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Water Sustainability and Financial Performance of Firms Listed on The Johannesburg Stock Exchange (JSE)

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Abstract: Objectives: The major purpose of this study was to examine the relationship between water sustainability and financial performance. **Prior Work:** Empirical research about water sustainability and financial performance is sparse in existing literature which created a research gap for this study. **Approach:** The study adopted a quantitative research method using secondary data. Panel data was collected for 8 years from 32 listed companies. The panel regression model was used to run the panel data. Henceforth, the Hausman test was used to select the perfect model between the fixed and random effects model, **Results:** The study established a significant positive relationship between water sustainability and the share price. This means that investors value firms which are actively involved in solving the water challenge in South Africa. **Implications:** Practically, the findings of this study can help to raise awareness among managers of listed companies that adopting proactive water strategies can eliminate water risk while positively enhancing financial performance. The findings may also shape water sustainability policies and legislation in South Africa and **Value:** The novelty of this study is that it produced new empirical findings on variables that have never been tested before in South Africa which can add value to the body of knowledge.

Keywords: Financial Performance; Johannesburg Stock Exchange; Sustainable Development; Share Price; South Africa; Water Sustainability

JEL Classification: M1

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1. Introduction

South Africa is on the brink of a sustainability threat if environmental variables such as water consumption are not efficiently managed (Girmay & Chikobvu, 2017). Additionally, South Africa ranks 142 out of 180 countries compared in terms of environmental and ecosystem protection (Environmental Performance Index (EPI), 2018). This shows that South Africa's environmental performance is weak. Water shortage is projected to be a serious challenge in South Africa as the country received the lowest rainfall in 2015 since 1904 (Piesse, 2016). On that note, the government warns that the country is likely to face a serious water shortage by 2030 if the issue is not dealt with effectively (Richards, 2018). Naturally, South Africa is a semi-arid country with an annual average rainfall far much below the world annual average rainfall (Cole, Bailey, Cullis & New, 2018). Worse still, the country has one of the most erratic water evaporation rates in the world causing rivers and dams to dry up quickly (South African Department of Water Affairs (DWA), 2013). This qualifies South Africa to be among the 30 countries in the world with water scarcity problems. According to Kurunthachalam (2014), acute water shortage is exacerbated by overuse, climate change and slow replenishment of natural water sources. In South Africa, the water challenge is caused by the growing population, droughts and inefficient use of water (Cole *et al.*, 2018). According to Sánchez-Hernández, Robina-Ramírez and De Clercq (2017), the water challenge in South Africa is being aggravated by the growing population where in most cities, the population growth of approximately 3.7% is far exceeding the water capacity. Water sustainability does not only focus on water scarcity but also the quality of water (Askham & Van der Poll, 2017). Recently, a water crisis has been felt in Cape Town where tap water became a luxury. This strongly signals the severity of the water crisis in South Africa. Hence, the water sustainability issue is going to pose a serious threat to humanity if the current situation is not abated. Moreover, acute water shortages in South Africa pose a serious threat to business profitability (James, 2017). This is because water is a crucial aspect which support several business activities. The authors of this study believe that it is through a vibrant, innovative and flexible business sector that the environmental sustainability issue can be effectively addressed in South Africa and globally.

In spite of their key potential role to solve the environmental conundrum in South Africa, listed firms still lag behind and lack serious commitment towards adopting environmental sustainability practices in their businesses (Ernst & Young Global, 2018). Given the new trend of customers and investors who prefer environmentally friendly businesses, listed firms should seriously engage in environmental sustainability issues (Johnson & Schaltegger, 2016). Individual firms may have small environmental damage but when the impact is aggregated for all firms, it becomes clear that firms need to rethink their environmental sustainability commitment strategies urgently (Higgs, 2015). Regardless of the above problems,

empirical research about water sustainability and financial performance is sparse in existing literature (Nguyen, 2016; Manrique & Martí-Ballester, 2017). In South Africa, Nyirenda (2014) examined environmental management practices of a JSE listed mining company. The study used return on equity as the measure of financial performance using one mining firm. This study attempts to test the relationship between water sustainability and the market-based measure of financial performance (share price). The market-based measures of financial performance provide an external valuation of a firm based on expected future performance. To that effect, it was deemed a crucial financial performance measure as it can help managers of listed firms to evaluate their market performance as this has a direct impact on future investments in the business. Additionally, this study attempts to test this relationship using firms from various industries such as mining, manufacturing, banking, health and pharmaceuticals, retail, telecommunications, energy and the services sector.

The novelty of this study is that it will produce new empirical findings on variables that have never been tested before in South Africa which can add value to the existing body of knowledge. Moreover, if it can be established that water sustainability positively influences financial performance, it can go a long way in motivating more listed firms as well as small and medium enterprises listed on the Alternative Exchange (AltX) to consider water sustainability initiatives seriously. The findings of the study may also positively shape water sustainability policies and legislation in South Africa as the review of the current water legislation showed that it is currently ineffective in positively shaping the behaviour of water users in a manner which can eliminate water risk.

2. Literature Review

2.1. Framework for Water Sustainability

2.1.1. Sustainable Development Goals

These are a set of global goals crafted by the United Nations General Assembly in 2015 to deal with sustainable development problems. Sustainable development goals consist of 17 goals, each addressing a different aspect identified as crucial in solving sustainable development challenges. The idea is for different states globally to adopt them and implement to reach the targets as set out in the 2030 Agenda. Since this study focuses on water sustainability, emphasis is made on sustainable development goal number six (6) which is based on the essence of having access to clean water and sanitation. Water is life as it is it supports all living organisms. As such, there is a need to safeguard water sources to ensure that human beings do not face water scarcity problems. It is imperative to ensure that sustainable goal number 6 is achieved since it is the key to achieving other goals (UN–United Nation. Sustainable

Development Goals, United Nations, 2015; Al-Qawasmi, Asif, El Fattah & Babsail, 2019).

Access to clean water is a necessity as it combats the chances of contacting water borne diseases such as bilharzia, diarrhoea, cholera and typhoid among others. Water scarcity is also another problem addressed by goal number 6. Water scarcity is a serious concern since above 40% of the world's population is directly or indirectly affected by water scarcity. Sanitation in this case covers issues such as water treatment from sewer systems to make it safer for human consumption (United Nations International Children's Emergency Fund (UNICEF), 2017). In terms of ensuring proper sanitation, targets have been set to stop open defecation and to ensure that each household or organisation has access to hand-washing facility especially after using the toilet (World Health Organization (WHO), 2017). Goal number 6 (Clean water and sanitation) is broken down into eight targets and eleven indicators for easy monitoring of progress. There is still a lot to be done in terms of attaining goal number 6 worldwide. It has emerged that a significant number of countries worldwide (67%) have no data for sanitation estimates and indicators and countries such as Brazil, China, Ethiopia, India, Indonesia, Nigeria and Pakistan among others, still practise open defecation (UNICEF, 2017). South Africa, like other developing countries, is struggling to attain the clean water and sanitation goal. Efforts are needed to ensure that all citizens have access to lean water and proper sanitation.

2.1.2. Water Management Legislation in South Africa

Water management in South Africa is governed by the National Water Act 36 of 1998, which was enacted to protect water resources in South Africa (Maphela & Cloete, 2019). The major purpose of the Act was to ensure access to clean and safer water for all, to protect aquatic life and to eliminate inequalities present in the previous Act. To protect water resources in South Africa, the Act has sections to eliminate water pollution and to attain environmental sustainability. The Act is one of the best ever legislations enacted in South Africa and has been used by other countries such as Zambia and China, among others, to shape water legislations in their countries (Schreiner, 2013). With such a brilliant legislation, one could have expected some improvements in water sustainability in South Africa. Nevertheless, it is argued that the Act has not added much value to South Africa (Schreiner, 2013). The outstanding factor is lack of implementation, which is pinned to factors such as lack of a clear implementation plan, poor leadership and trying to achieve many initiatives at once. To that effect, South Africa continues to face severe water challenges. Sadly, the country is on the verge of a water sustainability threat as other provinces such as Western Cape have already been hit by water scarcity (Schreiner, 2013). According to Maphela and Cloete (2019), rigidity in the National Water Act

36 of 1998 has also contributed to its ineffectiveness as some sections of the act fail to adjust to changing times and needs of the water users.

2.2. Water Sustainability

To investigate water sustainability practices successfully, the departing point should be defining water sustainability. This is crucial as the definitions can shape sense making around the water sustainability construct to critically investigate different firms' sustainability reports. According to Food and Agriculture Organization of the United States (FAO) (2017), water efficiency is defined as the balance between the water consumption and the withdrawal rate. Other studies define water sustainability as the different strategies adopted by firms to eliminate water wastage. In other words, water sustainability refers to the minimal use of water in all human activities. Suffice to say, the water input should be minimised whilst the output be it in production or domestic use is maximised (Al-Qawasmi et al., 2019; United States Environmental Protection Agency, 2019). The definitions of water sustainability given above agree that water sustainability deals with the minimisation and economic use of water to avoid water shortage risk. This is achievable by adopting proactive strategies such as water recycling, reuse and reduction in water consumption. The current study defines water sustainability as the adoption of proactive and lean strategies to avoid overconsumption and depletion of water bodies by firms.

Water is a precious resource as all human life and other living organisms rely on it. Nevertheless, the water crisis is slowly becoming a global problem. The critical challenge is that water is a finite resource, yet the human needs are infinite. This creates a disequilibrium where human needs for water exceeds the water available for consumption. Even though 70% of the earth is covered by water, fresh water constitutes only 2.5% and 97.5% is salt water. Furthermore, only 0.5% of fresh water is accessible for human consumption. With rapid growth in population and other human activities, some regions have already started experiencing dry spells as the demand for water is far exceeding its supply. The acute water shortage is likely to affect food production if the challenge is not quickly abated (United Nations World Water Assessment Programme, 2016). The UN World Water Development Report (2016) reverberates the same sentiment by adding that the water challenge has serious implications on the labour market as well as most jobs can be cut because of water scarcity.

2.3. Water Sustainability Strategies

It is crucial to adopt efficient methods of water consumption as all human species and the ecosystem depends on this scarce and precious resource (Maphela & Cloete, 2019). Unlike other resources, water does not have a substitute, which creates problems for survival if it is not managed efficiently. There is agreement in existing literature that water sustainability strategies such as water use minimisation, reuse, recycling and harvesting of rainwater for other purposes collectively enable a firm to attain water sustainability (Tolossa, Abebe & Girma, 2020). Integrating sustainability in water use eliminates overconsumption and ensures that the future generations are not affected by water scarcity. It is well-documented that the attainment of other environmental sustainability indicators such as energy efficiency, waste reduction and carbon efficiency depend on water efficiency. Hence, attaining water sustainability is a crucial step towards attaining sustainable development (Al-Qawasmi et al., 2019). Each of the strategies will be discussed in the next section.

2.3.1. Reducing Water Consumption

Water is used in most activities of the business. This ranges from drinking, use in toilets and in the production processes. Another stream of water is lost through leaking taps, fault machines and unattended irrigation pipes in corporate premises. This increases the total water withdrawal from water sources. To that effect, there are fears that businesses will face water risk as the environmental regeneration rate is being exceeded by human consumption. There is a need for serious water management in South Africa (McKinsey & Company, 2019). A holistic approach should be adopted by the government to attain water sustainability. This can include subsidies as well as punitive legislation to enforce water management and efficiency in the country. Sánchez-Hernández et al. (2017) support this assertion and add that all citizens should participate in the call to use water astutely lest future generations will be at risk. More importantly, awareness should be raised among all citizens on the importance of saving water if this crisis is to be mitigated.

2.3.2. Water Recycling and Reuse

Water withdrawn from water bodies should not be discarded permanently. Rather, recycling and reuse should be encouraged and integrated into the firm's activities. This enables firms to treat wastewater and reuse it for other purposes which could have needed fresh water. To that effect, water recycling and reuse can go a long way in enabling firms to attain water efficiency. Water recycling and reuse have been successfully implemented in other countries such as America and Singapore, among other countries, and have produced tangible benefits. In this case, firms can recycle water used in other parts of the production process and reuse it to clean toilets and watering some plants. This reduces water withdrawal rate and overall water consumption. Water recycling is made possible by cutting edge technology and innovation. Technology makes it possible to save water in the entire production

system by calculating the standard quantity of water required to produce something. Additionally, technology also makes it possible to recycle water where systems to automatically trap water from the production process are used. Thus, automation makes recycling and reuse possible by eliminating inefficient manual processes in the firm's operations. Furthermore, the recycle and reuse strategy requires the firm to effectively communicate with its organisational members. Most organisations fail to attain their set goals because organisational members are not informed and therefore, end up resisting the initiatives. Raising awareness about the importance of water efficiency ensures that the strategy is known by all and made a priority (EL-Nwsany, Maarouf & el-Aal, 2019; Tortajada & Nambiar, 2019).

2.3.3. Rainwater Harvesting

Rainwater has been identified as a low-cost strategy to save water. It is defined as water collected from rain and used to support other human activities (Milkias, Tadesse & Zeleke, 2018). It is one of the water source diversification strategies considered by water experts as one of the solutions to mitigate water risk. In semi-arid developing countries where water scarcity is a serious problem, rainwater harvesting can save several businesses from closing because of water shortages (Tolossa et al., 2020). Annually megalitres of water are received which firms can harvest and utilise in their businesses. This can significantly cut the firm's water demand and water bill. Rainwater harvesting brings various benefits to businesses. These include; its cost-effectiveness in terms of minimal investment in constructing roofs that can trap water, safe to drink and can be used for a wide range of things within organisations (Akter & Ahmed, 2015; Amos, Rahman, Karim & Gathenya, 2018). More importantly, harvesting rainwater can afford a firm a positive rating from its green stakeholders such as customers, suppliers, government and investors who are interested in environmentally conscious firms (Shrestha, Jha & Dahal, 2019).

2.4. Hypothesis Development

2.4.1. Relationship between Water Sustainability and Financial Performance

In their study on European firms, Zamfir, Mocanu and Grigorescu (2017) reported that firms located in the United Kingdom, Hungary and Slovakia which came up with ways to minimise water usage while concurrently maximising re-usage recorded an increase in firm financial performance. From that it is clear that water sustainability unlocks momentous financial benefits to firms (Zokaei, 2013). The author of this study believes that water efficiency can assist firms to cut cost in terms of reducing water bills which capacitates the firm to make profits. The section that follows presents a discussion of studies which reported a positive relationship between water efficiency and financial performance.

Ong et al. (2014) assessed the impact of environmental improvements on the financial performance of leading companies listed in Bursa Malaysia. The study's findings revealed that water sustainability is positively related to financial performance. Ong et al. (2014) further underscored that water sustainability has momentous cost benefits which directly boost the financial performance of a firm. When firms embark on water saving initiatives such as recycling, reduction in water consumption and formulating water sustainability policies, the firm is likely to experience superior firm financial performance (Ong et al., 2014).

Tasneem et al. (2016) posited that water sustainability improves the green image of the firm. This improves the value of the firm by investors and other stakeholders which boosts demand for the firms shares and its products. Existing literature links improved firm's value to superior financial performance. A firm which invest intensively in water sustainability can earn green trust from its customers and investors. Recently, green customers highly regard firms which are environmentally sensitive, and are willing to become loyal customers to such firms and pay a premium price to its products. This significantly contributes to enhanced financial performance.

Conversely, there is a stream of scholars who express that water sustainability may negatively affect financial performance. For instance, Appiah, Du, Boamah (2017) found a negative relationship between water sustainability and financial performance. This shows that investments in new technology to recycle and reuse water can be costly to a firm. These costs may outweigh the benefits of such initiatives leading to losses in the short run.

Raj (2015) also conducted a study to investigate the relationship between corporate water risk, water accounting and financial performance of metal mining firms. The study used GRI indicators to measure water consumption. These include annual water withdrawal, total water discharge and water recycled. The results showed that increased water consumption was associated with high financial performance and water sustainability initiatives such as water recycling were negatively related to financial performance. Raj (2015) explained that since the sampled firms were mines, more production means more water consumption which results in superior financial performance. The above results favour the profit maximisation goal but violates the environmental sustainability principle. On that account, firms are encouraged to invest in water sustainability to strike a balance between the economic goals and environmental performance.

The last strand of literature argues that water sustainability may have an insignificant effect on financial performance of listed firms. For instance, Nyirenda et al. (2014) investigated the effect of environmental sustainability on the financial performance of a mining firm listed on the JSE. Nyirenda et al. (2014) established an insignificant relationship between water sustainability and financial performance. Nyirenda et al.

(2014) argued that the insignificant relationship established could have been because the concerned mining firm was only investing in water sustainability for complying with regulations in the mining industry without much innovation. This inconclusiveness of literature calls for more empirical studies to demystify the nexus between water sustainability and financial performance of firms listed firms. Raj (2015) supports this assertion and alludes that there is limited information on the relationship between water sustainability and financial performance.

The authors of this study are of the view that attaining water sustainability can help listed firms in saving costs associated with paying excessive water bills and the possible opportunity cost emanating from disruptions in business activities due to water shortages. It has been noted that a significant number of firms end up paying excessive water bills because in some instances, the water is left running while some is lost through licking pipes. Hence, adopting water sustainability measures such as harvesting rainwater for other purposes, fixing licking taps and water recycling and reuse can positively influence financial performance. This can ensure that the business does not experience water shortage risk which may see their share price losing value. Essentially, attaining water sustainability can help firms to boost their share price as the business can attract favourable ratings from the market. This is because several stakeholders such as investors, banks and customers prefer businesses which are environmentally responsible as this may mean the business will stand a chance to operate as a going concern. Water sustainability has become a crucial metric to evaluate the extent to which businesses are committed towards sustainable development goals in South Africa and worldwide. In South Africa, this is exacerbated by the water challenge which have affected several big cities such as Cape town until an emergence was announced. Therefore, firms which come up with proactive ways of addressing the water crisis in South Africa are likely to boost their image and gain legitimacy in the view of stakeholders such as the community and the government. Based on the above evidence, this study posits that water sustainability positively influences the financial performance of listed firms. Thus, the following hypothesis is formulated.

Ha: There is a significant positive relationship between water sustainability and the share price of firms listed on the JSE.

3. Materials and Methods

The study adopted a quantitative research method. This study used a multiple case study design. The multi case study research design is widely used in studies linking environmental sustainability to financial performance (Boakye, 2018). Using the case study research design, the researcher used the longitudinal research design as it allowed the researcher to collect multiple observations over the 8-year period

considered. The population of the study was the 100 firms listed on the FTSE/JSE in South Africa. The logic behind considering firms listed on the JSE was that these firms are critically scrutinised in terms of sustainability engagement and reporting (JSE, 2016).

Sample description

A sample size of 32 firms listed on the FTSE/JSE Responsible Investment Index was considered in this study. Because the study was conducted over 8 years, this resulted in 256 observations. On the list of firms considered, 8 companies were from the mining industry, 4 in manufacturing, 3 in banking, 4 in health and pharmaceuticals, 4 in retail, 3 in telecommunications, 1 in energy and 5 in services. The researchers further introduced an inclusion and exclusion criteria to select the final sample. Thus, a firm was only included in the sample if it was currently listed on the FTSE/JSE Responsible Investment Index by the time of data collection, it has been actively reporting on water sustainability for the past 8 years and if its integrated sustainability reports had data required for the study. Notably, all newly listed firms were removed from the sample.

The convenience sampling technique was adopted in this study. Convenience sampling is defined as a sampling method which leverages on the easy availability of participants and their willingness to participate in the study (Etikan, Musa & Alkassim, 2016). According to Etikan et al. (2016), the key assumption made under convenience sampling method is that the individual members of the population are homogenous (Etikan et al., 2016). This assumption was adopted in selecting the sample of this study. From 2011, all the listed firms are required to publish their integrated annual reports. Hence, making the homogeneity assumption true in this case. This sampling method was used because the firms were readily available from the JSE website. The convenience sampling was adopted following similar studies in South Africa (Mans-Kemp, 2014).

Data collection

This study utilised secondary data, which is annual financial statements of firms listed on the JSE. Secondary data is widely used in studies linking environmental sustainability to financial performance (Ong et al., 2014; Amacha & Dastane, 2017; Boakye, 2018). Hence, it was adopted to maintain consistency with existing studies. Secondary data was used because it was readily available on the JSE website. Financial data such as liquidity, firm size and share price were collected from integrated annual financial statements on the firm's websites. Some of the financial data was obtained from the McGregor database. This data base provides financial data for listed firms to registered users. The data was imported from the McGregor database and exported to excel for sorting and further processing.

Quantitative content analysis was used to collect data related to water sustainability measures. The logic behind the use of quantitative content analysis was that there is no uniformity on how water sustainability is reported by listed firms considered in the study. Some used Kilo litres while some subjectively reported on their water use for the years under consideration. This data was sourced from sustainability reports following similar studies (Ong et al., 2014; Boakye, 2018) for consistency. Using content analysis, the researcher developed key search words per each variable which were used to trace whether the variable was reported or not. The research used a dichotomous scale ranging from 0 and 1. The dichotomous scale was endorsed by Cooke (1989) indicating that it effectively eliminates bias usually experienced when one uses a five-point Likert scale.

Quantitative content analysis procedure

Following recommendations by Cooke (1989), 0 was scored when key words related to water sustainability measures were not mentioned. The water sustainability measures included, total volume of water recycled, total volume of water reused, reduction in water use and rainwater harvested. A score of 0 was also scored for that year if there was an increase in water consumption by the concerned firm in the reporting year. This indicates the firm was not proactively minimising its water usage. On the other hand, a score of 1 was scored when the firm reported a decline in water use by adopting water sustainability measures such as recycling of wastewater, reuse, reduction in water consumption and an improvement rainwater harvesting from the previous financial year. The researcher utilised both textual data and pictorial presentation of information related to water sustainability measures. This approach was adopted following similar studies (Mans-Kemp, 2014; Amacha & Dastane, 2017; Boakye, 2018). The collected data was coded on Microsoft excel awaiting further processing. The content analysis procedure is shown below.

Table 1. Demonstration of the Quantitative Content Analysis Procedure

Firm Code 0	2011	2012	2013	2014	2015	2016	2017	2018
Water sustainability								
Total volume of water recycled	0	1	1	1	1	1	1	1
Total volume of water reused	0	1	1	1	1	1	1	1
Reduction in water use	0	1	1	1	1	1	1	1
Total	0	3	3	3	3	3	3	3
Firm Code 16	2011	2012	2013	2014	2015	2016	2017	2018
Water sustainability								
Total volume of water recycled	1	1	1	1	1	0	0	1
Total volume of water reused	1	1	1	1	1	0	0	1
Reduction in water use	1	1	1	1	1	0	0	1
Total	3	3	3	3	3	3	3	3

Table 1 presents the results regarding the content analysis procedure followed by the researchers to collect data related to water sustainability. For the purpose of demonstrating the content analysis procedure, 2 firms from the list considered were used. The firm with a code of 0 is a mining company while the firm with a code of 16 is a retail company. All their water sustainability strategies from 2011-2018 were captured as shown above. The content analysis procedure was conducted on all the 32 listed firms considered in this study.

Data analysis

Data was analysed using the panel regression model. The model was chosen because it allowed the researcher to analyse panel data from several companies and it has been used widely in similar studies (Nyirenda, 2014; Boakye, 2018). Panel data is advantageous in that it enhances consistency as the sample is observed repeatedly over several years (Mans-Kemp, 2014; García-Sánchez & Martínez-Ferrero, 2017). Specifically, the fixed and random effects model were used to analyse the data. Henceforth, the Hausman test was used to select the perfect model for the study. Diagnostic tests were run to assess if the data met the assumptions of the panel regression model. The data assumed the normal distribution. Tests for multicollinearity using variance inflation factors (VIF) showed that the data did not have multicollinearity since all the VIF values on the variables were less than 10.

The Breusch and Pagan test also showed that the data did not have heteroscedasticity. This means the data was fit for further analysis using the panel regression model.

Dependent variable

The dependent variable of the study was financial performance. Specifically, market-based measures of financial performance were used in this study. Market-based measures are highly regarded and adopted as measures of financial performance especially when the researcher is interested in understanding the future value of the firm. Market based measures of financial performance were adopted in this study because the study was interested in assessing the future value of a firm as predicted by its environmental sustainability behaviour. Essentially, the researchers deliberately used share price as the market ratio to measure financial performance because it's a crucial metric used by investors to evaluate if they can invest in the business. Since the JSE is a platform for firms to raise more capital and attain the desired growth, monitoring the value of the firm's shares becomes has become more crucial than before.

Independent variable

In this study water sustainability was the independent variable. Water sustainability was measured based on the firm's commitment to reduce water consumption. Additionally, it was measured based on the kilo litres saved for that year by the firm. Other water sustainability indicators used included: total volume of water recycled, total volume of water reused, reduction in water use and rainwater harvested. The data was collected from the companies' websites. Some of the data was collected from the companies' sustainability reports. The water sustainability measures used in this study were obtained from the Global Reporting Initiative guidelines. These guidelines are used globally and widely by several scholars in studies related to sustainability.

Dependent variable; Y: Financial performance

Dependent variable 1; Y: Share price

Independent variable; X: Water sustainability

Independent variable 1; X1: water sustainability

Panel regression model

$$Y_{it}=\alpha+X_{1it}+X_{2it}+X_{3it}+\varepsilon$$

Where y=financial performance; x_1= water sustainability; x_2=firm size; x_3=Liquidity; + ε = error term; α= constant

Control variables

It was crucial to identify other factors which can also influence a firm's profitability. This is pertinent to eliminate the possibility of these factors overshadowing the actual factors under study. Thus, the control variables of the current study were firm size and liquidity. A study by Warrad and Oqdeh (2018) reported that a firm size and liquidity positively influence a firm's profitability. In this study, market capitalisation was used to measure the size of the firm. The size of the firm has an effect on the profitability of a firm (Al Shahrani &Tu, 2016). It follows that large firms have slack resources which they can use to invest in environmental sustainability initiatives as compared to smaller firms (Boakye, 2018). Size influences the profitability of firms differently. For instance, Tarziján and Ramirez's (2011) findings indicated that large firms tend to be more profitable because of economies of scale. Hence, it is crucial to control the size of the firm before testing the relationship between water sustainability and financial performance. The data related to liquidity was sourced from the McGregor database.

4. Results

Descriptive Statistics

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Water sustainability	256	2.15625	1.217116	0	3
Share Price	256	15695.86	14525.73	0	86734
Liquidity	256	1.425118	0.9830142	0	6.8176
Firm size	256	9297.23	47711.28	0	428668

Table 2 present descriptive statistics for key variables of the study. In terms of water sustainability, the mean was 2.15625 and the standard deviation was 1.217116. The minimum value was 0 while the maximum was 4. The results also showed that share price had a mean value of 15695.86 and a standard deviation of 14525.73 with a minimum value of 0 and a maximum value of 86734. The findings show that the mean for liquidity was 1.425118 and the standard deviation was 0.9830142. The minimum value for liquidity was 0 and the maximum value was 6.8176. Considering firm size, the mean score was 929723 and the standard deviation was 47711.28. The minimum value was 0 and the maximum value was 428668.

Correlation Analysis

Table 3. Correlation Analysis

Variables	Liquidity	Firm size	Share price	Water sustainability
Liquidity	1			
Firm size	-0.0061	1		
Share price	0.7843	0.1034	1	
Water sustainability	0,0834	0.0131	0.164	1

Table 3 presents findings on correlation among variables. The results also show that liquidity was negatively correlated with firm size (-0.0061) while share price was positively correlated with liquidity (0.7843) and firm size (0.1034). The findings also showed that a positive correlation was established between water sustainability and liquidity (0.0834). Also, a positive correlation was established between water sustainability and firm size (0.0131) as well as with share price (0.164).

Relationship between Water Sustainability and Financial Performance

Table 4. Fixed Effects Model and Share Price

Fixed effects (within) regression					Nuber of obs =	256
Group variable: Year					Number of groups =	8
R-sq: withi=	0.2064				Obs per group: min=	32
Between =	0.1023				avg =	32
Overall =	0.2019				max =	32
corr (ui,Xb)=	-0.1296				Wald chi2 (10, 238)=	6.19
					Prob>F =	0.0000
Share price	Coef.	Std.Err.	t	P>|t|	[95% confi.	Interval]
Water sustainability	2578.609	858.244	3.00	0.003	887.8841	4269.33
Liquidity	1063.202	862.338	1.23	0.219	-635.5869	2761.99
Firm size	0.0188649	0.01913	0.99	0.325	-0.0188248	0.05656

_cons	17803.47	13458.9	1.32	0.187	-8710.289	44317.2
sigma_u	1446.8151					
sigma_e	13360.301					
rho	0.0115913	(Fraction of variance due to u_i)				
F test that all u_i=0:	F (7,238)=0.35			Prob>=	0.9280	

Table 4 presents findings of the Fixed effects model and Share price. A positive and significant relationship (2578.609; sig 0.003) was established between water sustainability and share price. This leads to the decision to accept the hypothesis that there is a significant positive relationship between water sustainability and share price of firms listed on the JSE. This suffice to say that investments in water sustainability strategies such as reuse, recycling, reduction in water consumption and rainwater harvesting can enhance the market performance of listed firms.

Random effects model on share price

Table 5. Random Effects Model and Share Price

Random-effects GLS regression					Nuber of obs =	256
Group variable: Year					Number of groups =	8
R-sq:within =	0.2060				Obs per group: min=	32
Between =	0.1124				avg=	32
Overall =	0.2022				max=	32
corr (u-i,Xb) =	0 (assumed)				Wald chi2 (10, 238)=	62.10
					Prob>F =	0.0000
Share Price	**Coef.**	**Std. Err.**	**z**	**P>|t|**	**[95% confi.**	**Interval]**
Water sustainability	2453.078	831.0994	2.95	0.031	824.153	4082.003
Liquidity	1016.959	853.3748	1.19	0.233	-655.6252	2689.543
Firm size	0.0175316	0.0187815	0.93	0.351	-0.0192794	0.054343
_cons	17699.1	13184.52	1.34	0.179	-8142.08	43540.29
sigma_u	0					
sigma_e	13360.301					

rho	0	(Fraction of variance due to u_i)		

Table 5 presents findings of the Random effects model on share price. The findings show that there is a significant positive relationship (2453.078; sig 0.031) between water sustainability and share price of JSE listed firms. Thus, the hypothesis that (***Ha)****: there is a significant positive relationship between water sustainability and the share price of firms listed on the JSE was fully supported and accepted.* A positive relationship between water sustainability and share price implies that investors value firms which are actively involved in solving the water challenge in South Africa. Another probable explanation may be that investors tend to value shares of firms which have water sustainability strategies in their business. This gives investors assurance that the business may not be affected by water shortage risks which makes it continue as a going concern.

Hausman test

Table 6. Hausman Test

	(b)	(B)	(b-B)	Sqrt(diag(V_b-V_B))
	FEM	REM	Difference	S.E.
Water sustainability	2578.609	2453.078	125.5313	214.1419
Liquidity	1063.202	1016.959	46.2437	124.0067
Firm size	0.0188649	0.0175316	0.0013333	0.0036455

b= consistent under Ho and Ha; obtained from xtreg

B =inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2 (9)= (b-B) '[(V_b-V_B) ^ (-1)] (b-B)

= 1.42

Prob>chi2= 0.9977

The author of this study adopted the Hausman test to identify the appropriate model for the data as recommended by Pedace (2013). The Hausman test null hypothesis states that the random effects is the preferred model (Snorrason, 2012). It follows that when the Hausman test is significant at ($p < 0.05$), then the fixed effect model will be the appropriate model (Hassett & Paavilainen-Mäntymäki, 2013). Based on the Hausman test in Table 6 (p. 0.9977) is above 0.05. This means the Random

effects is the appropriate model for the data, hence, the results from the Random effects model were considered for this study.

4.1. Discussion

4.1.1. Relationship between water sustainability and financial performance

A positive and significant relationship was established between water sustainability and share price. A positive relationship between water sustainability and share price implies that investors value firms which are actively involved in solving the water challenge in South Africa. Another probable explanation may be that investors tend to value shares of firms which have water sustainability strategies in their business. This gives investors assurance that the business may not be affected by water shortage risks which makes it continue as a going concern. Furthermore, with the growing awareness and strict requirements to consider Environmental, Social and Governance (ESG) issues, investors are becoming selective when considering shares to purchase. Investors are developing more interest in firms with a clear strategy regarding environmental sustainability issues such as water management. This is also because of the growing importance of responsible investments in South Africa.

The findings of this study are fully supported by existing empirical findings. For instance, Tasneem et al. (2016) posited that water sustainability enhances the green image of the firm. This improves the value of the firm by investors and other stakeholders which boosts demand for the firms shares and its products. Existing literature links improved firm's value to superior financial performance. Thus, a firm which invests intensively in water sustainability can earn green trust from its customers and investors. Recently, green customers highly regard firms which are environmentally sensitive. As such, they are willing to become loyal customers to such firms and pay a premium price to its products. This significantly contributes to enhanced financial performance. Ong et al. (2014) further underscore that water sustainability has momentous costs benefits which directly boost the financial performance of a firm. When firms embark on water saving initiatives such as recycling, reduction in water consumption and formulating water sustainability policies, the firm is likely to experience superior financial performance (Ong et al., 2014).

Firms should invest beyond their own water consumption needs but also help their supply chain members to eliminate wasteful ways of water consumption. Most manufacturing firms have already started risking the flow of their production processes due to water inefficiencies. Inefficient water management can expose a firm to unnecessary costs which can affect the firm's profitability negatively. For instance, Coca Cola was forced to close its plant in India due to water shortages. This

costed the firm a lot of revenue in terms of lost sales and stranded assets (Linneman, Hoekstra & Berkhout, 2015; Askham & Van der Poll, 2017).

On their study on European firms, Zamfir et al. (2017) reported that firms located in the United Kingdom, Hungary and Slovakia which came up with ways to minimise water usage while concurrently maximising re-usage recorded an increase in firm financial performance. From that it is clear that water efficiency unlocks momentous financial benefits to firms (Zokaei, 2013). The authors of this study believe that water sustainability can assist firms to cut cost in terms of reducing water bills which results in improved financial performance. The findings of Tortajada (2020) also support this study. Tortajada (2020) reported that adopting water sustainability strategies such as reusing wastewater goes a long way in helping firms to contribute towards sustainable development goals. Essentially, the study submitted that water sustainability strategies such as water reuse are pertinent in developing countries where access to clean water is still a serious challenge. Thus, given the erratic rainfall patterns being experienced in developing countries, Tortajada (2020) argued that water sustainability strategies can unlock economic value for businesses.

Weber and Saunders-Hogberg (2020) also assessed the relationship between water sustainability and financial performance of in the food and beverage sector. The study established that water sustainability positively predicted financial performance. Based on the above supporting evidence of studies conducted in different settings and contexts, it can be inferred that listed firms can benefit immensely from investing and excelling in water sustainability strategies such as reuse, recycling, water reduction and rainwater harvesting. This is because such strategies are positively linked to a positive firm image which enhances the share price of the firm. Given the water scarcity situation in South Africa, firms which adopt proactive strategies to minimise water usage are likely to gain a favourite rating from different stakeholders. This is supported by van Zyl and Jooste (2020) who emphasise the need for adopting serious water management strategies such as reusing wastewater, recycling and rainwater harvesting to ease the water challenge which is gradually spreading to most South African provinces.

5. Conclusion

The current study tested the relationship between water sustainability and the market-based measure of financial performance (share price). The study adopted a quantitate research method while it made use of secondary obtained from integrated sustainability reports. The longitudinal research design was used since the observations and collection of data was carried for 8 years. The panel regression model was used to run the panel data. Specifically, the fixed and random effects model were used to analyse the data. Henceforth, the Hausman test was used to select

the perfect model for the study. Interestingly, the study established a significant positive relationship between water sustainability and financial performance as measured by the share price. The implication of this is that water sustainability is a crucial determinant of share price of firms listed on the JSE. A positive relationship between water sustainability and share price implies that investors value firms which are actively involved in solving the water challenge in South Africa. This is because of the growing awareness and strict requirements to consider Environmental, Social and Governance (ESG) issues when considering shares to purchase. This is also because of the growing importance of responsible investment in South Africa. The findings of the current study were fully supported by other existing similar studies. The findings of the current study can contribute empirically to the body of knowledge. Practically, the findings of this study can help to raise awareness among managers of listed companies that adopting proactive water strategies such as reusing wastewater, recycling, reducing water consumption and rainwater harvesting do not only eliminate the water shortage risk but also positively enhance the value of their shares. This is applicable to firms operating in the mining industry, manufacturing, banking, health and pharmaceuticals, retail, telecommunications, energy and in the services sector as confirmed by the findings of this study. Nevertheless, this study had a weakness that it only considered water sustainability to determine the share price, yet other factors can also affect the share price of a firm. This creates an avenue for future studies to test other factors which may also affect the share price of listed firms. Based on the findings of this study, recommendations are suggested for the rest of the firms listed on the JSE as well as small and medium enterprises listed on the Alternative Exchange (AltX) to consider water sustainability serious as it was established that it can enhance their financial performance.

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