JURNAL AKUNTANSI
Vol. 18 No.2 Oktober 2024 : 191 - 203
Doi: https://doi.org/10.25170/jara.v18i2.4912

ISSN : 2580-9792 (Online)
ISSN : 1978-8029 (Print)

STRATEGI MANAJEMEN LINGKUNGAN MENGGUNAKAN *ENVIRONMENTAL MANAGEMENT ACCOUNTING* DENGAN *MATERIAL FLOW COST ACCOUNTING* DI AKTIVITAS PRODUKSI SEMEN

ENVIRONMENTAL MANAGEMENT STRATEGY USING EMA WITH MFCA IN CEMENT PRODUCTION ACTIVITIES

Firdha Rahmiyanti*
Usmiyati†

ABSTRAK

Penelitian ini mengkaji implementasi environmental management accounting (EMA) dengan material flow cost accounting (MFCA), yang berkaitan dengan biaya-biaya lingkungan yang timbul dan bagaimana penggunaan bahan baku dan energi dalam proses produksi sebagai strategi manajemen ekologi. Metode penelitian yang digunakan adalah kualitatif dengan pendekatan studi kasus. Hasil dari penelitian ini menunjukkan bahwa dengan menerapkan EMA dengan MFCA, diperoleh informasi bahwa dari seluruh biaya bahan baku, 92% merupakan output positif, dan 8% merupakan output negatif. Pada bagian produksi, 89% biaya energi menjadi output positif, dan 11% menjadi output negatif. Sebaliknya, perusahaan mengalami kerugian material sebesar Rp 75.648.480.000 atau 8%. Dengan mengetahui biaya kerugian tersebut, diharapkan perusahaan dapat memperbaiki proses produksi untuk mengurangi kerugian biaya produksi dan terus menerus memperbaiki pemborosan yang terjadi untuk meminimalisir dampak negatif terhadap lingkungan.

Kata Kunci: *Environmental Management Accounting (EMA), Material Flow Cost Accounting (MFCA),* Akuntansi Lingkungan, Industri Semen

ABSTRACT

This study examines the implementation of environmental management accounting (EMA) with material flow cost accounting (MFCA), which is related to environmental costs incurred and how to use raw materials and energy in the production process as an ecological management strategy. The research method used is qualitative with a case study approach. The results of this study show that by applying EMA with MFCA, information is obtained that of all raw material costs, 92% is positive output, and 8% is negative output. In production, 89% of energy costs become positive output, and 11% become negative output. In contrast, the company suffered a material loss of IDR

* Fakultas Ekonomi dan Bisnis Islam, Universitas Islam Negeri Walisongo Semarang, Indonesia, *emai:* firdharyanti@walisongo.ac.id
† Fakultas Fakultas Ekonomi dan Bisnis Islam, Universitas Islam Negeri Walisongo Semarang, Indonesia
Penulis Korespondensi: Firdha Rahmiyanti
Sitasi:Rahmiyanti & Usmiyati (2024). Environmental Management Strategy Using EMA With MFCAin Cement Production Activities. *Jurnal Akuntansi, 18*(2),
Artikel masuk: 15 November 2023; Artikel diterima: 19 September 2024

75,648,480,000 or 8%. By knowing the costs of these losses, it is hoped that the company can improve the production process to reduce production cost losses and continuously improve their waste to minimize the negative environmental impact.

***Keywords**: Environmental Management Accounting (EMA), Material Flow Cost Accounting (MFCA), Environmental Accounting, Cement Industry*

1. INTRODUCTION

Today, environmental issues are increasingly attractive to study, along with the rapid technological developments and changes in people's lifestyles. Environmental issues are no longer foreign and are becoming increasingly attractive to study. During the last two decades, Indonesia's economic development has been based on the concept of industrialization. Approximately 30,000 industries are operating, and there is an increase each year. That impacts pollution from industrial production (Azizah et al., 2011) because industrialization focuses on using technology as efficiently as possible and sometimes ignores environmental aspects (Dana, 2018). Therefore, public awareness of environmental issues encourages companies to implement industrial management in their business activities.

Environmental management strategies are an alternative for companies to ensure sustainable production because they can control the use of natural resources and waste management. The company's environmental management strategy can be improved by implementing environmental accounting, namely Environmental Management Accounting (EMA) or Environmental Management Accounting (Chikmatin, 2019). The current role of accounting is not limited to financial reporting for measurement. However, it has included the analysis of environmental aspects of company actions through EMA (Cho et al., 2012). EMA is a form of accounting that involves the dissemination of environmental information to support internal decision-making within a company (known as environmental costs), such as the amount of waste generated, the level of radiation released, and the carbon emissions released (Schaltegger, S., Hahn, T. & Burritt, 2000). The United Nations Division on Sustainable Development (UNDSD) states that the application of EMA is essential for companies so that ongoing procedures

can consider environmental aspects such as reducing carbon emissions, efficient use of physical resources such as water, raw materials, and others (Savage, D. E., Ligon, P. J., & Lomsek, 2001). The application of EMA in a company can be a reference for management in making decisions related to the environment (Chikmatin, 2019).

Companies require EMA as a form of corporate responsibility, and waste management carried out by companies requires measurement, evaluation, disclosure, and reporting of waste management costs due to company operations (Syarif & Novita, 2019). EMA with Material Flow Cost Accounting (MFCA) is a system that companies and industries need to solve this problem. The EMA system using MFCA requires companies to focus on inefficiencies in the production process and describe inputs and outputs in physical and monetary units (Christ & Burrit, 2018). MFCA combines physical and financial information into a single accounting model. This concept is based on inputs consisting of material costs (the physical quantities of materials involved in various production processes, such as purchase prices). System costs (all operating costs in an organization such as labor, depreciation, transportation, and maintenance); waste costs (positive and negative goods brought by the company in the form of wastewater, energy, and costs incurred to allow exit). The MFCA model's benefits are increasing profits and productivity (internal), reducing negative environmental impacts (external), and contributing to sustainable business development.

PT Semen Gresik (Persero), Tbk., is a cement producer where products and production processes have the potential to affect the environment. One of the primary raw materials for cement production is karst; data from the Kendeng Mountains Concerned Community Network (Jargalsaikhan et al., 2019) (JMPPK) (2017) shows that karst ecosystems have underground rivers that can meet the water needs of households and agricultural land. On the one hand, the company must continue producing to not burden the state as a state-owned company; conversely, cement mining has negative impacts.

Previous research on MFCA has been carried out by (Marota, 2017). In his study on MFCA (production costs, production plant area, and production value or

output), which is used as a variable in MFCA, the results show that MFCA affects company sustainability. In addition, Loen's research (Loen, 2018) regarding applying green accounting and MFCA results show that MFCA and green accounting can increase a company's sustainability.

EMA, along with MFCA, can provide views and information in making decisions for companies related to the efficiency of the production process and the use of raw materials and energy so that material losses do not occur. This study aims to analyze the company's activities in the production process as a strategy for managing raw materials efficiently while minimizing negative impacts on the environment.

2. LITERATURE REVIEW

Environmental accounting relates to implementing environmental costs in a company's accounting practices. The environmental accounting has a function to identify, measure, assess, and report environmental cost accounting. Environmental accounting terms can be divided into two main parts. First, the environmental bill is a cost that directly affects the entire company. Second, environmental accounting also includes unaccountable individual, company, and corporate environmental costs (Fitri, 2011).

EMA is a branch of accounting science that measures the impact of a company's business activities in monetary units. EMA is the generation, analysis, and use of financial and non-financial information to optimize companies' environmental and economic performance and achieve sustainable business (Bennett, 2002).

MFCA is a tool for a management approach called flow management. The aim is to control the manufacturing process regarding materials, energy, and data flow more effectively, efficiently, and effectively. MFCA can provide insider benefits, and productivity-boosting benefits can minimize negative impacts on the external environment and contribute to sustainable business development (Christ & Burrit, 2018). MFCA is a critical tool in environmental accounting management, from developing material flow models that can track and quantify the flow and inventory of materials in an environment to increasing the transparency of

material use practices—organization of physical and monetary units. The basic concept of MFCA is that inputs such as materials, energy, and water and other inputs and outputs such as primary or by-products, waste, waste, and emissions are determined centrally on the quantity (Schaltegger et al., 2000).

3. RESEARCH METHODS

This study uses qualitative research with a case study approach. According to (Creswell, 2003), qualitative research is a holistic approach involving discovery; this research also allows researchers to develop details in experience to describe models in a natural environment. If you look at the characteristics of the research to be examined, they are included in the case study research. Research here intensively focuses on one object and studies it as a case. Various sources can be collected in this study, and researchers can obtain data for case studies from all parties concerned (Hadari, 2003). The research object used is PT Semen Gresik (Persero), Tbk.

Researchers here use two qualitative types of data: primary data using data collection techniques using interviews and observation and secondary data using financial reports for 2021. The data analysis technique used in this study consists of three activity flows below.

Data Reduction

At this stage, the researcher conducts data analysis by summarizing, selecting, and focusing on matters relating to financial transaction records in the form of costs associated with the Design and Implementation of EMA with MFCA, starting from determining the role of the owner to providing results to become an alternative optimization related to the use of materials raw materials and energy through the results of the MFCA.

Data Display

The presentation of data is intended so that researchers can find meaningful patterns, and then conclusions can be drawn from these patterns. At this stage, the researcher focuses on techniques to facilitate the research process by

understanding the research problem. Techniques can be done in the form of narrative text. At this stage, it is seen through the Design and Implementation of EMA with MFCA: identifying, classifying, presenting, and disclosing environmental activities and costs.

Conclusion and verification

The researcher writes the conclusions of the results and verification of the analysis that has been carried out.

4. RESULTS AND DISCUSSION

The first stage in implementing MFCA begins with determining the roles and responsibilities of owners and employees. The first step in implementing MFCA at Semen Gresik is based on the three pillars of sustainability. The second step in implementing MFCA is building a material flow model by determining the boundaries of the production process. The third step in implementing MFCA is determining the allocation of costs to obtain an accurate calculation of material losses regarding products that become positive or negative outputs, presented in Table 1.

Table 1. Allocation of Raw Material Costs

Input	Cost Allocation (Rp)	Positive Input	%	Cost (Rp)	Negative Input	%	Cost (Rp)
Raw Material Preparation Process	164.875.000.000	-	100	164.875.000.000	-	-	164.875.000.000
Crushing Process	164.875.000.000	Limestone & Silica	98	161.577.500.000	Limestone & Silica	2	3.297.500.000
Storage and Feeding of Raw materials	161.577.500.000	-	100	161.577.500.000	-	-	0
Milling and Drying of Raw Materials	161.577.500.000	Clay	99	159.961.725.000	clay	1	1.615.775.000
Blending	159.961.725.000	Copper slag	98	156.762.490.500	Copper slag	2	3.199.234.500
Pre-heating	156.762.490.500	Pozzoland	98	153.627.240.690	Pozzoland	2	3.135.249.810
Firing Process	153.627.240.690	Gypsum	99	152.090.968.283	Gypsum	1	1.536.272.407
Cooling	152.090.968.283		100	152.090.968.283		-	0

Final Miling Process	152.090.968.283	99	151.634.695.378	0,3	405.968.283
Total	164.875.000.000	92		8	13.190.000.000

The first process, starting from the blasting of limestone, the exploding dynamite will produce chunks of limestone. These blocks will damage the surrounding ecosystem and have chemical effects on the soil. The material will only be collected partially because all the small pieces of limestone cannot be collected using a dozer. Then, the formatted size of the limestone will be sent to the warehouse. In the travel process, material loss is on the way to storage because the road texture is not smooth, which causes the material to fall. The loss is 6.5% of limestone tons and 5% of silica rock.

Second, the material in storage will be sent to silos to be milled in the raw mill. In the raw mill, tiny amounts of limestone and silica cannot be transferred to the kiln process. A collective combustion process will remove minimal raw materials from the chimney. EP filters these materials, but from 24 hours EP is active, there are times when EP does not work 100% correctly. The operator reduces the EP speed to 50%, so the dust coming out of the stack will be very dense. The amount is the same as 7%.

Third, the output from the raw mill, called a raw mix, is installed to be burned in the kiln. It used coal stoves as the primary fuel and diesel to add heat. Sometimes, coal transferred from suppliers cannot meet the kcal of coal. For example, In the first period, the shipment received 6,000 kcal of coal from 7,000 kcal, and the company had to add more coal. It does not count by weight, but by the heat it can generate. That is because the quality of the coal itself is lacking. In this case, coal mill management must be vigilant and careful when sending coal from suppliers. So, 7% is counted as a loss if this process exists; 7% of the total funds prepared was declared a loss. This point needs to be improved to guarantee factory coal quality.

In the combustion of the raw mix, again, small materials will be lost as dust, and some of the materials will stick to the walls of the kiln. The amount is calculated as 7%-7.2%. In this case, the management in charge of equipment and

machinery should improve and optimize the function of the kiln so that the amount of material adhering to the walls and grinding media inside the kiln can be reduced.

Fourth, the raw mix clinker fired in the kiln will be re-milled to obtain a certain fineness from the cement mill. In this process, the cement plant will be mixed with pozzolans if needed. The amount of this auxiliary material depends on needs. In this process, material loss is estimated to be 7% due to the cement mill patching into the raw mill wall.

Fifth, finished products such as cement will be stored in silos ready for distribution. In this process, cement stored in silos will be loaded into trucks. There are two models: packaged cement and non-packaged cement (bulk cement). In this process, there is a material loss of 5% of the total finished product. Employees will put paper or packaging into the filling machine; then, the machine will fill the paper with cement and place it on the shelf where it is. The packed cement will be loaded onto trucks and ready to be shipped. There is the possibility of human error here, poor paper quality, and other factors that cause packaged cement to break. The 5% material loss comes from here. Then, the piece of paper will be discarded. In this situation, the packing plan manager must minimize human error and improve packaging technology to reduce losses. Initial input materials by weight are identified as approximately 8% of the total losses resulting from the initial process until the product is shipped.

After determining the positive and negative outputs of all cement production process cost allocations, the fourth step is interpreting the MFCA results through the cost flow matrix. All costs are classified as components of the product or material losses. This cost flow matrix was created to provide the results of the MFCA analysis in a tabular format to make it easier for all parties and organizations (Table 2).

Table 2. MFCA Calculation Results

Component of Cost		Product (+)	Percentage	Material Losses (-)	Percentage
Raw Material	164.875.000.000	151.685.000.000	92%	13.190.000.000	8%

Costs					
Energy Costs	429.526.000.000	373.687.620.000	87%	55.838.380.000	13%
System Costs	-	-	-	-	-
Disposal Costs	-	-	-	-	-
Total Costs	594.401.000.000	525.327.620.000	89%	69.028.380.000	11%

Based on Table 2, energy use during the production process is 87% positive and 13% negative. The use of the system during the production process is 100%. In comparison, waste treatment/disposal is allocated entirely or 100% to be recycled to third parties so that no negative output is generated from waste disposal treatment. The material cost flow matrix shows that the loss of material that is still produced related to the cement production process is 11% or IDR 69,028,380,000.

In this fifth step, the researcher communicates and coordinates with the company to provide results related to steps 1 to 4 in implementing the MFCA so that the company can look for alternatives to optimize the production process in terms of raw material and energy costs as well as production costs.

Environmental Management Accounting (EMA)

Step 1: Identify environmental activities and costs. The basis for disclosure by GIS is measured based on the National Association for Environmental Management "Performance Measurement of EHS Management Programs Survey" (Meilanawati, 2009). Based on the analysis results, GIS discloses environmental costs voluntarily as a form of reporting to stakeholders. Step 3: Presenting and disclosing quality costs into environmental cost reports by identifying activities and costs.

Implementation of the environmental responsibility program Semen Gresik is fully aware that the company's operations have various impacts on the environment, both directly and indirectly. Therefore, the company seeks to manage operational activities to continue suppressing negative environmental impacts. In carrying out its business activities, from Table 3, it can be seen that Semen Gresik always strives to achieve a balance between the economic value

obtained with concern for environmental sustainability in the form of post-mining land reclamation in terms of external failures, as well as allocating environmental prevention and detection costs to creating an environmentally friendly operation. In addition, the company creates environmentally friendly operations by efficiently using energy. Energy is one of the primary needs, especially in the cement production process. Semen Gresik uses two types of energy, renewable and non-renewable, in its operational activities. The non-renewable energy used by the company includes coal, electricity, and biosolar, while the renewable energy used is corn cob waste.

Table 3. Environmental Costs

Component	Total
Environmental Prevention Costs	
Costs from partnership and community development programs	5.689.244.905
Employee welfare costs (training, development and occupational health services)	
Occupational safety (PPE procurement & manufacture and maintenance of K3)	
Total cost of environmental prevention	5.689.244.905
Environmental Detection Costs	1.410.184.551
Emission Fee	
Air	
Wastewater	
audit fees	
Total Cost of Environmental Detection	1.410.184.551
Environmental Internal Failure Costs	
Water pollution control & Air pollution control	
Resource Conservation Program	
Clean water channel	
Operation of equipment for prevention	
Recycle leftovers	
Total Environmental Internal Failure Costs	0
Environmental External Failure Costs	
Post-mining land reclamation costs & greening)	1.405.766.689
Accident pollution prevention	
Occupational accidents and illnesses	
Total Environmental External Failure Costs	1.405.766.689
Total Environmental Costs	7.109.113.439

5. CONCLUSION

Based on the results and discussion above, the application of EMA with MFCA revealed that raw material costs were 92% positive output and 8% negative output, and energy costs used in the production process were 89% positive output and 11% negative output. In contrast, the company suffered a material loss of IDR 75,648,480,000 or 8%. It can be concluded that PT Semen Gresik has made optimal use of raw materials and energy in production within the limits of expected losses.

In addition, the activities carried out by PT are as follows: Semen Gresik regarding environmental management has been identified and presented in the environmental quality cost report to determine environmental costs that can be minimized and repaired. Thus, Environmental Management Accounting with Material Flow Cost Accounting can significantly benefit PT Semen Gresik is good at increasing the transparency of activities related to environmental management in the production process and in improving production practices in the flow of materials in the form of raw materials, energy and systems that affect the production process physically and monetary and are converted into product shares or material losses for continuous improvement. To reduce production costs and minimize the negative impact on the environment.

ACKNOWLEDGMENT

We thank BOPTN LP2M UIN Walisongo for supporting funding.

REFERENCE

Azizah, N., A.R., M. D., & Endang, M. G. W. (2011). Analisis Environmental Management Accounting (EMA) sebagai Bentuk Eco-Efficiency dalam Meningkatkan Keunggulan Kompetitif Perusahaan. *Analisis Penerapan Environmental Management Accounting (EMA) sebagai Bentuk Eco-Efficiency dalam Meningkatkan Keunggulan Kompetitif Perusahaan*, *6*(2), 1–10. https://media.neliti.com/media/publications/78000-ID-analisis-penerapan-environmental-managem.pdf

Bennett, M. D., Bouma, J. J., & Wolters, T. J. (Eds.). (2002). *Environmental*

management accounting: Informational and institutional developments (Vol. 9). Springer Science & Business Media.

Chikmatin, E. (2019). Analisis Implementasi Environmental Management Accounting sebagai Bentuk Eco-efficiency pada CV.Mikado. *Seminar Nasional Ekonomi & Bisnis Dewanatara Call For Peper 2019*, 1–12.

Cho, C. H., Freedman, M., & Patten, D. M. (2012). Corporate Disclosure of Environmental Capital Expenditures: A Test of Alternative Theories. *Accounting, Auditing and Accountability Journal*, *25*(3), 486–507. https://doi.org/10.1108/09513571211209617

Christ & Burrit. (2018). Material flow Cost Accounting for Food Waste in the Restaurant Industry. *The Eletronic Library*, *34*(1), 1–5.

Creswell, J. W. (2003). *Qualitative, Quantitative, and Mix Methods Approaches. Second Edition*. Sage Publication.

Dana, G. (2018). *Analisis Biaya Lingkungan (Studi Kasus Pada PT. Semen Tonasa Di Kabupaten Pangkep)*. 45–50.

Fitri, S. (2011). Akuntansi dan Laporan Keuangan untuk Biaya Lingkungan dan Kewajiban Lingkungan. *Juris*, *10*(1), 270177.

Hadari, N. (2003). *Metode Penelitian Bidang Sosial*. Gajah Mada University Press.

Jargalsaikhan, B. E., Ganbaatar, N., Urtnasan, M., Uranbileg, N., Begzsuren, D., Patil, K. R., Mahajan, U. B., Unger, B. S., Goyal, S. N., Belemkar, S., Surana, S. J., Ojha, S., Patil, C. R., Mansouri, M. T., Hemmati, A. A., Naghizadeh, B., Mard, S. A., Rezaie, A., Ghorbanzadeh, B., … Yuanita, E. (2019). Pengaruh Kualitas Pelayanan Terhadap Kepuasan Konsumen Pada Hotel Pop Di Bandar Lampung. Molecules, *9*(1), 148–162.

Loen, M. (2018). Penerapan Green Accounting dan Material Flow Cost Accounting (MFCA) terhadap Sustainable Development. *Jurnal Akuntansi dan Bisnis Krisnadwipayana*, *5*(1), 1–14. https://doi.org/10.35137/jabk.v5i1.182

Marota, R. (2017). Green Concepts and Material Flow Cost Accounting Application for Company Sustainability. *Indonesian Journal of Business and Entrepreneurship*, *3*(1), 43–51. https://doi.org/10.17358/ijbe.3.1.43

Meilanawati, R. (2009). *Analisis Pengungkapan Biaya Lingkungan (Environmental Costs) pada PT Semen Indonesia Persero, Tbk*. 1–20.

Savage, D. E., Ligon, P. J., & Lomsek, J. (2001). *Environmental Management Accounting: Policies and Linkages.*

Schaltegger, S., Hahn, T. & Burritt, R. (2000). Environmental Management Accounting for, Overview and Main Approaches. *Centre Management., Sustainability*.

Schaltegger, S., Hahn, T., & Burritt, R. (2000). Environmental Management

Accounting: Overview and Main Approaches. *Centre for Sustainability Management*, 1–23.

Syarif, A. M., & Novita, N. (2019). Environmental Management Accounting with Material Flow Cost Accounting: Strategy of Environmental Management in Small and Medium-sized Enterprises Production Activities. *Indonesian Management and Accounting Research*, *17*(2), 143. https://doi.org/10.25105/imar.v17i2.5313