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Assessing the awareness of environmental management accounting in the mining industry in South Africa

Abstract

Mining activities normally have a huge impact on the environment. The whole lifecycle of a mining company with activities such as exploration, development, production and mine closure could result in high environmental costs. The years of waiting between the start of exploration, commencement of production and mine closure create specific challenges in the field of accounting for mining companies. Most of the damages caused by mining activities cannot be hidden and has to be accounted for, and that requires a sound accounting system. It is therefore important for a mining company to implement a system that accounts for environmental costs.

This study assesses the awareness of Environmental Management Accounting (EMA) in the mining industry. A questionnaire is administered to a selected group of participants, consisted out of mine management personnel, financial practitioners and environmental practitioners from different mining organizations in Gauteng, Mpumalanga and North West provinces of the Republic of South Africa.

The overall findings of the study indicated relatively high levels of awareness of environmental management accounting in the mining industry; however, there are differences between the different functional groups. In most of the responses it was clear that the environmental and financial practitioners have a stronger sense of awareness about the importance of EMA than the managers of the mine.

Keywords: environmental management accounting, environmental management system, sustainability reporting, mining industry.

JEL Classification: M41, O13, Q56.

Introduction

It is critical to ensure sustainability and save the environment, while developing countries are still in the process to expand their economies (Farouk, Cherian and Jacob, 2012). This is the case especially for countries depending on natural resources for economic growth. During times of an economic crisis or recession, the effect of environmental costs becomes more important for mining companies, specifically those in developing countries. Government authorities may introduce legislation and regulate the industry but the mining companies will have to buy-in and be sensitive to the environment. This requires the provision of adequate information on corporate social and ecological impacts and performance for decision makers. Society demands environmental responsible behavior from both the government and business by examining ecological disasters and degradation of the earth's ecosystem (Jasch, 2003).

According to Bennett, Bouma and Wolters (2002) organizations in the mining business, energy-reliant manufacturers and power generating utilities are more likely to be under pressure with respect to implementing environmental accounting. Environ-

mental Accounting (EA) is defined as a management tool that integrates financial implications of environmental issues in the financial systems of different organizations in order to enhance more effective decision-making to promote environmental and economic sustainability. Environmental accounting (EA) is important to determine and create awareness regarding costs related to environment. The awareness and practice of environmental accounting helps to identify the techniques for reducing and avoiding related environmental costs (Farouk et al., 2012).

EA is divided into three components, namely, environmental management accounting (EMA), environmental financial accounting and reporting, and auditing for environmental aspects in the financial statements (IFAC, 2005).

According to the International Federation of Accountants (IFAC) (2005), EMA is the management of the environment and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. The definition includes reporting and auditing. In some companies, EMA involves lifecycle costing, full-cost accounting, benefits assessment and strategic planning for environmental management. EMA is the management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices (Mohr-Swart, 2008). Another shorter definition by

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Ambe (2007) of EMA is the identification, collection, analysis and use of environmental information for internal decision-making and also to differentiate between the physical and monetary information. The focus of this study is in the field of EMA.

1. Literature review

1.1. Introduction. According to Kurniati, Rahadi and Danial (2010), EMA has formed part of an increasing literature research and approach that has emerged to assist organizations to utilize accounting information for environmental sensitive decision-making. Damages or disturbances to the original state of the environment are unavoidable and will require sound decision-making processes informed by credible data. Failure to collect data about the environmental impacts associated with business operations could result in information, which is insufficient to provide in the needs of corporate management to keep up with the changing requirements of the marketplace (Savage and Jasch, 2005; Debnath, Bose and Dhalla, 2012). Internal decision makers within the organization, including public authorities are finding it difficult to link environmental information to economic variables and are lacking environmental cost information (Betianu and Briciu, 2010, p. 1).

It is clear that with current practices a change is needed in the generally accepted accounting principles to record environmentally sensitive costs. Some companies are acting on voluntary disclosure practices which are not sufficient to address a sustainable environment. EMA principles, tools and new methods designed by researchers and practitioners can be used to generate information, containing economic as well as environmental sensitive costs, and support management to enable environmentally-sensitive decision-making. According to Ambe (2007), there is apparently a lack of awareness of the environmental costs because of organizational processes, and subsequently opportunities for cost savings are lost. This was also confirmed with a study done by Doorasamy, and Garbharran (2015), indicated that many companies were unable to meet their sustainability targets and ultimately impacted on company profitability. The study concluded by stating that environmental costs in many company's financial documentation were incorrect because environmental costs were previously reflected as production costs.

1.2. Background. The aim of EMA is to identify the environmental damages that may be caused by any activity, to measure the social and benefit cost, to report environmental accounting information, and to account for external problems quantitatively (Kurnati et al., 2010). The awareness and practice

of EMA helps to identify the techniques for reducing and avoiding related environmental costs (Farouk et al., 2012).

It is clear that the industry cannot avoid environmental impacts of the mining operations. The awareness of EMA will therefore benefit the companies in the mining industry. Mining companies that are certified under the International Organization for Standardization (ISO 14001) should have an Environmental Management System (EMS) for collecting and recording environmental information that can be easily used and imported into EMA.

As mentioned in the statements above and also according to Ferreira, Moulang and Hendro (2010), EMA is a growing area of research and has received relatively little attention from accounting researchers in the past. It is therefore necessary to assess the awareness of some stakeholders with regard to EMA.

1.3. Environmental management accounting (EMA). Most of the research articles on EMA are in developed countries and on the cost-benefit analysis of the implementation of individual EMA tools (Farouk et al., 2012). EMA is trying to establish the relationship that exists between decision-making situations and the motivation for the application of EMA tools, including barriers towards the implementation process (Farouk et al., 2012). The decision-making processes should be improved for the purpose of increasing responsibility and accountability by all people with regard to issues affecting the environment (Betianu et al., 2010).

1.4. Potential benefits of EMA. EMA is particularly valuable for internal management initiatives with a specific environmental focus. The same information collected could also be used for external reporting purposes. EMA is important for environmental management decisions and all types of management activities. It can further help business to reduce waste, generate value and work with other resources to support strategic planning in the business (Debnath et al., 2012). The utilization of Environmental performance indicators (EPI), that is a vital element of EMA, has various benefits for a company according to a study done by Henri and Journeault (2008). Some benefits of EPI are that it supports and communicates the environmental strategy throughout the company and supports and ensures conformity of the environmental processes helping the company to obtain and maintain ISO 14001 certification.

1.5. EMA challenges. Some of the challenges of EMA are communication, hidden costs and the availability of the information. Communication between the accounting and other departments is often not well developed. Environment-related cost information is

often “hidden” in overhead accounts. Materials used, flow and cost information is not often tracked adequately. Many types of environment-related cost information are not found in the accounting records, and investment decisions are often made based on incomplete information (Bennet et al., 2002).

1.6. Mining industry and environmental management accounting. There are communities living near the mines and therefore mining has a huge impact on these surrounding communities (Mohr-Swart, 2008). Mining activities affect the biophysical environment especially in the way it is performed in order to extract the final product from raw material. Environmental impacts are measured according to different types of mining methods, which are actually determined, by the size and geographic nature of the area being mined. Different types of mining operations or methods include underground (deep) and open cast (shallow) mining operations (Fuggle and Rabie, 2003).

Impacts of mining activities in South Africa are considered critical when it comes to water quality. The contamination of water due to acid mine drainage and other related factors reduce the amount of clean water available in South Africa (Clement and Forster, 2000, p. 22). South African mining industry is regulated and environmental issues are addressed in the legislation. Two acts that are directly related to the mining industry include the Minerals and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) (SA, 2002) and the Mine Health and Safety Act (No. 29 of 1996) (MHS) (SA, 1996).

The implementation of an EMA system will assist mining companies to improve the management of environmental costs, better formulate business strategies, more accurately cost products and processes, and discover new opportunities to reduce environmental costs (Mohr-Swart, 2008). It is important for accountants to have a clear understanding of the environmental management systems and to link the accounting methods to EMA.

1.7. South African perspective on environmental management accounting. There are some examples of EMA studies conducted within the South African mining industry. According to Mohr-Swart (2008) the companies in the South African mining industry need to recognize that the long term future and sustainability of operations is inescapably linked to the ability to reduce the environmental impacts and improve environmental performance. A case study was conducted on four South African mines. The main findings indicated the following:

- ◆ Financial criteria are not brought into consideration when identifying significant environmental aspects in the environmental management program reports.

- ◆ Environmental costs such as water, energy and consumables were hidden. Costs were accumulated and allocated in overheads by the current costing systems (Mohr-Swart, 2008).

Another study performed by Ambe (2007) has indicated that there is a growing awareness of the financial implications of environmental performance. Environmental accounting practices have shown a gradual increase although the current application of environmental accounting is still at low levels in South Africa (Ambe, 2007). According to KPMG (2012) survey findings, there is a growing awareness of financial implications of the environmental performance and environmental accounting practices are being explored in order to manage costs. There is still a lack of formal environmental accounting systems and environmental performance information is critical for EMA.

2. Problem investigated

Mining companies are exposed to legal and contractual obligations to meet costs of current production and mine closure. Environmental management accounting (EMA) can be of assistance in the process to manage and keep track of internal and external environmental costs (Betianu and Briciu, 2010, p. 6). Accountants and environmental officers need to realize the uses and benefits of EMA. The following research questions can be formulated based on the above-mentioned overview of the research problem:

- ◆ Is the mining industry (especially mine management, accountants and environmental practitioners) aware of EMA?
- ◆ Are the three identified groups equally aware of the importance of EMA?
- ◆ What is currently addressed by the different groups as important information in terms of environmental issues, environmental management systems (EMS), the drivers of EMS and other information that should be part of EMA?

3. Research objectives

The main objective of the study is to assess the awareness of EMA in the mining industry. This study will further assess current environmental management practices as well as mining companies' attitudes and awareness on environmental issues with regard to the incorporation and the practise of EMA in their accounting system.

4. Research method

The methodology to collect the data was based on a quantitative approach. A modified questionnaire adopted from Ambe (2007), where the main objective was to show a South African perspective on the theory and practice of environmental management

accounting, was administered to the participants. Participants of the study were mine management, environmental and financial practitioners. In order to collect data a convenience sample was taken from the above-mentioned population. The rationale for the chosen participants was based on their decision-making ability, knowledge and expertise in the mining environment. The participants were selected from the provinces of Gauteng, Mpumalanga and North West. The number of questionnaires distributed to participants in the mining industry were 200 and 129 were completed and returned. This results in a response rate of 64.5%. Measuring tools used in the analysis include statistical analysis and descriptive statistics.

Considering that environmental pollution is a sensitive issue in the mining industry the study could indicate some limitations. The fact that some green peace organizations and environmental activists are critical about the mining industry might lead to limited responses with regard to the environment. Some respondents may be afraid to expose, incriminate or implicate their employer in environmental non-compliance. This may subsequently compromise and limit honesty of respondents in completing the questionnaire.

5. Results

5.1. Organizational characteristics. The main objective of section 1 was to understand the differences in the companies and related perception of practises of EMA. Organizational characteristics of interest from the mining companies in this study were the legal status of the business, geographical location, approximate annual turnover, number of employees and functional responsibilities of the selected participants. Concerning the legal status of the participants 58.5% represented private companies and 40.8% were from public companies. There was only one close corporation organization that participated in the survey.

5.1.1. Geographical location of the organization. Percentage proportions for geographical locations of the companies’ respondents according to provinces

were Gauteng (29.2%), Mpumalanga (32.3%), and North West (38.5%).

5.1.2. Approximate annual turnover of the organization. In this study the approximate turnover of all the organizations that participated was more than R50 million according to respondents. The proportional percentages were R50 million to R500 million (6.9%), R500 million to R1 billion (57.7%) and more than R1 billion (33%).

5.1.3. Number of employees in the organization. In this study, all companies employ more than 100 employees, and most of the organizations employ between 501-1000 employees. This is an indication that most of the mining companies in this study are large companies and employ many people.

5.1.4. Participants’ functional roles in the organization. Targeted participants according to their roles in the company, expertise and understanding of the mining industry were mine management, environmental and accounting practitioners. The percentage proportions of participants were environmental practitioners (36.9%), mine management (33.1%), and financial practitioners (29.2%).

5.2. Environmental issues. Environmental issues are inevitable in the mining industry due to the nature of the business. The main objective of this section was to determine the existence of (1) environmental strategies and tools, (2) to identify the drivers of the organizations’ environmental management system, and (3) to indicate the current levels of importance of the protection of soil and ground water, surface water use and the importance of land management to mining organizations. Each one of these environmental issues were handled separately.

5.2.1. Environmental strategies and tools. The main objective of this sub-section was to assess the existence and level of awareness of environmental strategies and tools such as environmental policy, environmental management system (EMS), environmental action plans or/and whether the company has quantified environmental targets and lastly if the company is ISO 14001 certified.

Table 1. Environmental strategies and tools

Environmental strategies and tools	Yes		No	
	Frequency	Percent (%)	Frequency	Percent (%)
Environmental policy	129	100.0	0	0
Environmental management system (EMS)	129	100.0	0	0
Environmental action plan or/and quantified environmental targets	128	99.2	1	0.8
ISO 14001 certification	127	98.5	2	1.5

All 129 respondents answered yes on the first two questions and indicated that they are aware of the environmental policies and EMS that exist in their

organization. Ninety-nine percent of the employees answered yes, indicating that they have environmental action plans and quantified targets. Envi-

ronmental certification by the Organization for International Standard (ISO) was also indicated by 98.5% of the mining companies. In summary of this section all respondents have shown an overwhelming awareness of organizational environmental strategies and tools.

5.3. Drivers for the organizations’ environmental management system (EMS). A 5-point Likert-type-scale, ranging from (1) to (5), where (1) is extremely low and (5) extremely high, was used to rate the levels at which certain aspects serve as drivers for the organization’s EMS.

Table 2. Drivers for the organization’s environmental management system

Rating – Level	1	2	3	4	5	Mean	Std. deviation
Frequency	0	1	23	41	65	4.31	0.79
Percent (%)	0	0.8	17.7	31.5	50.0		
Frequency	0	4	27	56	43	4.06	0.81
Percent (%)	0	3.1	20.8	43.1	33.1		
Frequency	4	9	21	37	59	4.06	1.08
Percent (%)	3.1	6.9	16.2	28.5	45.4		

Compliance with regulation was rated extremely high by half of the respondents (50%) with a mean of 4.31 and standard deviation of 0.79 (Table 2). The drivers for the organizations to have an EMS, namely certification by an international standard body as well as attention to corporate citizenship were also rated high, by a mean of 4.06 for both drivers. The next step was to establish if there are any differences in how the different functional roles rated the drivers as important for a EMS.

It is a similar situation between mine management and both financial and environmental practitioners with regard to certification by an international standard body. Financial practitioners rate certification by an international standard extremely higher than environmental practitioners and mine management.

Table 3. Effect sizes with regard to drivers for EMS

Drivers for the company’s EMS	Functional roles		
	Environmental practitioners	Financial practitioners	Mine management
Compliance with regulation	0.71	0.80	*
Certification by an international standard	0.54	1.35	*
Corporate citizenship	1.05	1.11	*

Practical significant differences exist between mine management and both financial and environmental practitioners with regard to corporate citizenship as indicated in Table 3. Mine management rated corporate citizenship extremely lower as a driver for EMS in the company in comparison with the financial and environmental practitioners.

Notes: * refer to unpractical significant difference.

There is a practical significant difference between mine management and both financial and environmental practitioners with regard to compliance with regulation as indicated by the effect sizes in Table 3 of 0.71 and 0.80. Compliance with regulation does not necessarily serve as a main driver for an EMS for mine management personnel.

5.3.1. Environmental issues of current importance to organizations. Different organizations view the current importance of environmental issues differently. It may be due to the type of commodity and its impact on the environment. Organizations should ensure the protection of soil and ground water during mining activities. Mining operations require lot of water and large area of land, so surface water use and land management remain important environmental issues affecting the mining industry. Environmental issues considered of current importance to the mines in this study were (1) protection of soil, (2) protection of ground water, (3) surface water use and (4) land management.

Table 4. Ratings on current important environmental issues

Current important environmental issues	Rating – Level	1	2	3	4	5	Mean	Std. deviation
Protection of soil	Frequency	0	2	21	50	54	4.23	0.78
	Percent (%)	0.0	1.5	16.2	38.5	41.5		
Protection of ground-water	Frequency	0	7	20	42	58	4.19	0.90
	Percent (%)	0.0	5.4	15.4	32.3	44.6		
Surface water use	Frequency	0	4	18	30	77	4.28	0.90
	Percent (%)	0.0	4.6	15.4	26.2	51.5		
Land management	Frequency	0	2	14	37	74	4.44	0.75
	Percent (%)	0.0	1.5	10.8	28.5	56.9		

Respondents have rated land management as the highest priority of current importance to the mine compared to the other environmental issues. A maximum of seventy-four respondents (56.9%) with a mean of 4.44 rated land management as of extremely high importance. Surface water use was rated the second high-

est environmental issue, followed by the protection of soil and the protection of ground water in the fourth place. The environmental issues were grouped into one category with a calculated group mean. The average mean for the group of environmental issues were then evaluated for differences between the functional roles.

Table 5. Effect sizes with regard to environmental issues of current importance and functional roles

Environmental issues of current importance	Functional roles	Mean		Effect size
		1	2	
Protection of soil	Mine management	3.595		*
Protection of ground water	Financial practitioners		4.623	1.91
Surface water use	Environmental practitioners		4.638	1.94
Land management				

Notes: * refer to unpractical significant difference.

Mine management rated current environmental issues of less importance to the organization comparing to the other respondents. Financial and environmental practitioners rated environmental issues of extremely high importance to the organization as indicated by the large effect sizes of 1.91 and 1.94 in Table 6.

5.4. Compilation of sustainability reports. The main objective of this section was to assess participants' awareness of environmental information disclosed by the mines in their annual reports. Disclosures of environmental information contribute towards the awareness of EMA in the mining industry.

Environmental information to be disclosed by the mines in their annual reports could include items such as environmental objectives, quantitative non-financial information, financial environmental in-

formation, environmental performance indicators, initiatives to manage the environmental impacts and information regarding incidents, fines or non-monetary sanctions for non-compliance. Performance indicators are the measures for the objectives and goals set by the organizations in terms of their environmental performance. During the process of mining unwanted or unintended spillages or accidents might occur, so these spillages, accidents or non-compliance to regulations, are incidents that should be reported on.

A yes or no answer was provided on whether the organization discloses the environmental information (Table 6) in their annual reports. These kind of information could serve as an indication of their awareness of environmental information disclosures.

Table 6. Awareness of disclosures of environmental information in the annual report

Environmental information in the annual report	Yes		No	
	Frequency	Percent (%)	Frequency	Percent (%)
Environmental objectives	129	100	0	0
Quantitative non-financial information	105	80.8	24	18.5
Financial environmental information	95	73.1	34	26.2
Environmental performance indicators relating to materials, energy & water	120	92.3	9	6.9
Initiatives to manage the environmental impacts of products	126	96.9	3	2.3
Incidents, fines or non-monetary sanctions for non-compliance	104	80.0	25	19.2

All 129 respondents answered yes to disclosures on environmental objectives. One-hundred and five respondents (80.8%) were aware of quantitative non-financial information in annual reporting. The least responses were on the awareness of disclosures on financial environmental information by companies in their annual reports (73.1%).

All the other indicators were rated 80% and above, illustrating that the respondents were all well informed about the disclosure of these items in their reports. In the next Table some of the environmental disclosures were once again evaluated to indicate the differences between the different functional roles.

Table 7. Indicates percentage awareness responses of participants on environmental disclosures in the annual reports

Environmental information in the annual report	Percentage (%) responses of participants		
	Mine production personnel	Environmental practitioners	Accounting practitioners
Quantitative non-financial information	47.6	95.8	100

Table 7 (cont.). Indicates percentage awareness responses of participants on environmental disclosures in the annual reports

Environmental information in the annual report	Percentage (%) responses of participants		
	Mine production personnel	Environmental practitioners	Accounting practitioners
Financial environmental information	21.4	97.9	100
Incidents, fines or non-monetary sanctions for non-compliance	42.9	100	100

Mine management was less aware of disclosures on quantitative non-financial information. The percentage proportions were mine management (47.6%), environmental (95.8%) and accounting practitioners (100%) as indicated in Table 7.

Mine management was also less aware of the companies disclosures on financial environmental information. Only 21.4% of the mine management were aware of the financial environmental information. 42.9% of mine management were also not aware of the organizations' disclosures on incidents, fines or non-monetary sanctions for non-compliance in their annual reports.

Conclusions

Most of the mining companies in the research study were privately owned. The majority of the respondents were from the North-West province. There was almost an equal distribution between the respondents in terms of their functional roles in the mines. Companies that participated in the study achieved an approximate annual turnover of R500 million – R1 billion.

Almost all respondents have indicated that their companies have environmental strategies and tools with regard to environmental policies, environmental management systems, environmental action plans or/and quantified environmental targets and ISO 14001 certification. In summary of this section all respondents have shown an overwhelming awareness of organizational environmental strategies and tools.

In terms of identifying the drivers for companies' EMS it seems that to comply with regulations was the main driver for a company to have an environmental management system. Corporate citizenship was rated lower by mine management, which is an indication that environmental costs are strongly associated with mining activities and that the mine management is not very concerned about corporate citizenship. Mine management also rated current environmental issues such as protection of soil and protection of ground and surface water of lower importance to the company. Financial and environmental practitioners rated environmental issues as extremely important to their companies.

All the indicators related to environmental information that should be part of the annual report, except financial environmental information, were rated 80% and above, illustrating that the respondents were all well informed about the disclosure of these items in their reports. Mine management was the least aware of the company's disclosures on financial environmental information. 42.9% of mine management were also not aware of the company's disclosures on incidents, fines or non-monetary sanctions for non-compliance in their annual reports. To report on these kind of environmental errors or some or other high profile incident could emphasize the fact that the company takes these incidents seriously. There is also the possibility that these incidents could threaten the company's license to operate. To be open about these incidents would restore the trust of the society in the legitimacy of the company's operations.

Managerial implications and recommendations

Environmental information should be available for the implementation of EMA. Mining companies have put environmental management systems in place to monitor environmental information. Communication between the accounting and other departments is often not well developed and could be emphasized. Environment-related cost information that is often part and hidden in the overhead accounts could be analyzed by using the principles of activity based costing. This improved analysis and costing methods are needed to identify these environmental-related costs. Environmental costs should be clearly defined to avoid misunderstanding and incorrect allocation for mine management, and both environmental and accounting practitioners.

It is recommended that companies should integrate their systems in order to raise the awareness of EMA in the mining industry. Increased awareness of EMA will lead to easy implementation of EMA and the mining industry will realize the benefits and advantages of EMA.

Employee awareness campaigns, education and training could improve the awareness of EMA in the mining industry. The communication gap between mine management, environmental and financial practitioners should be addressed in order to ensure awareness and implementation of EMA.

References

1. Ambe, C.M. (2007). Perspectives on environmental management accounting in South Africa, *Southern African Journal of Accountability and Auditing Research*, 7, pp. 59-66.
2. Bennett M.J.J., Bouma and Wolters, T. (Eds.) (2002). *Environmental Management Accounting: Informational and Institutional Developments*. Selected papers from EMAN-Europe conferences, 1999 and 2000. Dordrecht: Kluwer Academic.
3. Betianu, L.J. and Briciu, S. (2010). *The impact of the economic crisis on environmental costs*. Alexandru Ioan Cuza University of Iasi, Romania.
4. Burrit, R.L. and Christ, K.L. (2013). Environmental management accounting: the significance of contingent variables for adoption, *Journal of Cleaner Production*, 41, pp. 163-173.
5. Clement, K. and Forster, S. (2000). An investigation into mining as energy and water using sector and its environmental impacts. Paper presented to the Development Bank of Southern Africa as part of the WWF funded project: Macroeconomic reforms and the environment. Midrand: DBSA.
6. Debnath, S., Bose, S.K. and Dhalla, R.S. (2012). Environmental management accounting: An overview of its methodological development, *International Journal of Business Management*, 5, pp. 44-57.
7. Doorasamy, M. and Garbharran, H. (2015). The role of environmental management accounting as a tool to calculate environmental costs and identify their impact on a company's environmental performance, *Asian Journal of Business and Management*, 3(1), pp. 8-30.
8. Farouk, S., Cherian, J. and Jacob, J. (2012). Green accounting and management for sustainable manufacturing in developing countries, *International Journal of Business and Management*, 7(20), pp. 34-48.
9. Ferreira, A., Moulang, C. and Hendro, B. (2010). Environmental management accounting and innovation: exploratory analysis, *Accounting and Auditing Journal*, 23, pp. 920-948.
10. Fuggle, R.E. and Rabie, M.A. (2003). *Environmental management in South Africa*. Cape Town: Juta.
11. Henri, J-F. and Journeault, M. (2008). Environmental performance indicators: An empirical study of Canadian manufacturing firms, *Journal of Environmental Management*, 87, pp. 165-176.
12. IFAC. (2005). *International guidance document: Environmental Management Accounting International Federation of Accountants*. New York, NY: IFAC.
13. Jasch, C. (2003). The use of environmental management accounting (EMA) for identifying environmental costs, *Journal of Cleaner Production*, 11, pp. 667-676.
14. KPMG. (2012). *Energy and natural resources. Impact of IFRS: Mining*. London: KPMG International.
15. Kurniati, E., Rahadi, B. and Danial, M. (2010). Implementing environmental management accounting (EMA) in improving eco-efficiency on corporate activities: Case study on sugarcane company, *Journal of Applied Sciences in Environmental Sanitation*, 5(4), pp. 403-410.
16. Mohr-Swart, M. (2008). *Environmental Management Accounting Model for the South African Mining Industry*. Pretoria: Chamber of Mines of South Africa, pp. 1-396.
17. Savage, D.E. and Jasch, C. (2005). *International guidance document: environmental management accounting*. New York, NY: IFAC.