Eco-efficiency and eco-innovation: strategy to improve sustainable environmental performance

W H Putri 1 and N Y Sari 2

1 Accounting Department, Faculty of Economics, Janabadra University, Jl. Tentara Rakyat Mataram 55-57 Yogyakarta 55231, Indonesia
2 Accounting Department, Faculty of Economics, Janabadra University, Jl. Tentara Rakyat Mataram 55-57 Yogyakarta 55231, Indonesia

Email: wikaharis@janabadra.ac.id

Abstract. Triple bottom line is a movement to inspire entities in developing and harmonizing social, environment, and economy to run their business. This paper aims to see the impact of implementing Eco-efficiency and Eco-innovation to environmental performance. Environmental performance in this article appears from the PROPER value of each company (category gold, green, blue, red, and black) as one of Indonesian nomination in environmental performance. Furthermore, activities Eco-efficiency and Eco-innovation is seen in the presence of disclosure of such activity in the sustainability report (yes/no). Data Analysis Method using multinomial logistic to see about Eco-efficiency and Eco-innovation impact to increasing environmental performance. This model is rarely applied in the case of environmental performance. These research results show details both of each environmental performance criteria and the whole value of environmental performance indices of eco-efficiency and eco-innovation. Processed data results still gift a variety value in range 2013 - 2015 years from each environmental performance category. The advantages of this method are in each category; it can search an effect of Eco-efficiency and Eco-innovation to environmental performance indeed. This research was giving feedback to the corporates that Eco-efficiency and Eco-innovation actions could increase the environmental performance value

1. Introduction
The shifting paradigm of the company from profit maximization to triple bottom line (people, profit, and planet) has inspiring that without environmental performance support, the financial performance will not be as good as desired by stakeholders. Although started and guarded by the approach of command control approach 1 and followed by a mandatory measuring instrument, it is enough to make companies to apply the concept of sustainability. To express their commitment on triple bottom line implementation, the companies have initiated a sustainable reporting community and created a Sustainable Reporting Award to expand implementation of commitments for sustainability 2.

Previous research has found that environmental performance has been shown to have a positive effect on financial performance 3. The measurement of environmental performance is still voluntary and provides a good precedent for the company. Eco-efficiency is the most rational concept of the relation between environmental and financial performance. In order to save costs while maintaining the environment, this concept helps to show the ratio of product value and environmental load 4. Nevertheless, environmental performance is not necessarily believed to be a driver of environmental
performance. It is confirmed when the number of companies that disclose sustainability is not increased massively. In Indonesia, there was only one company who prepared sustainability reporting in 2005. The number is growing slowly. It was recorded that only 60 companies did it in 2014. It confirmed the assumption that mandatory approaches are necessary to drive the company's environmental performance.

This research is expected to be able to bridge the previous research findings on the application of eco-efficiency and eco-innovation and its relation with environmental and company performance.

In order to realize harmonization between three pillars, one of the instruments that has been tried to be introduced is the measurement of company's environmental performance. Environmental performance is a measurable result of the environmental management system, which is connected to the control of its environmental aspects. The assessment of environmental performance is based on environmental policies, environmental objectives and environmental targets. In particular, the study measures environmental performance using PROPER (Rating of Corporate Performance in Environmental Management) published by the Ministry of Environment and Forestry. The PROPER assessment criteria are as follows:

- **Gold** is awarded to businesses and/or activities that have consistently demonstrated environmental excellence in the production or service process, as well as conducting ethical and responsible business to community;
- **Green** is for businesses and/or for activities that have undertaken environmental management beyond the required compliance by implementing environmental management systems, utilizes resources efficiently, and carried out their social responsibilities well;
- **Blue** is for businesses and/or activities that have undertaken environmental management efforts, which are required in accordance with applicable laws and regulations;
- **Red** is for those who have undertaken environmental management efforts but not yet comply with the requirements as stipulated in the laws and regulations;
- **Black** is given to those who have intentionally made negligence so that cause pollution or damage of environment in doing their business and/or activity, and violate the prevailing laws and/or do not implement administrative sanction.

Meanwhile, in order to improve its environmental performance, some companies do eco-efficiency and eco-innovation. Eco-efficiency is a concept that encourages companies to develop their environmental performance level, or at least equivalent to economic performance. The effort could reduce environmental impact and excessive consumption of resources. While eco-innovation is defined as the ability to innovate in products and services without causing environmental impact and damage. Eco-innovation means creating competitiveness in the price of goods, production processes, production systems, services, and procedures that can meet human needs and improve the quality of life of all people by minimizing the use of natural resources, including energy sources outputs per unit. The nine concepts of eco-innovation according to Doran & Ryan (2014). Based on the nine concepts, this study tries to examine whether eco-innovation measures undertaken by the company have included these and are able to contribute to environmental performance or not.

Discussions on improving environmental performance will always be linked to financial performance. It is difficult to separate because the company always associate the profit element in every operational decision. Therefore, this study also intends to see whether there is a certain trend between the performance of financial performance and environmental performance. The financial performance used in this study is proxy to the company's profitability ratio.

Previous research that examines the environmental performance and financial performance of the company is conducted by Tjahjono (2013), which analyzed the effect of environmental performance on company value and financial performance. Samples taken were annual financial reports of companies listed and published by the Indonesia Stock Exchange in 2010 and 2011. The results of the study found that environmental performance has a significant effect on financial performance. Based on several studies above, the first hypothesis in this study is
H1: Environmental performance affects the financial performance.

The prior research on eco-efficiency and financial performance performed by Putri (2012). It found that the implementation of eco-efficiency in the hotel industry is the most considered by the general manager of hotels. The conclusion of the research ultimately found that saving resource consumption, is the most preferred way to reduce costs, and to encourage environmental performance. Managers have the most choice by managing waste, and treating environmental costs in the financial statements as a savings on accounting period runs. Based on some previous studies related to eco-efficiency and financial performance, the second hypothesis of this study is

H2: Eco-efficiency affects the financial performance.

While the influence of eco-efficiency on financial performance has also been examined by some previous research. One of them is Rahmadhani & Meylani (2016)’s research. It found that the influence of eco-control on environmental performance has a positive influence on mining companies. Companies with good environmental control (eco-control) will support the improvement of company’s environmental performance. In this study, the third hypothesis proposed is as follows:

H3: Eco-efficiency effect on environmental performance

The study related to eco-innovation, as described earlier, was conducted by Doran & Ryan (2014). It examined the relationship between eco-innovation and company performance. Based on the research, in the empirical context in Indonesia, researcher proposed the following hypothesis:

H4: Eco-innovation has an effect on financial performance and
H5: Eco-innovation has an effect on to environmental performance.

2. Research Methods

This study focuses on whether companies that follow the PROPER program as a proxy for environmental performance apply eco-efficiency and eco-innovation and how it impacts on the financial performance they have after implementing the program. As the population of the study, we use the PROPER program that followed by corporate in primary industry, chemical, mining, oil and gases that joint the program in the 2013-2015 period. Meanwhile, the object is the participant company PROPER which publishes the financial report, annual report and sustainability report for the year 2013-2015.

The independent variables in this study are eco-efficiency and eco-innovation, proxied by the disclosure of eco-efficiency / eco-innovation activities in a sustainability report with code 0 for non-disclosing and 1 for disclosing. The category of eco-efficiency disclosure in the company is said to do eco-efficiency if in its sustainability report use one of the essences of aspects of savings (efficiency) the use of raw materials, energy and water, minimization of accidents and minimization of waste. While the category of disclosure for eco-innovation is reducing the use of materials per unit of output (1), reducing energy use per unit of production (2), reducing CO2 (3) production, replacing elements with low pollution or replacing hazardous materials (4) use of soil, water, and noise (5) recycling waste, water or materials (6) reducing energy use (7) reducing soil, water and air pollution (8) increasing product recycling after use (9). The category of eco-innovation disclosure is if it meets one of the nine classes defined above.

While the dependent variable, at once independent variables in this study, is environmental performance, which is proxied by using PROPER value. As for the 4th variable, the financial performance is proxy with profitability ratio, with code 0 for not profit and 1 for profit, assessed based on ROA, ROE, and NPM (positive/negative) ratio. As for determining the profit category, then the three ratios and the three years must show a positive number, and if one of the three ratios in one year alone shows negative, then the financial performance is not profitable (coded 0).

This research using two models, the first model shows the influence of eco-efficiency and eco-innovation to environmental performance. The second model examines those variables in the first model to financial performance. The consideration for the second model uses eco-efficiency and eco-innovation in addition to environmental performance as the variable can explain the dimension beyond
that context. The goal of the second model shows the variables that most influence financial performance. The figure of the model shown in the illustration below:

![Figure 1. Research Models](image)

The first model of this research using multilevel multinomial logistic regression. The PROPER, as a proxy for Environmental performance, have five ranks that show the corporate performance in an environment. The levels have symbolized in gold (5), green (4), blue (3), and red (2) black (1). Moreover, regression with dummy variables more than two, have to use one category for the reference. Thus, the formula for some dummy variables is \( k - 1 \), which \( k \) represents the amount of group number.

The second model can analyse with binary logistic regression. This model will use financial performance as the dichotomy variable (profit/no profit) of an independent variable. Financial performance can measure with profitability ratio (e.g. Return on Assets, Return on Equity and, Net Profit Margin). Also divides into two categories, i.e. that zero to the one does not have profit, and one has this profit.

3. Result and Discussion
Based on the research method and facts that we find related to the accuracy of classification prediction for three years, can be submitted summary results in Table 1.

The results of data processing using logistic regression of both binary and multilevel multinomial logistics produce essential findings while confirming the descriptive data, where companies with eco-efficiency and eco-innovation will have the most excellent chance of achieving the environmental performance of BLUE PROPER or more. Meanwhile, companies that do not implement eco-efficiency or eco-innovation is likely to only get a RED or BLUE for the maximum PROPER categories.

4. Conclusion
As a result of this research, we can conclude that the essential findings describe in the discussion below:

First, environmental performance in a company has no significant effect on company's financial performance. The results of tests that have been done indicate that the environmental performance shown in PROPER does not affect financial performance. This result is in line with research conducted Rakhiemah & Agustia (2009) stating that environmental performance does not affect financial performance.

Second, eco-efficiency affects the company's financial performance. The test results show that eco-efficiency affects the financial performance demonstrated in Wald's 2015 test with a sig value of 0.025. Third, eco-innovation has no significant effect on company's financial performance. Testing in 2013-2015 shows that eco-innovation does not affect financial performance. The results of the Wald test with P-Value more than 5%, i.e. sig <0.423 in 2013, sig <0.893 in 2014 and sig <0.238 in 2015.
This result is not in line with research conducted by Doran & Ryan (2014) eco-innovation effect on financial performance.

### Table 1. Summary Result

| No | Independent Variables | Dependent Variables | Analysis Method | Output 2013 | Output 2014 | Output 2015 | Notes |
|----|------------------------|---------------------|-----------------|-------------|-------------|-------------|-------|
| 1  | Environmental Performance (PROPER) | Financial Performance (0 for not profit, 1 for profit) | Binary Logistic Regression | Environmental performance did not significantly affected to financial performance | Environmental performance did not significantly affected to financial performance | Environmental performance did not significantly affected to financial performance | Consistent for the three years |
|    | a. Red                  |                      |                 |             |             |             |       |
|    | b. Blue                 |                      |                 |             |             |             |       |
|    | c. Green                |                      |                 |             |             |             |       |
|    | d. Gold                 |                      |                 |             |             |             |       |
| 2  | Eco-efficiency          | Financial Performance (0 for not profit, 1 for profit) | Binary Logistic Regression | Eco-efficiency did not significantly affected to financial performance | Eco-efficiency did not significantly affected to financial performance | Eco-efficiency significantly affected to financial performance | Indicates that Eco-efficiency have better quality, and corporate take more attention in environmental issue than past year |
| 3  | Eco-innovation          | Financial Performance (0 for not profit, 1 for profit) | Binary Logistic Regression | Eco-innovation did not significantly affected to financial performance | Eco-innovation did not significantly affected to financial performance | Eco-innovation did not significantly affected to financial performance | Consistent for the three years |
| 4  | Eco-efficiency (1 for eco efficiency efforts is exist, 0 for vice versa) | Environmental Performance (PROPER) a. Red b. Blue c. Green d. Gold | Multilevel Multinomial Logistic Regression | The absence of eco-efficiency has significant effect on the RED category PROPER result | The absence of eco-efficiency has significant effect on the RED and BLUE categories PROPER result | The absence of eco-efficiency has significant effect on the RED category PROPER result | The analysis for three years shows that firms that do not apply the concept of eco-efficiency tend to get a RED category or a maximum of BLUE category for PROPER |

Fourth, companies that do not apply eco-efficiency concepts have an effect on environmental performance gains in the red PROPER and PROPER blue categories. The results of multilevel multinomial logistic regression testing in the Parameter Estimates table in 2013, 2014 and 2015 show that variables that can be used to predict environmental performance (EP) shown in red PROPER are eco-efficiency and eco-innovated variables coded 0 or company category which does not apply the concept of eco-efficiency and eco-innovation. This condition indicated by a statistically significant value at the 5% level. Meanwhile, only in 2014 shows that eco-efficiency and eco-innovated variables coded 0 can contribute to environmental performance in blue PROPER. It is also indicated by a statistically significant value at the 5% level whereas in 2013 and 2015 are not.

And the last, companies that do not apply eco-innovation concepts affect environmental performance gains in the red and blue PROPER categories. Tests of eco-innovation were also performed and from the results in the parameter estimates table showing the same trend with eco-efficiency.

There are several limitation of the study which could trigger further research as follows:
There is an element of subjectivity in determining the essence of eco-efficiency and eco-innovation. Whether or not the concept of eco-efficiency and eco-innovation in the company that decide by looking at the spirit of the idea described in the sustainability report.

This study uses scoring that contains qualitative elements in fulfilment of the criteria used so that it can happen human error.

This study uses samples that are still classified as universal or have not been individually selected based on companies that have to implement excellent environmental performance.

5. Acknowledgment

We grateful to late Professor Gudono for the insight and inspiration to do the researches and studies on Eco-efficiency and Eco-innovation. We thank to Irfan Bakhtiar for assistance with comments and inputs that greatly improved the manuscript. We would also like to show our gratitude to our colleagues at the Economic Faculty of Janabadra University for the support and opportunity to explore our research ideas, although they may not agree with all of the interpretations/conclusions of this paper.

References

[1] Putri, W. H. (2012). Paradigma Eko-efisiensi dalam Akuntansi Biaya sebagai Pembentuk Preferensi Pengambilan Keputusan Manajer Perhotelan bagi Pembangunan Berkelanjutan. Magister Science, Economics and Business Faculty, Accounting. Yogyakarta: Gadjah Mada University

[2] National Center for Sustainability Reporting. (2016). Retrieved May 19, 2017, from Sustainability Reporting Award: http://sra.ncsr-id.org/

[3] Tjahjono, M. E. (2013, May 1). Pengaruh Kinerja Lingkungan terhadap Nilai Perusahaan dan Kinerja Keuangan. Jurnal Ekonomi, 4(1), 38-46

[4] Verfaillie, H., & Bidwell, R. (2000). Measuring Eco-efficiency: A Guide to Reporting Company Performance. Geneva: World Business Council for Sustainable Development.

[5] Kusumaatmaja, S. (2014, December 10). National Center for Sustainability Reporting. Retrieved May 19, 2017, from Sustainability Reporting Award: http://sra.ncsr-id.org/sustainability-reporting-award-sra-2014/

[6] Daniela, S. A., & Tarigan, J. (2016). Perilaku Manajer Atas Isu Manajemen Lingkungan terhadap Kinerja Keuangan Dengan Menggunakan Variabel Intervening Customer Satisfaction Pada Perusahaan di Surabaya. Business Accounting Review, 229-240.

[7] Doran, J., & Ryan, G. (2014). Eco-Innovation – Does Additional Engagement Lead to Additional Rewards? Munich Personal RePEc Archive, Paper No. 52797, pp. 1-21.

[8] Rahmadhani, S., & Meylani, D. (2016). Pengaruh Eco-control terhadap CSR Disclosure dan Financial Performance dengan Environmental Performance sebagai Variabel Intervening. Jurnal Dinamika Ekonomi & Bisnis, 32-46.

[9] Zaenuri, Sudarmaji, Fandeli, C., & Sudibyakto. (2011, Maret). Pengelolaan Industri berbasis Eko-Efisien di Kawasan Simongan Kota Semarang. Jurnal Manusia dan Lingkungan, 18(1), 29-42.