainable energy management system (Marti-Ballester, 2017).

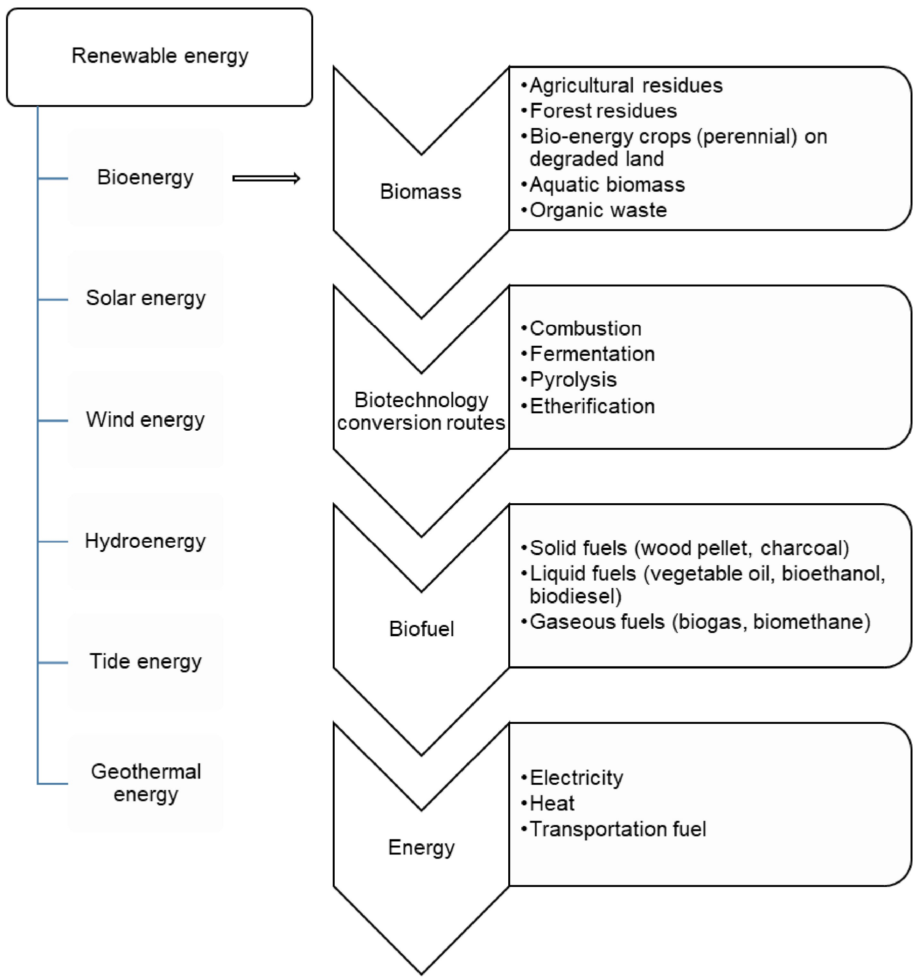

Figure 1. Bioenergy production process.
Source: Authors' compilation.

Financial issues act as both drivers and barriers in bioenergy production. They include high initial capital costs, available arrangements to buying and selling energy to a national grid, fluctuations in fuel prices (Hall & Howe, 2012). In spite of financial barriers, it has been found, that those heating companies which used renewable resources, performed remarkably better (Bikar et al., 2018). The use of renewable technologies may increase profits in the long and short-term (Hart & Ahuja, 1996). Also, the integration of sustainable energy strategies and systems may facilitate the improvement of financial performance (Lopez-Gamero et al 2009; Endrikat et.al, 2014), more precisely increasing the profitability in the long term (Schaumann, 2007).

Investments in bioenergy technology enable to realize financial benefits in terms of additional profits and cost savings, but require significant capital expenditures. Depending on current financial structure, these investments involve a significant amount of debt financing. Therefore, it is necessary to evaluate the relationship between financing decisions, and profitability in order to control the financial performance of the agricultural company.

Data and method of analysis

This analysis bases on the financial statement information of all Estonian agricultural companies, which have invested in biomass production equipment or bioenergy production facilities in 2009–2015, having used financing from the ERDP 2007–2013 Measure 3.1.3. These were micro-entrepreneurs, engaged in agricultural production, which employed at least 10 people and which sales revenue and/or total annual assets did not exceed 2 million euros. According to the measure the objective of the investment was the diversification of the activities of agricultural company with non-agricultural production; the production of biomass, biofuels, bio-electricity and bio-heat from biomass. Altogether, there were 123 farms in Estonia which made supported investments in biomass production equipment or bioenergy production facilities. Of these, 49 were agricultural sole proprietors and 74 agricultural companies.

The data of financial statements of the analysed companies were obtained from Estonian Agricultural Registers and Information Board (ARIB) and Estonian Commercial Register. The financial statements of agricultural sole proprietors are not included in the database of Estonian Commercial Register. The final sample consists of 74 agricultural companies. Of these 34 have invested in biomass production equipment, and 38 in bioenergy production facilities. 2 companies were invested both in biomass production equipment, and bioenergy production facilities. The types of investment objects were determined according to the information obtained from ARIB. The scope scale of biomass investments was calculated according to the type of investment by year.

The information found in companies' financial reports was the starting point of the analysis, providing information and data about their financial position and performance, including profitability. The observations exist every year. The steps that followed in analysis according to the set purpose and context of the analysis included collection of input data; processing of data, and interpretation of the processed data; development and communication of conclusions and recommendations. Carrying out descriptive statistics, companies' financial performance and trends in that performance were examined. Major considerations in analysis was the ability to maintain sufficient profitability after the implementation of the investments. The financial ratios for the agricultural companies for each pre-and post- investment year were calculated. The guide used in assessment of the financial performance of Estonian agricultural companies that have invested in biomass production equipment, and bioenergy production facilities was DuPont identity. DuPont analysis, a common technique that bases on the interrelationships between performance measures, is commonly used in the context of agricultural finance to analyse the components and linkages of a business (Escalante et al., 2009; Mishra et al., 2012). Financial performance is measurable by financial ratios, typically the ratio of return on equity in quantitative assessments of the financial performance at the company level. The ratios are inter-related and treatable as a system, and assessment of a company's efficiency, profitability, and leverage in combination provides a concrete information about financial performance for decision-makers in agriculture (Isberg, 1998; Latruffe et al., 2016).

DuPont identity decomposes the ratio of return on equity on three separate components: the net profit margin ratio, the asset turnover ratio, and the equity multiplier ratio. The formula is:

$$ROE = \frac{NI}{S} \cdot \frac{S}{A} \cdot \frac{A}{E} \quad (1)$$

where NI – net profit; S – sales revenue; A – total assets; E – equity. Specifically, the three indicators are NI/S – net profit margin ratio, S/A – asset turnover ratio, and A/E – equity multiplier. Financial performance analysis of the agricultural companies in pre- and post- investment years included these components as it enables to assess the financial situation of a company in detail. The data allows the analysis of a time series of diverse agricultural companies, but due to the small number of agricultural companies, the regression analysis cannot be performed. Since the data is not normally distributed, the non-parametric testing for comparison of the average indicators of the two differently financially structured groups is added. The comparison of different companies was done by using financial ratios instead of absolute values.

RESULTS AND DISCUSSION

The results of the study indicate that the bioenergy investments of Estonian agricultural companies, which were intended to facilitate the supply and use of renewable sources of energy were diverse. The equipment for biomass production included wood chips devices, biomass loaders, collectors of scrub and logging waste, woodpecker machines, logging waste loaders, energy brush harvesters. The bioenergy production facilities' investments included various types of heaters, biogas pipelines, boiler house heat pipes, mobile dry ovens, wood based bioenergy chimneys, renovation of bioenergy production complex, boiler plant equipment, biogas sediment pools, pellet stoves, wood chip warehouses, biomass storages etc. More than 73% of the bioenergy investments, in total amount of 21,911,187 euros, were made by agricultural companies (Table 1).

Table 1. Number and amount of investments of Estonian agricultural companies that were supported from the ERDP 2007–2013 Measure 3.1.3. – Investments into the production of bioenergy national resources (2009–2015)

	Total agricultural entities supported (number)	Total investment amount (€)	Agricultural companies supported (number)	Investment amount of the ag. companies (€)
Biomass production equipment	49	12,293,627	35	11,018,442
Bioenergy production facilities	74	17,404,798	39	10,892,745
TOTAL	**123**	**29,698,425**	**74**	**21,911,187**

Source: Authors' calculations.

During the period of 2009–2015 nearly 22 million of these investments, measured in euros, were made either in biomass production equipment or bioenergy production facilities. Half of the investments, i.e. more than 11 million euros, were allocated in biomass production equipment, and another half in bioenergy production facilities. Most of the investments were completed between 2013 and 2015 as can be seen from Table 2.

Table 2. The number of agricultural companies and amount in euros invested in biomass production equipment or bioenergy production facilities (2009–2015)

Year	Biomass production equipment		Bioenergy production facilities	
	Agricultural companies (number)	Investment amount (€)	Agricultural companies (number)	Investment amount (€)
2009	3	298,744	4	301,861
2010	3	679,796	0	-
2011	4	1,487,983	0	-
2012	5	1,823,026	5	898,762
2013	6	1,355,814	10	2,926,964
2014	10	3,906,051	7	814,888
2015	4	1,467,029	13	5,950,270
TOTAL	**35**	**11,018,442**	**39**	**10,892,745**

Source: Authors' calculations.

The summary statistics of financial indicators in investment year is shown in Table 3. Comparing to another group, these companies which invested in bioenergy production facilities, had higher sales revenues, and slightly lower net profits. The financial indicators were estimated for the groups according to investment type.

Table 3. Mean group comparisons of financial indicators in investment year (t)

Biomass production equipment, *n=35*				
Indicator (€)	mean	min	max	SD
Sales revenue (S)	470,503	2,766	2,384,297	463,035
Net profit (NI)	59,849	-427,598	625,919	135,476
Total assets (A)	1,254,769	11,147	11,340,197	1,643,438
Equity (E)	625 187	-189 404	6 874 054	940 722
Bioenergy production facilities, *n=39*				
Indicator (€)	mean	min	max	SD
Sales revenue (S)	796,865	0	10,717,000	1,340,644
Net profit (NI)	33,708	-2,414,411	985,278	257,621
Total assets (A)	1,486,519	3,389	10,524,000	1,525,748
Equity (E)	731,484	-223,772	4,173,000	899,933

Source: Authors' calculations.

The key financial indicators of companies have been changed year-by-year. The amount of sales revenue, net profit, total assets, total equity, and the ratio of investments-to-assets can be seen in Table 4, where the financial indicators for the year of the investment, for the years prior to investments (t-2), (t-1), and after the investment (t+1)…(t+4) are shown. During the observable period, the sales revenue was increasing, and the net profit was decreasing. Thus, implementation of the new technology have mostly increased the costs of agricultural companies. Thus, sales revenue and costs move in diverging directions, accounting for trends in profits and margins.

Table 4. Annual average financial indicators of Estonian agricultural companies, supported from the ERDP 2007–2013 Measure 3.1.3. – Investments into the production of bioenergy national resources (2009–2015)

\Year Indicator\	t-2	t-1	t	t+1	t+2	t+3	t+4
S	474,652	534,693	533,685	587,950	714,364	883,976	1,033,767
NI	86,765	99,439	44,473	37,279	-2,961	21,744	21,396
A	956,992	1,160,956	1,356,143	1,453,158	1,578,038	1,618,982	1,719,339
E	541,187	623 482	655,777	710,155	796,759	756,476	698,000
I/A	0.113	0.181	0.101	0.032	0.009	0.021	0.027

Source: Authors' calculations.

Financial performance analysis of the agricultural companies in pre- and post-investment years according to the DuPont model for financial statements evaluating the ability to earn a return on the capital, measured by financial ratios such as asset turnover ratio, net profit margin ratio and equity multiplier, is in Table 5. Profitability ratios show that companies were able to generate profit not in all years. The financial performance, measured by return on equity (ROE) has been higher before the years of the investment. The profitability ratio (NI/S) reveals low profitability of agricultural companies' after the investment has been implemented (t … t+4). In general, the higher the ratio, the better – this applies throughout the profitability ratios (Zorn et al., 2018). If costs are growing in faster rate than the sales revenue, profits will decrease. The decline of profits reflect company's weaker competitiveness in markets.

Table 5. Financial ratios of agricultural companies which invested in biomass production equipment or bioenergy production facilities (2010–2017)

Ratio \ Year	t-2	t-1	t	t+1	t+2	t+3	t+4
NI/S	0.183	0.186	0.083	0.063	-0.004	0.025	0.021
S/A	0.447	0.407	0.372	0.397	0.433	0.545	0.580
A/E	1.963	2.108	2.185	2.087	2.069	2.145	2.552
ROE	0.161	0.159	0.0067	0.0052	-0.004	0.029	0.031

Source: Authors' calculations.

The asset use efficiency has improved as asset turnover ratio (S/A) shows a slight increase in post-investment years. Compared to pre-investment period, the ratio is higher on the second year after investment, and growing. Asset management control seems to be not a potential weakness of companies. The more detailed assessment of indicators that comprise in asset turnover and profitability ratios indicate that the weaker financial performance is not as much the result of weaker generation of income as it is the problem of cost control. Both operating and financial costs have been grown in agricultural companies during the observable period.

The financial leverage, measured by asset-to-equity ratio (A/E) has been increased, precisely at the end of the period indicating that financial risk has been increased as the use of loan capital has increased interest expenses. The loan repayment capacity has decreased with the extensive use of leverage. Lack of sufficient equity capital is a problem of many smaller agricultural companies.

Several companies ended the second year after the implementation of bioenergy investment (t+2) with a loss. According to the micro-level data the declining return on equity, which is considered as negative change, was reported by 51 companies. Of 74 companies, 23 experienced an increase in return on equity. Since the number of analysed companies is small and the data are not normally distributed, the non-parametric test was used for evaluation. First, the significance of the return on equity change with the paired samples Wilcoxon test (difference between two years (t-1 and t+2)) was tested, and comparison of the average indicators of the two groups was done. The results on the Fig. 2 show that the *p-value* of the paired-samples test is 0.010 and average-samples test 0.049, which is less than the significance level alpha = 0.05. Of this the conclusion can be made that the median weight of the return on equity before treatment differs significantly from the median weight after treatment with a *p-value*, but the change of indicator value is negative.

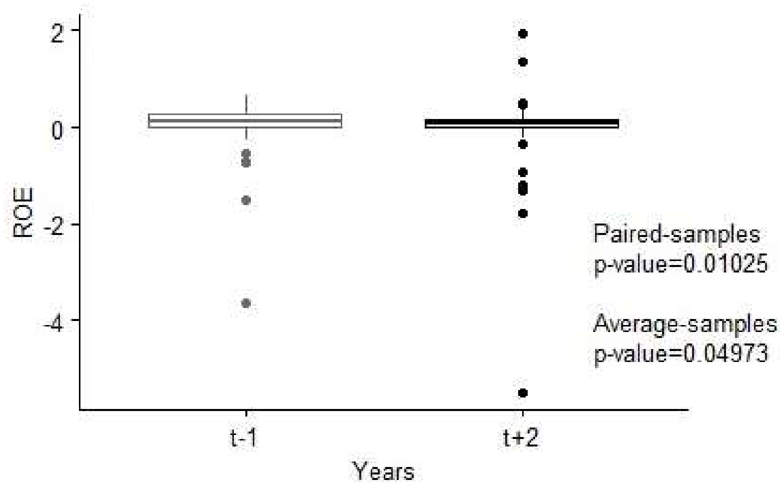

Figure 2. Return on equity before and after implementation of the bioenergy investment.

The fact that net profit was negative in many agricultural companies at that period, leaded to the situation where nearly 23% of the companies' equity was negative at the end of the period. The negative profitability for multiple years requires financing of these losses from retained earnings or additional external sources. These results are explainable as a result of various factors. The financial performance depends both on management decisions made inside a company, and on external factors. Plans for bioenergy investments have developed on estimates and assumptions in light of company's experience and perception of historical trends, current conditions and expected future developments. The future developments were predicted according to the management's expectations regarding the company's financial performance. In reality, the non-coincidence of the expectations and reality may occur. The factors that could cause the company's actual financial results, performance or achievements of future developments may differ from initial expectations. These factors could be the impact of adverse economic conditions, unfavourable weather conditions, seasonal sales, high levels of indebtedness, unavailability of additional capital, dependence on financing sources or strategic partners. Sometimes, unreasonable investments are also motivated by the thoughtless use of support measures. Therefore, recommendations for improving the financial performance relate to controlling costs, profitability and financial leverage constantly. Although results of many previous studies by Hart & Ahuja, 1996; Schaumann, 2007; Lopez-Gamero et al 2009; Endrikat et al., 2014; Marti-Ballester, 2017; Bikar et al., 2018 etc. are encouraging, showing positive return from investments in sustainable renewable energy facilities, some obstacles may occur in achieving high performance if specific control is neglected.

The current study captured 100% of Estonian agricultural companies that invested in biomass production equipment, and bioenergy production facilities in 2009–2015, having used financing from the ERDP 2007–2013 Measure 3.1.3., enabling to make conclusions about all of the companies. Still, the limitations remain in this study that could be taken into account in the future research. The dataset included relatively small number of agricultural companies. The further analysis would benefit from a larger sample.

CONCLUSIONS

In this article, the financial performance of Estonian agricultural companies in 2009–2017 was assessed. The purpose, to find what change has occurred in the efficiency, profitability, and financial structure of Estonian agricultural companies that have invested in biomass production equipment, and bioenergy production facilities in 2009–2015, having used financing from the ERDP 2007–2013 Measure 3.1.3., was estimated using the DuPont analysis. A comprehensive analysis of the financial indicators captured three components: asset turnover ratio, net profit margin ratio and equity multiplier.

The results of the descriptive statistics analysis confirm mainly that there is no improvement in the financial performance in the short run. Return on equity has generally been higher in years' before the investment. The profitability ratios indicate a low performance of agricultural companies' after the investment has been implemented. Although the asset use efficiency has improved, the weaker financial performance in post-investment years is not as much the result of weaker generation of income as it is the problem of cost control. Implementation of investments in biomass production equipment, and bioenergy production facilities may reduce environmental impact, but it does not necessarily improve financial performance. The results indicated that many of the agricultural companies that invested in biomass production equipment, and bioenergy production facilities did not show remarkable improvement of financial performance. The lack of equity capital is a problem of many agricultural companies. This reveals to the necessity of improvement of the company's control over profitability, costs and financial leverage.

ACKNOWLEDGEMENTS. The authors acknowledge the financial support from Institute of Economics and Social Sciences of Estonian University of Life Sciences. We would like to thank the referees for valuable comments.

REFERENCES

Abulfotuh, F. 2007. Energy efficiency and renewable technologies: the way to sustainable energy future. *Desalination* **209**, 275–282.

Adams, C.A. 2002. Internal organisational factors influencing corporate social and ethical reporting: Beyond current theorising. *Accounting, Auditing & Accountability Journal* **15**(2), 223–250.

Ahrendsen, B.L. & Katchova, A.L. 2012 Financial ratio analysis using ARMS Data. Agricultural Finance Review **72**, 262–27.

Bikar, M., Sedliacikova, M., Vavrova, K. & Hitka, M. 2018. Does the Combustion of Biomass Increase the Efficiency of Heating Companies? Evidence from Slovakia. *Bioresources* **13**(2), 2452–2472.

Endrikat, J., Guenther, E. & Hoppe, H. 2014. Making sense of conflicting empirical findings: a metaanalytical review of the relationship between corporate environmental and financial performance. *European Management Journal* **32**(5), 735–751.

Escalante, C.L., Turvey, C.G. & Barry, P.J. 2009. Farm business decisions and the sustainable growth challenge paradigm. *Agricultural Finance Review* **69**(2), 228–247.

Estonian Agricultural Registers and Information Board (ARIB). http://www.pria.ee/ Accessed 7.11.2018.

Estonian Commercial Register: e-Business Register. Estonian Centre of Registers and Information Systems. https://www.rik.ee/en/e-business-register. Accessed 17.11.2018.

Estonian Rural Development Plan 2007–2013. 2008. Ministry of Agriculture. https://www.agri.ee/sites/default/files/public/juurkataloog/MAK/RDP_2007–2013.pdf Accessed 7.9.2018.

Grashuis, J. 2018. A quantile regression analysis of farmer cooperative performance. *Agricultural Finance Review* **78**(1), 65–82.

Hall, M.G. & Howe, J. 2012. Energy from waste and the food processing industry. Process Safety and Environmental. *Protection* **90**(3), 203–212.

Hart, S.L. & Ahuja, G. 1996. Does it Pay to be Green? An Empirical Examination of the Relationship between Emission Reduction and Firm Performance. *Business Strategy and the Environment* **5(**1), 30–37.

Isberg, S.C. 1998. Financial analysis with the DuPont ratio: A useful compass. *Credit and Financial Management Review* **2**, 11–21.

Jensen, J.K. & Govindan, K. 2014. Assessment of renewable bioenergy application: a case in the food supply chain industry. *Journal of Cleaner Producrion* **66**, 254–263.

Lassala, C., Apetrei, A. & Sapena, J. 2017. Sustainability Matter and Financial Performance of Companies. *Sustainability* **9**, 1498.

Latruffe, L., Diazabakana, A., Bockstaller, C., Desjeux, Y., Finn, J., Kelly, E., Ryan, M. & Uthes, S. 2016. Measurement of sustainability in agriculture: A review of indicators. *Studies in Agricultural Economics* **118**(3), 123–130.

López-Gamero, M.D., Molina-Azorín, J.F. & Claver-Cortés, E. 2009. The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables, *Journal of Environmental Management* **90**, 3110–3121.

Martí-Ballester, C.-P. 2017. Sustainable energy systems and company performance: Does the implementation of sustainable energy systems improve companies' financial performance? *Journal of Cleaner Production* **162**, S35–S50.

Mishra, A.K., Harris, J.M., Erickson, K.W., Hallahan, C. & Detre, J.D. 2012. Drivers of agricultural profitability in the USA: An application of the Du Pont expansion method, *Agricultural Finance Review* **72(3)**, 325–340.

National Development Plan of the Energy Sector until 2030. 2017. Tallinn. https://www.mkm.ee/sites/default/files/ndpes_2030_eng.pdf Accessed 7.1.2019.

Oh, S., Hong, A. & Hwang, J. 2017. An Analysis of CSR on Firm Financial Performance in Stakeholder Perspectives. *Sustainability* **9**(6), 1023.

Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005. *Official Journal of the European Union* L347/501, 1–62.

Schaumann, G. 2007. The efficiency of the rational use of energy. *Applied Energy* **84**, 719–728.

Schmidt, O., Padel, S. & Levidow, L. 2012. The bio-economy concept and knowledge base in a public goods and farmer perspective. *Bio-Based and Applied Economics* **1**, 47–64.

Schmidhuber, J. 2006. Impact of an increased biomass use on agricultural markets, prices and food security: A longer-term perspective. In: *"International symposium of Notre Europe"*, Paris, 27-29 November, 2006. Available at: http://www.fao.org/WAICENT/FAOINFO/ECONOMIC/ESD/BiomassNotreEurope.pdf

Zorn, A., Esteves, M., Baur, I. & Lips, M. 2018. Financial Ratios as Indicators of Economic Sustainability: A Quantitative Analysis for Swiss Dairy Farms. *Sustainability* **10**, 2942.

Renewable Energy Directive (2009/28/EC). Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. ELI:http://data.europa.eu/eli/dir/2009/28/oj, https://eur-lex.europa.eu/legal-content/ET/ALL/?uri=CELEX:32009L0028 Accessed 7.1.2019.

Republic of Estonia. The approved Energy Sector Development Plan ensures Estonia's energy supply. Ministry of Economic affairs and Communications 19.10.2017. https://www.mkm.ee/en/news/approved-energy-sector-development-plan-ensures-estonias-energy-supply. Accessed 7.1.2019.