ISSN 2520-6303

Economics, Management and Sustainability
journal home page: https://jems.sciview.net

Nyahuna, T., Doorasamy, M., & Baldavoo, K. (2024). Does air pollution motivate organizations to adopt environmental management accounting practices? Evidence from South Africa. *Economics, Management and Sustainability, 9*(1), 53-60. doi:10.14254/jems.2024.9-1.4.

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# Does air pollution motivate organisations to adopt environmental management accounting practices? Evidence from South Africa

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OPEN ACCESS

**Article history:**
Received: December 03, 2023
1st Revision: February 07, 2024
Accepted: May 06, 2024

**JEL classification:**
Q56
M415

**DOI:**
10.14254/jems.2024.9-1.4

**Abstract**: This paper identifies the extent of air pollution in motivating companies to implement environmental management accounting (EMA) practices in 67 mining and cement companies listed on the Johannesburg Stock Exchange (JSE), South Africa, from 2012 to 2021. Pooled ordinary least squares regression is applied to analyse the data. EMA is proxied by environmental training, environmental audits and energy efficiency, while air pollution is measured based on the air quality index (AQI). The results show that air pollution is essential for companies to adopt EMA practices. This means that when air quality declines within a company's locality, a company proactively adopts EMA practices. This suggests that air pollution is a key basis of companies' adoption of EMA, as predicted by the legitimacy theory. The study includes three control variables: size, return on assets (ROA) and number of years listed on JSE. Two control variables, namely Size and ROA, portray a positive and significant effect on adopting EMA from air pollution. This portrays that a financially stable company tends to submit to air pollution and use EMA to counter the pollution. In contrast, as the number of years increases for companies listed on JSE, EMA will likely be adopted less to reduce air pollution.

**Keywords:** environmental management accounting, environmental management, air pollution, Johannesburg Stock Exchange, King Code IV

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## 1. Introduction

With the rising development of South Africa's economy, air pollution produced from manufacturing production remains increasingly serious (Tshehla & Wright, 2019). The World Air Quality Report (2019) shows that South African towns are responsible for 23 of the world's 100 worst polluted towns, and 40% surpass the maximum guidelines of the World Health Organization. In line with Ali et al. (2020), air pollution produces almost $60 billion in economic damages annually, and about 2 million people die from it. Moreover, it has been scientifically proven that air pollution is responsible for social instability (Yin et al., 2017).

Given the above scenario, governments worldwide continually improve environmental regulations by propagating laws and policies. For instance, in South Africa, the recently revised Air Quality Act (No. 20 of 2014) was revised in 2016, and it made corporations answerable to formal institutions, thus augmenting their sustainability. Because of the solid externality of ecological problems, air pollution also requires close monitoring by the corporate sector to minimise ecological damage. This helps organisations maintain their credibility and reputation through a positive corporate image (Li & Zhang, 2019).

Scholars argue that one of the critical platforms for monitoring air pollution is the corporate sector's use of environmental management accounting practices. This system empowers organisations to attain sustainability. It calls for organisations to assume the responsibility of ecological conservation and pollution control, thus accomplishing the economic, environmental and social benefit. Therefore, will air pollution motivate corporations to implement EMA practices? Contemporary literature is silent on how air pollution can prompt the adoption of EMA practices within corporations. Hence, Li et al. (2018) contend that prior research papers studied the effects of environmental strategies on air pollution, ignoring the importance of air pollution in adopting EMA practices. Therefore, the link between air pollution and EMA adoption within corporations is unclear, and this research attempts to narrow this gap.

## 2. Literature review

According to an emerging body of literature, air pollution in the city where a firm is located significantly affects the firm's business strategy (Danie & Tobias, 2020; Lin et al., 2021; Liu et al., 2021). These studies on business strategies and air pollution focus on the levels of corporate investment, corporate social responsibility (CSR), and cash holdings. However, it is unclear how air pollution in a city in which a firm is located influences its business strategy for employing capital and labour in operations.

Contemporary literature holds the view that there are two key elements of literature on the drivers of EMA. The first element centres on the costs and benefits of EMA from a strategic perspective. Adopting EMA is a component of a wider corporate strategy. EMA is viewed as the intersection between environmental management and accounting, in which a company attains economic and environmental imperatives equilibrium. EMA provides physical and monetary environmental information for decision-making that the traditional accounting system cannot provide. Therefore, EMA makes environmental costs accurately known by management. Travaglio et al. (2021) identify that when a firm implements proactive EMA tools, negative environmental impacts such as air pollution are reduced through improved production processes and systems. Hence, scholars argue that EMA enhances corporate financial performance (Wasara & Ganda, 2019; Voinea et al., 2020; Şimşek & Öztürk, 2020). Using a sample of Chinese companies, EMA can be documented as contributing to better financial performance because of enhanced production processes, an amplified corporate image, and customer satisfaction. Prior research submits that, in marketing perspective, EMA brings benefits to an EMA adopting company in terms of customer satisfaction. In terms of financial outlook, EMA assists corporations in augmenting their financial performance.

The second component of the literature establishes a non-strategic outlook of EMA. Agyemang et al. (2021) and Burrit et al. (2016) postulate that management's commitment is vital to EMA adoption. Chathurangani and Madhusanka (2019) accept that drivers for EMA stem from numerous internal institutional factors such as company culture and corporate leadership. Additionally, external institutional factors of "globalisation pressure, politics, and society" are fundamental in compelling organisations to implement EMA. Le et al. (2019) studied 56 manufacturing companies in Vietnam concerning the effect of institutional underlying forces on EMA adoption. The authors theorised that the Vietnam companies generally lack a logical and institutionalised approach to EMA. Instead, managers rely on management's leadership and cultural customs when approaching EMA.

Overall, this literature component suggests that companies adopt EMA based on public moral motives and/or institutional factors related to their corporations internally and externally.

It can be observed that adopting EMA practices within a company is intricately linked to the air environment. Therefore, studying the effect of air pollution on EMA adoption is of broader connotation. However, research on the relationship between the two remains missing at this stage. Therefore, based on the perspective of an emerging market- South Africa- this study is more favourable for filling this lacuna in the literature.

## 2.1. Hypothesis development

Our opinion on the association between air pollution and EMA adoption is in line with the environmental stress theory (Lee & Schaltegger, 2018) and stakeholder theory (Wang et al., 2020). The environmental stress theory claims that environmental factors lead to individual reactions. When individuals face unsafe events near them, they encounter the antagonistic effects disclosed through their reasoning, mood or attitude. Consequently, when air pollution deteriorates, managers feel angry and respond to the harmful environment. To support this, the World Health Organization performs a 27-country study on the effect of air pollution on welfare and provides results in line with the environmental stress theory (Tan et al., 2020).

The environmental stress theory on its own, nonetheless, does not clarify why managers participate in more EMA practices. Borrowing from the stakeholder theory, managers discover that EMA assists them in upsurging their legitimacy among stakeholders (Mahmood et al., 2017). As a result, stakeholders put direct and indirect pressure on corporations to adopt EMA practices (Petera et al. 2021). Fundamentally, EMA drives a company to attain a balance of economic and environmental commitment but requires to fit in the anticipations of shareholders and stakeholders. Integrating both environmental and stakeholder theories, air pollution worries managers and shoves them to take action. Considering all reactive undertakings, managers are expected to adopt EMA to involve external stakeholders, particularly those associated with the environment, such as air pollution.

This paper argues that due to personal health motives, managers are more pro-environment after their contact with severe air pollution. Everything being constant, we assume managers upsurge their attentiveness to the negative effects of pollution and become more EMA-friendly when they reside or work in an area characterised by high air pollution. Therefore, based on these arguments, the proposed hypothesis is:

*H1: Air pollution influences companies to adopt environmental management accounting practices*

# 3. Methodology

This research explores the link between air pollution management and environmental management accounting practices for companies in South Africa. The sample choice, air pollution index and environmental management accounting practices proxies are explained below:

## 3.1. Sample

The study uses a sample of polluting companies from the mining and manufacturing sectors listed on the Johannesburg Stock Exchange. In total 67 companies were used to collect data from 2012 to 2021. However, 22 companies were excluded due to the absence of air pollution data. The research focuses on 2012 because it is the first publicly available air quality index period for cities.

## 3.2. Data

EMA practices are obtained from the sustainability and environmental reports on the Johannesburg Stock Exchange website. Wasara and Ganda (2019) note that annual corporate reports from the Johannesburg Stock Exchange are reliable for providing accurate environmental information due to the operation of the King Code IV, which mandates companies to report their environmental and sustainability issues extensively. In this paper, EMAP is proxied by environmental audits, training, and energy efficiency.

Air quality index data is extracted from the South Africa Ministry of Tourism and Environment database. Kong et al. (2020) said that "a high-quality index signifies bad air pollution." The advantage of applying the air quality index is that it makes available the 6 indexes of "sulphur dioxide, nitrogen dioxide, PM2.5, PM10, carbon monoxide, and ozone" (Li et al., 2019).

## 3.3. Model specification

To investigate the nexus between air pollution and EMAP adoption, the following regression model is displayed:

$$EMAP_{i,t} = \beta_0 + \beta_1 AQ1_{i,t} + \beta_2 List + \beta_3 ROA + \beta_4 SIZE + \varepsilon_{i,t}$$

Where, $\beta_0$ is a constant; $\beta_{1\text{-}4}$ are regression coefficients; *i* and *t* signify company and year; EMAP symbolises environmental management accounting practices applied to reduce air pollution; AQI represents the firms' pollution level.

Certain internal variables influence companies to adopt EMAP (Phan et al., 2017); therefore, it is important to control these variables to test the influence of air pollution on EMAP adoption. This study used three metrics as control variables: years listed on the Johannesburg Stock Exchange (LIST), return on assets (ROA), and SIZE. Size is measured as the company's total assets, while ROA is quantified as the "ratio of surplus/deficit of total assets" (Pratiwi et al., 2020). Hupp et al. (2018) hypothesise that larger companies are more often than not likely to reveal environmental accounting information to achieve legitimacy from various stakeholders. ROA is adopted as a metric of corporate financial sustainability. Gu et al. (2020) identify that organisations with higher returns on assets tend to disclose additional environmental information. Additionally, several years of sampled companies listed on the Johannesburg Stock Exchange were used to control the hypothesis. This stems from Wasara and Ganda's (2019) postulation that companies listed on a stock exchange are more likely to adopt EMAP than unlisted companies due to strict measures by most stock exchanges.

## 3.4. Data analysis

In testing the hypothesis indicated in the literature review, pooled Ordinary Least Squares regressions were applied with the SPSS version 26 software.

## 4. Results

Table 1 depicts the descriptive statistics linked with each variable used in the model. Averagely, EMAP is 45.761. This shows that most sampled companies extensively disclose environmental issues in annual reports. Additionally, most companies have been listed on the Johannesburg Stock Exchange for an average of 45 years. The means of EMAP and AQI are more significant than their standard deviations. Therefore, sampled companies are primarily weak in their EMAP and located in areas with poor air quality.

**Table 1: Descriptive statistics**

| Variables | N | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| *EMAP* | 670 | 45.761 | 21.520 | −2.761 | 112.440 |
| *AQ1* | 670 | 57.112 | 31.772 | 37.273 | 334.871 |
| *SIZE* | 670 | 41.554 | 4.912 | 22.954 | 189.391 |
| *ROA* | 670 | 0.021 | 0.091 | −0.126 | 0.251 |
| *LIST* | 670 | 45.677 | 23.98 | 0.001 | 71.003 |

The coefficients of air pollution (AQl) are favourable and significant at the 5% or 1% levels, implying that when air quality deteriorates in a town where a company is situated, a company engages in more EMAP. The findings are materially significant. Control variables in Table 3 reflect that SIZE and ROA are positive and significant at the 1%, 5% or 10% level, whereas the number of years listed on the Johannesburg Stock Exchange (LIST) is negative and material at the 1% or 10% level. This suggests that when a company is more significant, profitable or older, the company participates in more EMAP. On the contrary, as companies increase their years listed on JSE, they appear to be less interested in engaging in EMAP. This might mean that companies that spend more years listed on JSE have fewer resources to conduct EMAP or tend to ignore EMAP at that stage.

**Table 2: The effect of air pollution and EMAP**

| Variables | Score (1) | Score (2) |
|---|---|---|
| *AQI* | 0.001** | 0.041*** |
| | (4.52) | (3.21) |
| *SIZE* | | 1.992*** |
| | | (6.01) |
| *ROA* | | 12.181*** |
| | | (12.67) |
| *LIST* | | −0.001 |
| | | (−4.87) |
| *Constant* | 67.281*** | −171.981*** |
| | (23.76) | (−6.11) |
| *N* | 670 | 670 |
| *R2* | 0.223 | 0.431 |

***, **, and * signifify 1%, 5%, and 10% significance levels

**Table 3: The effects of control variables**

| Variables | Score (1) | Score (2) |
|---|---|---|
| *AQI* | 0.001*** | 0.031** |
| | (1.39) | (2.26) |
| *SIZE* | 2.459*** | |
| | (2.63) | |
| *ROA* | 0.214*** | |
| | (5.47) | |
| *LIST* | | 1.991** |
| | | (1.71) |
| *Control* | YES | YES |
| *Constant* | −32.921*** | −92.842*** |
| | (−21.91) | (−34.46) |
| *Firm FE* | YES | YES |
| *Year FE* | YES | YES |
| *N* | 670 | 670 |
| *R2* | 0.321 | 0.313 |
| *F* | 142.92 | 198.67 |

***, **, and * signify 1%, 5%, and 10% significance levels

## 5. Discussion

Our results indicate that air pollution is instrumental in motivating companies to adopt environmental management accounting (EMA) practices as a tool to reduce pollution. This supports recent findings by Raharjo (2019). That means that to attain legitimacy, companies use various initiatives such as adopting EMA. This suggests that this paper is a proponent of legitimacy. This emanates from the fact that companies have to respond to interested stakeholders' activism to alleviate air pollution when air pollution worsens. However, our results demonstrate that the number of years companies have been listed on JSE is less critical in pushing companies to apply EMA. As suggested by Burritt et al. (2019), adopting EMA remains voluntary in most developing countries; hence, most regulatory agencies are limited in enforcing environmental regulations. Therefore, the paper establishes that the number of years listed on JSE is of no effect in pushing companies to engage in EMA. This suggests that the JSE has no significant effect in stimulating companies to adopt environmental management initiatives to reduce air pollution. Therefore, This study provides a basis for the policy formulators to ensure that JSE is mandated to monitor its member that they are applying and implementing EMA practices to improve environmental management. Sambasivan et al. (2013) argue that the government alone cannot effectively manage and monitor companies' environmental performance; hence, there is a need to pass the responsibility to regulators such as stock exchanges. This proves that stock exchanges can be critical in reducing air pollution.

Overall, the paper identifies that companies in South Africa respond to air pollution by adopting EMA practices such as environmental auditing, environmental training and energy efficiency. Empirically, this proves that air pollution is a determinant of EMA adoption. In contrast, most previous studies (Anwar & Masawi, 2018; Burritt et al., 2019; Doorasamy, 2015) have focused on identifying the effect of EMA on air pollution.

## 6. Conclusion

By applying data on 67 listed mining and cement firms in South Africa from 2012 to 2021, we investigate air pollution's effect on EMA practices adoption. We argue that companies are forced to adopt EMA to accomplish societal legitimacy due to air pollution. In this case, EMA acts as a mitigation tool and legitimacy instrument. Our findings show that air pollution favourably determines companies adopting EMA practices. That means the poorer the air quality, the higher the companies are motivated to implement EMA and vice versa. Also, the study results indicate that size and return on assets positively improve the nexus between air pollution and EMA adoption. This implies that companies with higher assets and sound financial performance are likely to adopt EMA as an initiative to address air pollution directly. This indicates that financial performance and air quality are critical determinants of EMA adoption. Our research also provides empirical evidence that small companies are unlikely to implement EMA to reduce air pollution. This emanates from the findings that size is a crucial basis for adopting EMA practices to lessen air pollution. In this case, various incentives should be proposed for small companies to be conventional players in reducing air pollution. This is important as smaller companies produce a great deal of air pollution.

The findings of this study permit us to arrive at the following conclusions. First, high air pollution in South Africa is leading to the adoption of EMA practices by various public companies. This buttresses previous studies that established that cities with poor air pollution force managers to act to reduce air pollution (Pan et al., 2019). Thus, air pollution is a solid motivation for corporations to implement critical measures to lessen pollution. In this context, corporate financial performance plays a crucial role in formulating managers' motivation to adopt measures to reduce air pollution. Second, our research makes available empirical proof that the number of years companies are listed on the stock exchange is of no significance in determining companies' adoption of EMA from air pollution. Therefore, the number of years companies have on the stock exchange appears irrelevant to improving people's quality of life due to air pollution and EMA adoption. This means that the motivation to participate in EMA is multifaceted.

In the above, this paper uncovers theoretical and practical contributions to contemporary literature. In the view of legitimacy theory, our research stresses that companies tend to hunt for specific environmental measures to address air pollution to gain legitimacy from society. About the EMA literature, our results provide evidence that air pollution is a determining factor in companies' EMA practices. Al-Waeli et al. (2020) argue that extant literature only justifies that EMA is a valuable tool for reducing air pollution. However, the study is without limitations. We restrict it to JSE-listed companies in South Africa. For robustness, it would be prudent to get direct evidence from other developing countries involving listed and non-listed companies. Future research can focus on the financial consequences of participating in EMA practices after air pollution.

## Declarations

## Ethics approval and consent to participate

Not applicable.

## Consent for publication

Not applicable.

## Availability of data and material

The data are available on request.

## Competing interests

The authors declare no conflict of interest or competing interests.

## Funding

This work received no funding.

## Citation information

Nyahuna, T., Doorasamy, M., & Baldavoo, K. (2024). Does air pollution motivate organisations to adopt environmental management accounting practices? Evidence from South Africa. *Economics, Management and Sustainability, 9*(1), 53-60. doi:10.14254/jems.2024.9-1.4

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