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# A systematic review of corporate carbon accounting and disclosure practices: Charting the path to carbon neutrality

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**Abstract:** The study examined the theoretical motivation for carbon disclosure and its adequacy for deliberate responsible action. Generally, there is an increase in corporate carbon disclosures in the business sector. Organizations are mostly disclosing their carbon emissions through annual reports, integrated reports, or stand-alone sustainability reports for different reasons and motives. However, the study infers that the quality and adequacy of the current disclosures are debatable due to a lack of consistency and technical details. The causal reason may be due to the inherently voluntary nature of the corporate carbon disclosure. The study finds that there is less research on carbon accounting and disclosures in developing countries especially, in Africa. There is a need for organizations to streamline the application and approaches to carbon accounting. The study suggests the necessity for government regulators and standard setters in accounting to provide a framework that will guide carbon disclosure practices.

**Keywords:** Carbon accounting, climate change, social accounting, carbon emission, sustainability reports, social responsibility, Global Reporting Initiative

**JEL codes:** M41

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## 1. Introduction

Carbon accounting is also known as environmental disclosure refers to the measuring and reporting of emissions by companies. Carbon dioxide, succinctly known as carbon is a general term used to describe all greenhouse gases. In recent years, one prominent environmental issue that has become so contentious is the subject of climate change, also known as global warming. The burning of fossil fuels which emit greenhouse gases and heat the atmosphere during industrial activities as well as other human activities are warming the earth at a precarious level (Buchholtz and Carroll, 2012). Climate change is a leading and rising phenomenon that poses a major risk to the continued existence of every life on earth. The frequency and intensity of catastrophic events such as heatwaves, droughts, floods, water shortages, insufficient food, increasing health risks, are classic examples of the effects of human actions and global economic development. According to WHO estimates, climate change will cause an additional 250,000 deaths per year between 2030 and 2050 if carbon emission is not reduced (Neira, 2014). More so, human activities are continuing to drive many species of plants and animals into extinction which has been termed the 'sixth mass extinction' in the history of the planet (Mulligan, 2018). Mulligan further reports that at least 200 species become extinct every year; while the global

forest cover was reduced by 5.2 billion hectares between the years 2000 and 2010 with the biggest losses affecting tropical forests in Africa and South America.

Governments are no longer considered solely responsible for building and maintaining sustainable societies; corporate leaders also have an important role to play. The particular role of business as proposed by the United Nations include calling on businesses to “apply their creativity and innovation to solving sustainable development challenges” such as environmental and social challenges (Danish Institute for Human Rights (DIHR), 2018). Consequently, companies are starting to take a deliberate climate action plan to become climate neutral (Robertson, 2017). While not all business leaders are yet on board, many companies are measuring and reporting their carbon footprints as well as finding ways to reduce emissions of greenhouse gases. According to Teichman and Larson (2009), the measurement of greenhouse gas emission is very important for three reasons. First, carbon accounting allows for voluntary disclosure of data to organizations such as the Global Reporting Initiative (GRI) and Carbon Disclosure Project (CDP). Secondly, it provides a crucial dataset that facilitates participation in mandatory emissions regulation systems. More so, it encourages the collection of key operational data that can be used to improve business activities. Hence, carbon accounting provides decision-makers with access to a critical source of global data that delivers the evidence and insight required to drive action.

The emergence of this practice reflects increasing pressures from various stakeholders pressing companies to provide reports on the harmful effects of their operations on the environment and society at large. For instance, institutional stakeholders are paying keen attention to ways in which climate change impacts on investment return (Solomon, Solomon, Norton & Joseph, 2011). With all the pressures for responsible business practices, companies around the world are increasingly adopting the triple-bottom-line (TBL) approach to reporting that covers not only economic performance but also social and environmental. Andrew Savitz and Karl Weber explain the triple-bottom-line as “a kind of balanced scorecard that captures in numbers and words the degree to which any company is or is not creating value for its shareholders and society” (cited in Weiss, 2009, p. 452). Also known as social accounting, companies disclose information regarding their social and environmental performance. The economic dimension includes return on investment, profits, sales, etc., while the environmental or ecological dimension includes emission controls and waste produced. The social dimension includes community impacts, human rights, and labor practices.

In comparison to financial accounting, social accounting is a relatively new field that lacks consistent terminology (Griseri & Seppala, 2010). For example, corporate social responsibility (CSR) reporting, sustainability reporting, social accounting connotes the same thing. According to the Global Reporting Initiative (2006), a disclosure should provide a balanced and reasonable representation of an organization's performance including its positive and negative impact on society. Corporate responsibility reports are therefore similar to the traditional financial reports in the sense that both are designed to disclose organizations' activities over the reporting period. Particularly, carbon accounting is an important tool that enables organizations to measure and report on their greenhouse gas emissions. Therefore, using a systematic literature review, this study sought to examine corporate carbon accounting and disclosure practices in the business world. Therefore, the following research questions were set to accomplish the objectives of the review. How do companies report their carbon emissions? What are the drivers of carbon emissions disclosures? What is the role of accounting professionals on firms' carbon emissions activities? What is being done to mitigate carbon emissions? What regulations are in place? What is the role of carbon emissions disclosures in investor decisions?

## **2. Theoretical Framework**

The studies were reviewed using the principal theories in environmental research. Theories such as institutional theory, stakeholder theory, legitimacy theory, signaling theory, economic theory, contingency theory, and transaction cost theory have been used to discuss the various aspects of carbon accounting. The stakeholder theory was used by some of the authors to explain that the managers of firms disclose information to meet stakeholder demands. The studies reviewed show that

some groups of institutional investors are significant users accounting information and drive the voluntary disclosure of carbon information which in effect augments the soundness of stakeholder theory (Gonzalez-Gonzalez & Ramírez, 2016; Liesen, Dennis Patten & Figge, 2015; Luo, Tang & Lan, 2013; Comyns and Figge, 2015).

The search in the literature also found that legitimacy theory has been used to explain the reasons why companies voluntarily disclose the impact of their activities on society and the environment. The legitimacy theory posits that organizations disclose information voluntarily to regain or maintain legitimacy. Thus, corporate disclosures are aimed at conforming to societal expectations or as a way of maintaining or regaining legitimacy (Comyns & Figge 2015; Schaltegger, Csutora, 2012; Pellegrino & Lodhia 2012; Liesen *et al*, 2015; Hrasky, 2011; Gonzalez-Gonzalez & Ramírez, 2015; Choi, Lee & Psaros, 2013). The majority of the studies used legitimacy theory to explain why firms provide voluntary disclosures; and the probable underlying reason could be that carbon emissions have not widely been regulated and as such most studies are using legitimacy theory to explain why such disclosures are made even though they are not mandatory.

Few of the studies reviewed used institutional theory, resource constraints theory, signaling theory, institutional governance system theory, neo-classical economic theory, contingency theory, and transaction cost theory to explain how and why firms undertake carbon accounting. Out of the sampled papers, only Luo & Tang (2014) used signaling theory to forecast that firms which are performing well would give more voluntary carbon disclosure as an indication to emphasize their actual carbon performance, and due to that their actions cannot be emulated by other poor carbon performing firms. More studies on carbon emissions disclosures may require the use of the signaling theory to determine the voluntary carbon disclosures is pinpointing the actual carbon position of an organization. This would be important in assessing a firm's risk of carbon exposure, devotion to climate change, and accomplishment in plummeting greenhouse gas emissions in reporting.

The review showed that out the sampled papers only Luo *et al* (2013) have used resource-constraint theory to argue the reasons for the lack of voluntary disclosures on carbon information where firms are not mandated to disclose in developing countries. Further studies are required to ascertain the claim that funding shortages are indicative of firms' inability to provide voluntary carbon information disclosures. Rankin, Windsor, and Wahyuni (2011) used the institutional governance systems theory to explain the internal organization systems, governance, and use of private guidance factors relating to corporate greenhouse gas disclosures. More studies are required on the use of the institutional governance system theory as a framework that can give more knowledge into corporate strategies for achieving greenhouse gas reductions. Neoclassical economic theory was used to forecast that potential investors whose main aim of investing in a company is to maximize wealth will not be affected by the green disclosures made by management (Martin & Moser, 2016).

### 3. Methodology

This study utilizes a systematic literature review method as an appropriate means for summarizing the literature. According to Fink (2010), there are four steps for a systematic review, this has been adapted as a foundation in conjunction with the structure proposed by Tranfield, Denyer, and Smart (2003). First, the research objectives for the study, the article databases and websites, and appropriate search terms were determined. Secondly, the practical review criteria for the inclusion or exclusion of the relevant literature was applied. Finally, the findings were synthesized.

#### *The Determination of Research Questions, Databases, Websites, and Appropriate Search Terms*

There are various uses and definitions of carbon accounting. Therefore, the following research questions were set to accomplish the objectives of the review. How do companies report their carbon emissions? What are the drivers of carbon emissions disclosures? What is the role of accounting professionals on firms' carbon emissions activities and carbon mitigation? What regulations are in place? What is the role of carbon emissions disclosures in investor decisions? To search the literature from the databases, these terms were utilized: "carbon \* accounting", which also comprised, for example, "carbon dioxide accounting"; "CO2 \* accounting"; "greenhouse gas \* accounting" as well as

“GHG \* accounting”; carbon disclosure, carbon reporting; greenhouse gas reporting; greenhouse gas disclosure; climate change accounting; and climate/climatic change reporting. Databases searched include Elsevier ([www.sciencedirect.com](http://www.sciencedirect.com)), Emerald ([www.emeraldinsight.com](http://www.emeraldinsight.com)), and Wiley ([www.wiley.com](http://www.wiley.com)). The following eleven journals were included in the search: Australian Accounting Review, Accounting, Organization and Society, Sustainability Accounting, Management and Policy Journal, Review of Accounting and Finance, Journal of Accounting and Organizational Change, Accounting Research Journal, Accounting Forum, Journal of Cleaner Production, Journal of Contemporary Accounting and Economics, and Journal of Accounting and Economics

### 3.1. Applying Practical Screening Criteria

The search included journal papers and practitioner-oriented contributions that are written in English with restrictions from publications from 2009 to 2016. The restriction on a date was to ensure that the only current discussions on carbon accounting are included. The emphasis of the selection was both empirical and conceptual publications. In the search process, journal rankings were of much importance as a measure of inclusion. The search was restricted to journals from accounting with ABS 2015 rankings of 4\*, 4, 3, and 2. Journal of Cleaner Production was included due to its subject important to the study. Articles from Accounting, Auditing, and Accountability Journal and Journal of Cleaner Production featured dominantly due to the special issues both papers published in 2011/2012 on the multiple perspectives of carbon accounting.

**Figure 1.** Country/Continent Distribution of Studies Included

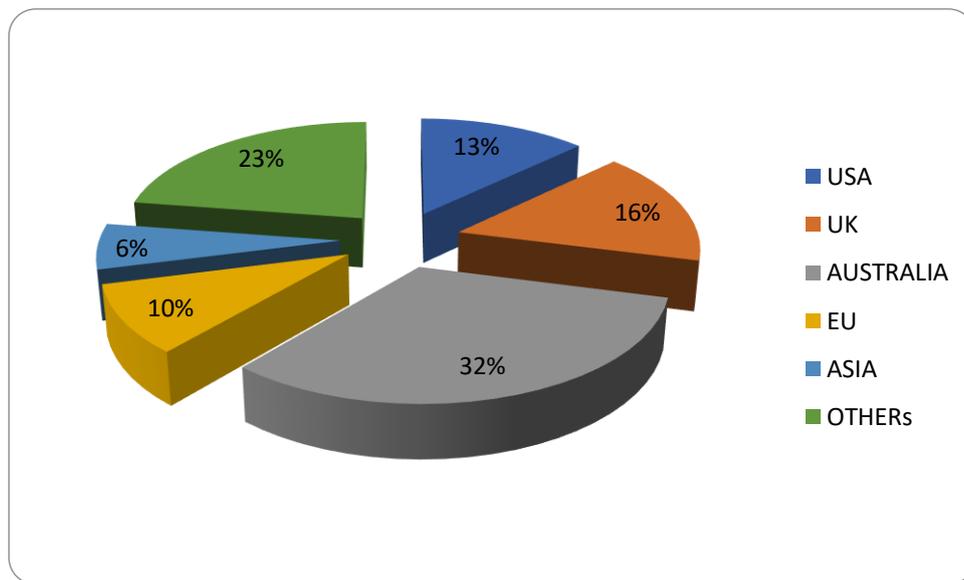


Figure 1 provides a graphical distribution of the countries/continent from which the sample studies were undertaken. It shows that approximately 32% of the sampled papers were done in Australia, representing the majority of all the countries/continents from which the papers were selected. The papers selected from the United Kingdom represented 16%, while 13% and 10% of the papers were from the United States and European Union respectively. About 6% of the papers were from Asia, while other countries had approximately 23% of the papers. Other countries, basically consist of researches which were undertaken either across countries or continent of which majority of the studies were undertaken in Australia, the United Kingdom, and the United States. Out of all the 43 studies reviewed, interestingly, none was done in Africa despite Africa’s exposure to carbon emissions resulting from the activities of multinationals and mining companies.

**Figure 2.** Type of Article.

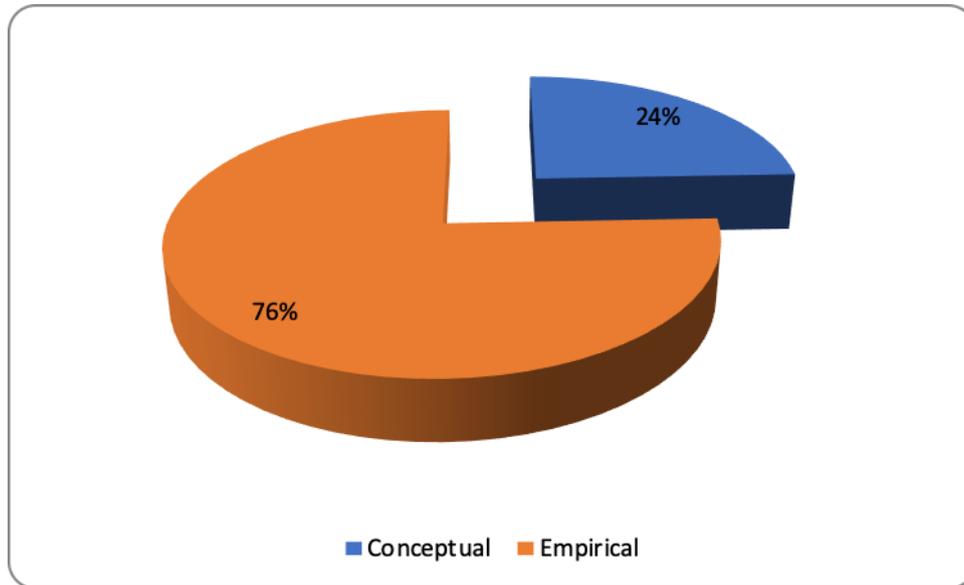


Figure 2 confirms that 24% of the papers were conceptual studies, while the remaining 76% were empirical studies. This shows that more empirical studies are being undertaken in carbon accounting and reporting.

**Table 1.** Journals Included in the Study

Journal	Frequency	Percentage
Australian Accounting Review	5	12.2
Accounting, Organization, and Society	4	9.8
Accounting, Auditing and Accountability Journal	12	29.3
Sustainability Accounting, Management and Policy Journal	6	14.6
Review of Accounting and Finance	1	2.4
Journal of Accounting and Organizational Change	1	2.4
Accounting Research Journal	1	2.4
Accounting Forum	3	7.3
Journal of Cleaner Production	6	14.6
Journal of Contemporary Accounting and Economics	1	2.4
Journal of Accounting and Economics	1	2.4
<b>Total</b>	<b>41</b>	<b>100</b>

Table 1 also shows that 2.4% were from each of the following journals Review of Accounting and Finance, Journal of Accounting and Organizational Change, Accounting Research Journal, Journal of Contemporary Accounting and Economics, and Journal of Accounting and Economics. Seven-point three percent (7.3%) were from Accounting Forum, 9.8% of the articles were from Accounting, Organization, and Society and 12.2% were from Australian Accounting Review. Additionally, 14.6% each were from Sustainability Accounting, Management and Policy Journal, and Journal of Cleaner Production. The journal from which the highest number of papers were obtained is Accounting, Auditing, and Accountability Journal (29.3%).

Figure 3. Type of Research

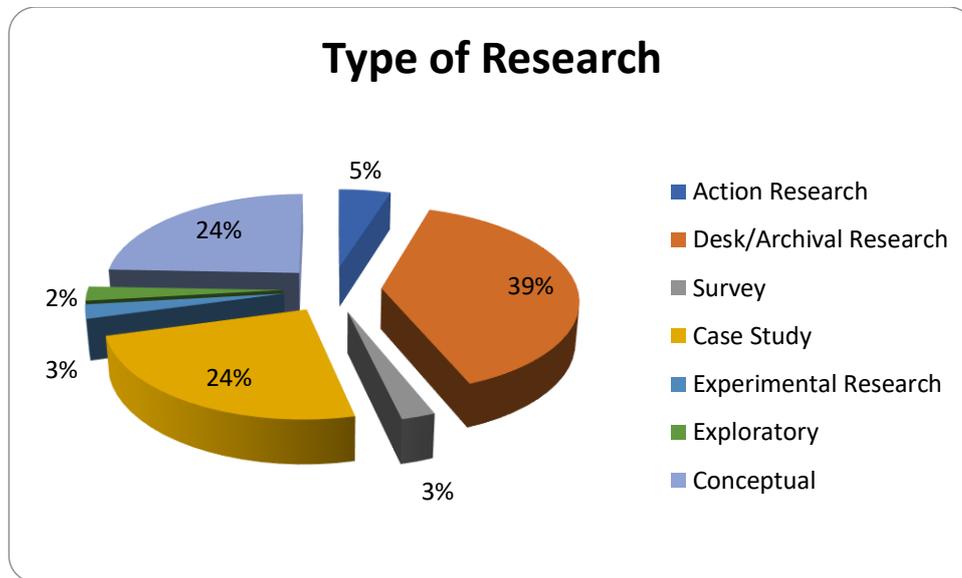


Figure 3 indicates that the sample articles consisted of action research, desk/archival research, survey, case study, event study, experimental research, exploratory research, and conceptual study. 2.4% of the papers were each from the survey, exploratory, and experimental research. Action research consisted of 4.9%, 24.4% each were case studies and conceptual papers, while the majority of the studies were desk/archival research (39%).

#### 4. Results and Discussion

##### 4.1. Dimensions of Carbon Accounting

Studies have shown that there are diverse means by which carbon accounting is measured. For example, Bowen and Wittneben (2011) grouped the counting of carbon into three organizational fields: Scientific organizations, traditional accounting actors, and organizations in the accountability for carbon. The scientists are counting carbon by focusing on the accuracy of carbon measurement. On the other hand, accounting professionals in the carbon accounting field are concerned with credibility in reporting carbon with a high degree of certainty. Conversely, the organizations in the accountability for the carbon field insist on consistency in the calculations of carbon. De Aguiara and Bebbington (2014) also argue that there is a wide variety of approaches that can be found in the accounting literature that looks at the subject of climate change and carbon accounting. They further indicated that the area is slowly emerging since there is no financial accounting standard on the recognition of carbon emissions in the financial statements. Conversely, Ascui and Lovell (2011) argued that the apprehensions and inconsistencies in carbon accounting are due to five conflicting structures of reference consisting of physical, political, market-enabling, financial, and social/environmental modes. Drawing on the theories of framing, the authors argue that there are divergent meanings and practices of the term carbon accounting. The different directions in carbon accounting are responses to the issue of climate change. They further argue that the divergent forms of carbon accounting have not received enough attention. In a similar sense, Jones and Solomon (2013) also contend that accounting for biodiversity can be grouped into philosophical and scientific problems, accountability problems, technical accounting problems, and problems of accounting practice.

Literature has suggested the need to separate the methods and application of carbon accounting and the need for an environmental framework to distinguish between physical and monetary aspects

of carbon accounting. For example, Schaltegger and Csutora (2012) have differentiated between the application and methods of carbon accounting with a firm. They indicated the need for an environmental framework for decision-makers and to distinguish between the physical and monetary approaches to carbon accounting. Carbon accounting practice should be expanded to product life-cycle and input-output methods in hybrid accounting. Lee (2012) explored the functions of environmental management accounting and the eco-control method to manage the carbon in the supply chain of a firm. The study employed a case study of automobile manufacturers in Korea to study the functions and the practicality of environmental control to ascertain and compute greenhouse gas performance in a manufacturing plant. The results showed that ecological control may be used as a substitute for the carbon control plan and its performance measurement of a firm. He further noted that feasible planning of carbon movement in organizations offers vital prospects to increase carbon performance in the supply chain.

#### *4.2. Carbon Emissions Disclosures*

Although there is a growing need for carbon disclosures by organizations, such emission disclosures remain voluntary in most jurisdictions. Choi et al (2013) for example, found that the number of companies in Australia that provide voluntary carbon disclosures increased significantly from 2006-2008. Andrew and Cortese (2011) revealed that greenhouse gas emissions related disclosures keep increasing over the last five years with most of the disclosures being done voluntarily by firms. Carbon disclosure rates keep increasing and its signals are becoming more and more notable (Hrasky, 2011). Additionally, Choi et al (2013) found that generally, the scope of the information on greenhouse gas and climate change improved in areas such as risk assessment and prospects created by climate change, quality and quantity of carbon emissions information, quantity of energy consumed, carbon emission reduction strategies, and climate change responsibility policies. More so, the size of the firm, its emission level, and the quality of corporate governance are the major factors that determine the volume of voluntary carbon disclosures. Raquel, Aguiara, and Bebbington (2014) however, question the quality of voluntary disclosure on carbon emissions and the means of communication; which is generally through annual reports, stand-alone reports, and web pages.

#### *4.3. Drivers for Carbon Disclosures*

The need for environmental and for that matter carbon disclosures may be driven by diverse reasons; one such reason is pressure from stakeholders. An organization may disclose its carbon-related information to satisfy apprehensions from stakeholders. For example, Gonzalez-Gonzalez and Ramirez (2016) argue that the likelihood of a firm's carbon disclosure and its transparency level is due to the pressure from society, markets, shareholders, and international interactions. Liesen, Hoepner, Patten & Figge (2015) studied 431 European Union companies and reported that the companies usually report their carbon emissions as a response to the pressures from external stakeholders. Moreover, some Australian companies disclose their greenhouse gas emissions voluntarily to gain competitive advantage (Rankin, Windsor, and Wahyuni, 2011). According to a study from UCLA's Applied Management Research Program (Crawford, 2015), companies under higher scrutiny or external pressure are more likely to report to enhance their public image. Also, investor demand is a key reason why businesses choose to disclose, followed by environmental concerns and to improve the understanding of their business. The study also revealed that the main benefit of disclosure is being able to identify opportunities and manage risks.

Additionally, membership or ownership of a firm may also influence its carbon emissions disclosures. For instance, Luo, Tang, and Lan (2013) sampled 2,045 large firms representing various industries from 15 countries that provided the Carbon Disclosure Project (CDP) reports. The study showed that organizations that are owned by CPD participants mostly disclose carbon information and helps them to be seen as influential stakeholders. De Aguiara and Bebbington (2014) also explored the extent of greenhouse gas disclosure in the financial statements and stand-alone reports of firms that were part of the UK Emissions Trading Scheme. They used content analysis in coding to

differentiate the emissions disclosures in the various media used for reporting and the subsequent influence of reporting by organizations that are members of the UK emissions trading scheme. The longitudinal study results revealed that the UK emissions trading scheme is related to the disclosure differences.

Liesen, Hoepner, Patten & Figge (2015) revealed that in Spain the key mediating factors for disclosures were the size of the firm, its financial risks, ownership concentration and whether the company is listed on the IBEX35 or FT500 indexes. Luo, Tang, and Lan (2013) also used profitability, leverage and growth, and the company's involvement in CPD as proxies for resource availability and carbon disclosure propensity. Their results showed that carbon disclosure tendency is associated with the availability of the resource, and especially stronger in the developing countries, signifying that the scarcity of resources is a cause for some companies' inability to commit themselves to carbon alleviation and disclosures. Luo et al (2013) observed that with regards to the tendency to disclose carbon-related information and carbon alleviation activities, countries in developing countries are comparatively sluggish when likened to developed nations.

More so, firms may be driven to voluntarily disclose their impact on the environment to legitimize their operations. Hrasky (2011) noted that carbon-intensive industries use carbon disclosure as a legitimating strategy, while the less carbon-intensive industries depend on symbolic disclosures. Other studies also confirmed that legitimacy is the main driver of firms' voluntary carbon emissions disclosures (Comyns & Figge, 2015; Schaltegger & Csutora, 2012; Pellegrino & Lodhia, 2012; Liesen, Patten & Figge, 2015; Hrasky, 2011; Gonzalez-Gonzalez & Ramírez, 2015; Choi, Lee & Psaros, 2013). However, disclosures driven by legitimacy are sometimes not adequate. A study by Liesen et al (2015) suggested the incomplete nature of the reports by the firms can be associated with the legitimacy theory, which states that firms can disclose incomplete carbon emissions to address legitimacy exposures. Also, companies may engage in a voluntary disclosure to improve their business reputations in society. Thus, companies that are perceived as not mindful of the environment run the risk of inviting society's anger and negative public reactions. Most importantly, several governments have taken measures to encourage companies to produce responsibility reports.

Also, theories such as institutional theory, stakeholder theory, and legitimacy theory, signaling theory, economic theory, contingency theory, and transaction cost theory have been used to discuss the motive and various aspects of carbon accounting. For instance, institutional investors are significant users of accounting information who drive the voluntary disclosure of carbon information; which in effect augments the soundness of stakeholder theory (Gonzalez-Gonzalez & Ramírez, 2016; Liesen, Patten & Figge, 2015; Luo, Tang & Lan, 2013; Comyns and Figge, 2015). Also, legitimacy theory has been used to explain the reasons why companies voluntarily disclose the impact of their activities on society and the environment. The legitimacy theory posits that organizations disclose information voluntarily to regain or maintain legitimacy. Thus, corporate disclosures are aimed at conforming to societal expectations. Few of the studies reviewed used institutional theory, resource constraints theory, signaling theory, institutional governance system theory, neo-classical economic theory, contingency theory, and transaction cost theory to explain how and why firms undertake carbon accounting.

#### 4.4. Adequacy of Disclosures

Though firms are disclosing their carbon-related activities and impact on climate change, most of these disclosures are either not adequate or inconsistent. The fundamental challenge of social accounting is qualifying issues that are essentially qualitative (Griseri & Seppala, 2010). Norman and MacDonald contend that social performance and environmental impact cannot be objectively measured in ways that are comparable to economic measurements of a company's activities. For instance, the findings of Liesen *et al* (2015) revealed that out of the sample of 431 European Union companies surveyed, only 15% of greenhouse gas emissions disclosure is believed to be complete. Haque and Deegan (2010) investigated five major Australian energy-intensive firms over 16 years on climate change-related governance disclosures. With the use of content analysis, they tried to identify

disclosures on policies and procedures on climate change using the annual reports and sustainability reports of the sampled firms. Their results found a general increase in the trend of disclosures over time; nevertheless, most of the companies are not giving out enough information on the risks and prospects of their activities on climate change. Cotter, Najah, and Wang (2011) explored the breaches between regulatory requirements and authoritative guidance regarding climate disclosure in Australia; reporting practices; and the needs for increased disclosure and standardization of that disclosure. The results suggest there is inadequate disclosure on numerous dimensions of climate change impacts and management on the sampled firm's reports and web sites. They found that the disclosures lack technical details and tend to be tilted toward the more positive features of climate change impacts and management.

No wonder Laasch and Conaway (2013) remarked that accounting for the three interconnected bottom lines is a highly complex task. Many have also questioned the accuracy of the carbon-related information that is provided by firms. For instance, Dragomir (2012) studied the sustainability reports of the top five largest oil and gas European companies over the last ten years in line with the effects of their operations on global warming. Dragomir used complex tools like the Greenhouse Gas Protocol for his study. The results surprisingly showed that the five oil and gas industry giants have issued baffling figures in their reports and are inconsistent in the methods used. Thus, Sullivan and Gouldson (2012) criticized that even though investors require companies to report the effects of their activities on climate change, much attention has not been paid to the quality of the reported information. Again, Haslam, Butlin, Andersson, Malamatenios, and Lehman (2014) studied how carbon footprint has been reported to the society. The authors made use of numbers and narratives to discover what has changed in the carbon footprint reports with the use of the UK's national carbon emissions data from 1990-2009 and FTSE100 carbon emission data from 2006-2011 of carbon emissions data. They concluded that the current carbon disclosure practices create flexible, unreliable, and contradictory numbers and descriptions. Andrew and Cortese (2011) therefore argue that the diverse carbon disclosure methods are likely to constrain the practicability of climate change-related information.

Furthermore, Warwick & Ng (2012) studied how companies in the European Union emissions trading system (EU ETS) accounted for carbon in 2007. The results suggest that there was no standardization in how the companies account for emissions. The heavy carbon-emitting companies on EU ETS are using a variety of accounting methods in accounting for greenhouse gas releases allowances. Liempd and Busch (2013) studied the ethical reasons for reporting biodiversity issues and to investigate the actions of firms on their reasons for reporting. Their study describes the poor biodiversity reporting in Denmark even though the country used to be a global trendsetter in environmental reporting. Comyns and Figge (2015) also explored the development of greenhouse gas reporting eminence and whether its quality is associated with the kind of information conveyed in line with the exploration, capability, and credibility of the firms. They studied 245 sustainability reports of 45 oil and gas firms from 1998 to 2010 using the content analysis disclosure index. The results suggest that the quality of greenhouse gas reports over the 12 years did not improve significantly.

In line with the inconsistencies and inadequacies of the carbon disclosures, studies have suggested the need for mandatory carbon disclosures and its related regulations, standards, and assurance services to curtail the situation. Sullivan and Gouldson (2012) argue that due to the lack of quality of the climate change reports, the investors are not able to make valuable comparisons between companies, which have resulted in low interest on the part of the investors of that information. They suggested the need for both voluntary and mandatory reporting, and the encouragement of investor interest to deal with the problem. Khan (2014) has suggested the need for a comprehensive and versatile framework of biodiversity reporting and disclosures to promote accountability. The framework will ensure transparency in line with the activities of stakeholders that affect biodiversity. Khan also remarked that biodiversity reporting can encourage the monitoring and managing of the use of land and labor by businesses. Adams (2010) suggested the need for the regulatory requirement to increase transparency on sustainability issues. Cook (2009) has, however, proposed that the International Accounting Standard Board should not resolve the issue of the standard with the stand-

alone rule, rather, they should focus on the clear application of a principle in the accounting framework.

#### 4.5. Carbon Disclosure and Performance

Several studies have associated corporate carbon disclosure with performance. For instance, Rankin, Windsor, and Wahyuni (2011) used institutional theory to clarify voluntary corporate carbon reporting in a market governance system framework in which there is no climate change public policy. They argued that the credibility and extent of disclosure of greenhouse gas emissions are mostly related to firms that have environmental management systems, high-quality corporate governance, and those who openly report to the carbon disclosure project. Such firms are usually huge and, in the mining, energy, and industrial sectors. Again, Saka and Oshika (2014) examined how carbon emission disclosures affect corporate value. Based on their study, they concluded that there is a negative relationship between corporate carbon emissions disclosures and market value of equity. On the other hand, they found a positive relationship between the disclosure of carbon management and the market value of equity. More so, the positive relationship between the disclosure of carbon management and the market value of equity is stronger in situations where the volumes of carbon emissions are bigger. Similarly, Luo and Tang (2014) examined 474 US, UK, and Australian firms to find out whether voluntary carbon disclosure replicates the actual carbon performance of firms. Content analysis was utilized based on Carbon Disclosure Project reports and carbon performance index on carbon intensity and mitigation designed by the authors. The findings suggest that there is a relationship between the greenhouse gas emissions disclosure and the performance of the firm. The study concludes that the voluntary carbon disclosure in the Carbon Disclosure Project pinpoints the real firm's carbon performance.

#### 4.6. Carbon-Related Investment Decisions

Carbon emissions disclosures are becoming more interesting for investors. Potential investors are concerned about the impact of the activities of firms on the environment and as such attaching importance to investing in socially responsible firms. For example, Dilla, Perkins, and Raschke (2016) studied the value that investors attached to firms that are environmentally responsible and whether the investors consider firms that environmentally responsible to yield higher returns. The study also examined the relationship between the use of socially responsible investment monitors and the reported socially responsible investment holdings. The results are consistent with the view that investors attach importance to investment in socially responsible firms. Also, Solomon, Solomon, Norton, and Joseph (2011) explored the kind of upcoming discussions of private climate change reporting which takes the form of private meetings between institutional investors and their investee firms. The study found that private climate change reporting is mostly on the discussion of risk and risk management. Institutional investors consider climate change-related issues as a material risk and the most prominent sustainability issue.

Also, studies reviewed show that the carbon intensity of firms affects their cost of debt. That is, firms that emit high volumes of carbon are expected to pay indirectly for their emission volumes through their cost of capital. For example, Li, Eddie, and Liu (2014) sampled ASX 200-indexed listed companies and found that the cost of capital, both equity and debt would increase in companies that are emissions liable. The study also found that the cost of debt positively correlates with the intensity of the carbon emission of a company. Martin and Moser (2016) undertook an experimental study on whether investors react to the disclosure of corporate social responsibility investment not depending on the firm's future cash flows. They also investigated whether managers expect investors to react to the information they disclose in their disclosure decisions. The results show that probable investors respond to the voluntary disclosure of greenhouse gas emissions by companies than when no such report is provided. They also found that investors tend to react positively to information disclosed which has a focal point to benefits society. Luo and Tang (2014) explored the effect of a recommended carbon tax on the financial market return of firms in Australia. The study investigated the market

response of carbon legislative information, using a sample of 48 different firms. The results suggest that the proposed tax taken as a whole hurts the shareholder's wealth with different negative effects across sectors. The study suggested that investors will punish firms with huge direct operational carbon emissions. Thomson, Grubnic, and Georgakopoulos (2014) argue that there are constraints that come together to disturb the sustainable developmental transformation in organizations and its decision-makers.

#### *4.7. Role of Accountants and Accounting Researchers*

Accountants and accounting researchers play a critical role in carbon and climate-related mitigation and reporting. Hopwood (2009) for example suggests the need for more research in the role accounting plays in the area of environmental and sustainability reporting. Lodhia (2011) studied the insinuations of the National Greenhouse and Energy Reporting (NGER) Act in Australia. The results suggest that researchers in the field of accounting with interests in the area of social and environmental reports have a crucial role to play in stressing the ability of accountancy in the management and ensuring accountability of carbon emissions. Also, Jones and Solomon (2013) studied the problems surrounding accounting for biodiversity and also give a framework to examine and comprehend the role accounting play in safeguarding and improving biodiversity on the planet. The study indicated that accounting has an exclusive and special function to make sure that the activities of organizations do not destroy species that are being discovered by scientists. They called on accounting researchers working around biodiversity to investigate a wide variety of disciplines in an attempt to curb the effect of human activities on the environment. There is the need to include interdisciplinary schemes in which accountants can facilitate reporting and communicating the environmental data given by scientists. Gibassier and Schaltegger (2015) argue that carbon accounting is a feature of accounting that has impacted environmental capital. Therefore, accountants can combine two corporate carbon management methods within an organization. That is, combining the products and the organization into a joint carbon management system. This will in turn result in more efficient and effective performance management and external reporting.

Burritt and Tingey-Holyoak (2012) suggested that there is a need for accountants in practice to tap knowledge from accountants in academia to manage the issue of climate change. They argue that accountants in practice should use their professional abilities to deal with the effects of their business activities on the environment. They emphasized the need for accounting professionals in practice and academia to team up to tackle the issue of greenhouse emissions for cleaner production. Additionally, carbon management accounting can offer a chance for organizations to exceed the legal requirements for reporting greenhouse gas and carbon equivalent emissions. It is suggested that when carbon management accounting is properly practiced, it will lead to effective and efficient carbon management performance (Burritt, Schaltegger & Zvezdov, 2010).

### **5. Conclusions and Recommendations**

This paper has systematically presented the state of both empirical and conceptual research in carbon accounting and reporting. It has also analyzed the rationale for carbon disclosure, its adequacy, and inconsistencies as well as the role of accountants on the mitigation. The review has shown the diverse ways by which the term 'carbon accounting' is perceived. Therefore, there is a need to streamline the application and methods of carbon accounting. There is also the need for an environmental framework for decision-makers. Generally, corporate disclosures are mostly inconsistent, contradictory, unreliable, lack technical details, among others. Hence, there is a critical need for government regulators and standard setters in accounting to provide a framework that will guide carbon disclosure practices.

Furthermore, there is a general increase in carbon disclosures practices. Organizations are disclosing their carbon emissions through annual reports, integrated reports, or stand-alone sustainability reports. However, these disclosure practices are for various reasons and motives. Generally, there is a lack of research on carbon accounting and disclosures in the developing countries

and especially Africa. Researchers should therefore focus on Africa and direct their research into why the availability of resources affects disclosures on carbon-related activities. The practical implication of the study is that businesses should act in a manner that benefits all stakeholders by deliberately engaging in responsible business practices for the benefit of society.

Responsible business implies taking responsibility and being accountable for the environmental and social impacts of business activities. With the growing level of societal awareness of social issues, human rights, and environmental impact of business, proactive companies must measure and manage all impacts to create a neutral to positive triple-bottom-line of social, environmental, and economic business impacts.

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