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The Disclosure of Carbon Emission in Indonesia: A Systematic Literature Review

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ABSTRACT

This study aims to provide a systematic review of research on carbon emission disclosures in the context of Indonesia. Thirty articles published in Indonesian Journals indexed by Science and Technology Index (SINTA) were selected using mapping approach (charting the field). The review found that 87% of the studies employing secondary data based quantitative method, while the other 10% studies used survey method. The resarch findings also revealed two group of determinants of carbon emission disclosure in Indonesia. 53% of the reviewed articles tested the impact of non-financial variables, for example firm age, type of industry. Meanwhile, 47% of the studies investigated the influence of financial variables (for example, leverage, firm value, and profitability) for the carbon emission disclosure. The results of this study provide an updated evaluation of prior studies and research agend for further research in carbon emission.

Pengungkapan Emisi Karbon di Indonesia: Sebuah Kajian Literatur Sistematis

ABSTRAK

Artikel ini bertujuan mereviu penelitian mengenai pengungkapan emisi karbon di Indonesia. 30 artikel diperoleh jurnal yang terindeks Sinta 1 dan Sinta 2. Metode pengumpulan artikel menggunakan pendekatan pemetaan (charting the field). Berdasarkan klasifikasi metode penelitian, metode analytical mendominasi penelitian sebesar 87%, metode survey 10%, dan metode literature review 3%. Temuan lain menunjukkan bahwa masih sedikit penelitian carbon emission yang menggunakan variabel financial factors contohnya variabel leverage, firm value, profitability (47%). Sebaliknya, penelitian tentang carbon emission disclosure didominasi oleh variabel non-financial factors contohnya variabel firm age, type of industry (53%). Hasil penelitian ini tidak hanya menggambarkan keterbaharuan penelitian, namun juga agenda riset untuk penelitian selanjutnya pada topik pengungkapan emisi karbon.

1. Introduction

Climate change is becoming an exciting issue and worldwide concern. It induces global warming (Azar, 2021) impacting environmental damage and pollution (Larasati et al., 2020; Egbunike & Emudainohwo, 2017). According to Andrian & Kevin (2021) Indonesia produces approximately 15-20 million tons of carbon emission per day. This makes Indonesia as the 6th largest country producing carbon emission (Larasati et al., 2020). If the increase in carbon emission takes place in the long term, then companies around the world will experience decline of profitability, investment, and productivity (Rezai et al., 2018). Thus, it requires efforts and awareness from the government to reduce the impact of environmental change.

Indonesia government has taken initatives to achieve sustainable development with aim to reduce carbon emission (Hapsari et al., 2020). The Kyoto Protocol is part of the international-scale conferences held in Kyoto, Japan. This protocol is a commitment and awareness of international world on sustainable development. The Kyoto Protocol implies that companies must recognize, measure, record and disclose carbon emission (Irwhantoko & Basuki 2016).

Indonesia ratified the Kyoto Protocol on June 28, 2004 in the first period issuing Law No. 17 of 2004. The Indonesian government continues to strive to reduce carbon emissions by giving various policies, namely Presidential Regulation No. 61 of 2011 concerning the National Action Plan for Reducing Greenhouse Gas Emissions (or RAN-GRK) and Presidential Regulation Number 71 of 2011 concerning the Implementation of the National Greenhouse Gas Inventory (Nainggolan & Rohman 2015).

Indonesia government also signed the signing of the Paris Agreement in 2015 with 196 countries in the world as a form of commitment and contribution from the state to reduce gas emissions and restore natural damage (Muhammad & Aryani 2021). The agreement implies that Indonesia seeks to reduce carbon emissions to 29% by 2030. Pollution due to carbon emissions motivates companies to disclose carbon emissions as a form of environmental responsibility. However, carbon emission disclosure for companies in Indonesia is still voluntary (Hardiyansah & Agustini, 2021).

Carbon emission disclosure is a form of accountability for company activities to climate change. Carbon emission disclosure is part of sustainability reporting (Alsaifi et al. 2020). However, carbon emission disclosure may contribute to improved risks, such as increased operating costs. Similarly, Irwhantoko & Basuki (2016) argue that companies tend to disclose carbon emission required, but there are no efforts or actions to reduce the carbon emission.

There have been various factors that motivate companies to disclose carbon emissions, such as stakeholder awareness and concern for the environment to put new pressure on companies to reduce carbon emissions from operational activities. In addition, the disclosure of carbon emissions is considered valuable information for stakeholders concerning the company's assessment (Cong & Freedman 2011). Equity markets are increasingly worried about a low-emissions economy directly impacting companies' long-term competitiveness (Hermawan et al. 2018). However, not all Indonesian companies support the disclosure of carbon emissions. The reasons could be: it is costly, not mandatory, and the benefits of such disclosure may not exceed the gain obtained (Trinks et al., 2020; Yu et al., 2022).

Several studies have documented determinants and their inconsistent influence on carbon emission disclosure. For instance, Narsa & Jannah (2021), Widiastutik & Khafid, (2021), and Yusuf (2020) revealed that leverage positively affects carbon emission disclosure. However, Prasetya & Yulianto (2018) found that leverage negatively affects carbon emission disclosure.

Hapsoro & Falih (2020), and Larasati et al., (2020) uncovered that firm size and profitability positively and significantly affect carbon emission disclosure. Meanwhile, Ummah & Setiawan (2021) & Kholmi et al., (2020) found that firm size and profitability negatively affect carbon emission disclosure in Indonesia. This is because corporations are more likely to consider other disclosure that affects public legitimacy (Kholmi et al., 2020).

This study aims to review research on carbon emission disclosures in Indonesia context. This study examines articles from the accredited journal Sinta 1 and Sinta 2 using charting the field approach. Charting the field is a mapping used to classify research results. In addition, the reason for conducting literature review, few literature reviews discuss the inconsistency of research results on the disclosure of carbon emissions (the author's observations). The contribution of this research is to highlight and discuss empirical evidence research on carbon emissions disclosures in Indonesia and research agenda for future.

2. Literature review

Carbon emission disclosure

The contributor to carbon emissions comes from human activities such as aviation, the use of fossil fuels, deforestation, and the increase in the number of industries. The intermediate contributor to carbon emissions comes from human activities such as aviation, the use of fossil fuels, deforestation, and the increase in the number of industries. Environmental issues and their changes raise the governments' awareness to make various efforts to reduce the adverse effects. Environmental changes can occur due to global warming, climate change and emission from company activities. &rian and Kevin (2021) find that land transportation accounts for 43% of global carbon emissions, while air transport accounts for 10% of global emissions.

The public is increasingly concerned about environmental issues, which results in new pressure for companies to disclose information on operational activities that impact the environment (Muhammad & Aryani 2021). Companies must include corporate social and environmental issues through disclosure of carbon emissions. The disclosure is a communication tool about the company's social and environmental activities (Ben-amar & Mcilkenny 2014).

The basis for preparing carbon disclosure in Indonesia is Global Reporting Initiative (GRI) standard 305 (2016) regarding emission (Muhammad & Aryani 2021). GRI standard 305 can apply to all industry. However, the disclosure is still voluntary depending on company policies and stakeholder pressure. Stakeholders act as users of mandatory and voluntary disclosure. Thus, the company is obliged to fulfill its responsibilities to stakeholders (Larasati et. al. 2020). Carbon emission disclosure is part of sustainability reporting or annual report (Rahmanita, 2020). This topic is worth to study because it is not uncommon for companies to disclose carbon emissions even though the report is voluntary. Several studies on carbon disclosure in Indonesia have been done. Saraswati (2020) aand Andrian (2020) examined the carbon emission calculation. Meanwhile, Muhammad & Aryani (2021); Hardiyansah & Agustini (2021); Rahmadhani & Indriyani (2019); Yendrawati & Asy'ari (2017) investigated the impact of carbon emissions on firm value. Other research examines the factors that influence carbon emission disclosure by Andrian & Kevin (2021); Narsa & Jannah (2021); Iswati & Setiawan (2020); Larasati et al., (2020).

Systematic literature review

Systematic literature review (SLR) is a part of qualitative research and mapping topics for analysis materials. The main purpose of SLR is to discover the development of a particular research topic and finally obtain a research gap (Villas et al., 2008). The review must involve high-quality articles as it is crucial to maintain results of the review credibility.

Hesford et al., (2007) using SLR to evaluate management accountin literature using a sample of 916 articles from 10 journals published between 1981 and 2000. The research uses two approaches, namely community analysis and charting the field.

Several literature review in Indonesia have been conducted. Ernawati & Aryani (2019) review 36 artiles from 10 journals indexed in Sinta. Meanwhile, Amri & Aryani (2021) review literature on financial distress in Indonesia and Herawati & Bandi (2019) evaluate the research of tax in Indonesia.

Figure 1 illustrates the framework of this research that relies on Hesford et al. (2007) SLR approach and charting the field analysis. This research framework consists of four main analyzes. First classification based on articles according to the research of Herawati & Bandi (2019) which consists of journals, authors, and articles. Second, the variety of articles based on research methods following Ernawati & Aryani (2019). Third, grouping in the form of financial and non-financial factors according to the variables used in the research on carbon emission disclosures. Fourth, mapping cause and effect to determine the relationship between variables that affect carbon emission disclosures and variables that influenced by carbon emission disclosures.

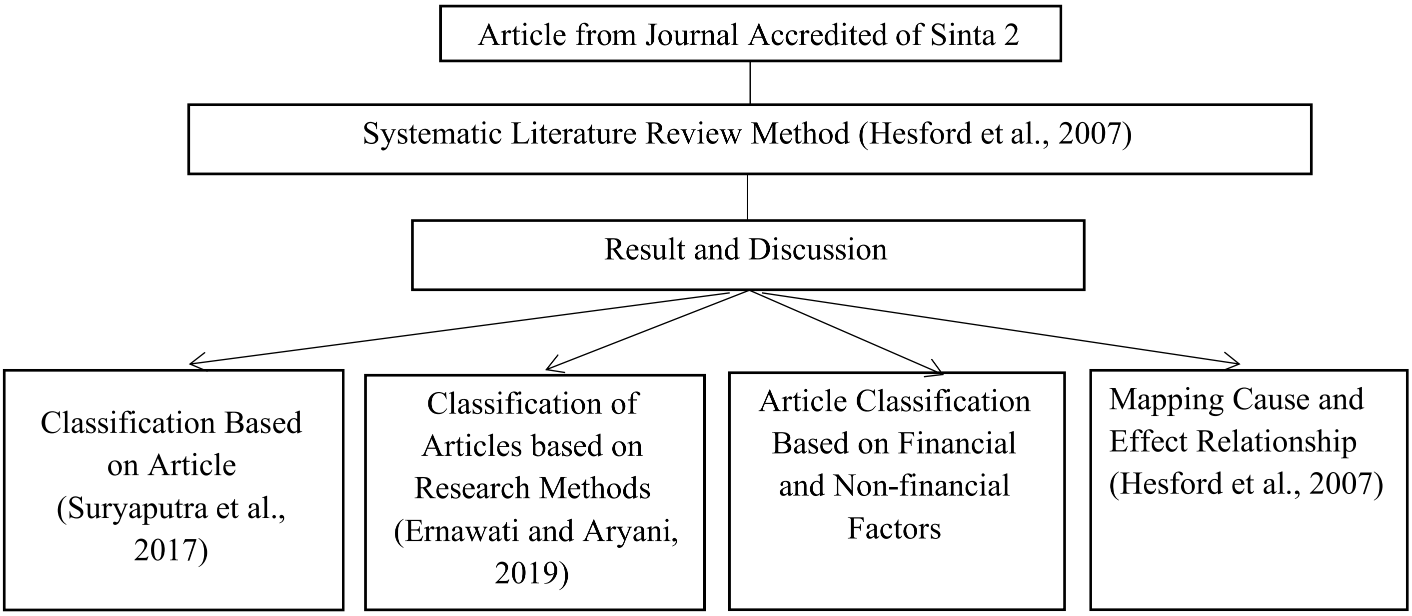

Figure 1. Research framework

3. Research method

Data and samples

Charting the field developed by Hesford et al. (2007) was used in this study. The advantage of this method is that it can provide an overview of the gaps from previous research for the development of further research. It aims to classify previous studies' variables and conclude the research results' inconsistencies.

Articles collected from journals accredited by Sinta 1 and Sinta 2 (Sinta.kemdikbud.go.id) because Sinta 1 and Sinta 2 have the highest quality of the published articles. These journals are more qualified (score of accredited Sinta 1 minimal 85 to 100 and Sinta 2 minimal 70 to 85), have better classifications, and have strict selection processes on published articles, therefore they have high-quality articles. In acquiring the articles, the authors conduct an online search at Sinta.kemdikbud.go.id. The authors limited the search area to *manajemen*, management, *akuntansi*, and accounting (Table 1).

Table 1. Sample selection

No.	Criteria	Total
1.	Sinta 1 accredited accounting and business journal	1 journal
2.	Sinta 2 accredited accounting journal	29 Journals
3.	Sinta 2 accredited business management journal	10 Journals
4.	Sinta 2 accredited banking journal	3 Journals
5.	Journals where there is no research on carbon emissions disclosure	(25 Journals)
6.	Number of journals used in research	18 Journals

Table 1 describes the sample selection of this study. The criteria for this research sample are Sinta 1 and Sinta 2 accredited journals in the scope of accounting, business management, banking, and 43 journal pages were obtained. The following selection is whether there are articles on carbon emission disclosures and whether the research in Indonesia is on each journal page. There were 18 accredited national journals by Sinta 2. The journals is *Jurnal Ilmiah Akuntansi dan Bisnis*, Indonesia Journal of Sustainability Accounting and Management, *Jurnal Dinamika Akuntansi dan bisnis*, Journal of Economics, Business, and Accountancy Ventura, Journal of Accounting and Investment, Accounting Analysis Journal, *Jurnal Akuntansi dan Keuangan, Jurnal Akuntansi Bisnis, Jurnal Akuntansi dan Keuangan Indonesia, Jurnal Akuntansi, Jurnal Dinamika Akuntansi, Jurnal Akuntansi,* The Indonesia accounting review, *Jurnal Review Akuntansi dan Keuangan, Jurnal Keuangan dan Perbankan, Jurnal Manajemen Teknologi,* The Indonesia Journal of Accounting Research, *Jurnal Ekonomi & Keuangan Islam,* Corporate Social Responsibility and Environmental Management.

This study reviewed 30 articles on disclosure of carbon emissions publishe from 2010 to 2021. The accredited journal Sinta 2 published its first carbon emission disclosure article in 2010, while 2021 was this study taken place. The use of articles without restrictions on the year of publication is due to the absence of laws governing the company's obligation to provide carbon disclosures.

The stages of this research are as follows: the first step is looking for articles on journal sources Sinta.kemdikbud.go.id with the keyword *akuntansi*, accounting, *manajemen*, management, financing, banking, and then looking for articles using the keyword carbon emission disclosure in each journal. The second stage is filtering the suitability of the paper with the topic. The third stage is grouping articles based on research by Okoli & Schabram (2012) based on the title, authors, year, sample, data, and results.

4. Results and discussion

Classification based on article

Table 2 displays information about the journals containing research on carbon emission disclosure, most widely by *Jurnal Ilmiah Akuntansi dan Bisnis*, Indonesia Journal of Sustainability Accounting and Management and *Jurnal Dinamika Akuntansi dan Bisnis* each publishing four articles with a percentage of 13% per journal. Second, the Journal of Economics, Business, and Accountancy Ventura, Journal of Accounting and Investment and Accounting Analysis Journal have a percentage of 7% in which there are two articles. Thus, the number of articles publishing in the journal is six articles. Third, the percentage of 3% is publishing in the following journals: *Jurnal Akuntansi dan Keuangan, Jurnal Akuntansi Bisnis, Jurnal Akuntansi dan Keuangan Indonesia, Jurnal Akuntansi, Jurnal Dinamika Akuntansi, Jurnal Akuntansi*, The Indonesia accounting review, *Jurnal Review Akuntansi dan Keuangan, Jurnal Keuangan dan Perbankan, Jurnal Manajemen Teknologi*, The Indonesia Journal of Accounting Research, *Jurnal Ekonomi & Keuangan Islam*, Corporate Social Responsibility and Environmental Management. Thus, the total publishing is 12 articles.

Table 2. Article classification carbon emission disclosure

No.	Journals	Author(s)	No. of articles	Percentage
1.	Journal of Economics, Business, & Accountancy Ventura	(Allam & Diyanty 2020), (Irwan & Utama 2018)	2	7%
2.	*Jurnal Akuntansi Bisnis*	(Widiastutik & Khafid 2021)	1	3%
3.	*Jurnal Akuntansi dan Keuangan*	(Irwhantoko & Basuki 2016)	1	3%
4.	*Jurnal Akuntansi dan Auditing Indonesia*	(Yusuf 2020)	1	3%

5.	*Jurnal Akuntansi*	(Rahmadhani & Indriyani 2019)	1	3%
6.	*Jurnal Dinamika Akuntansi*	(Prasetya & Yulianto 2018)	1	3%
7.	*Jurnal Dinamika Akuntansi dan Bisnis*	(Narsa 2021), (Astari, Saraswati, & Purwanti 2020), (Muhammad & Aryani 2021)	4	13%
8.	*Jurnal Ilmiah Akuntansi dan Bisnis*	(Astari, Saraswati and Pratiwi 2020), (Gabrielle & Toly 2019), (Kelvin, Pasoloran, & Randa 2019), (Monica, Daromes 2021).	4	13%
9.	Accounting Analysis Journal	(Hapsari & Prasetyo 2020)¸(Kiswanto 2016)	2	7%
10.	Indonesia Journal of Sustainability Accounting and Management	(Daromes 2020), (Evana & Lindrianasari, 2020), (Egbunike & Emudainohwo 2017), (Setiawan 2021)	4	13%
11.	The Indonesia Accounting Review	(Pratiwi, Maharani, & Sayekti 2021)	1	3%
12.	*Jurnal Review Akuntansi dan Keuangan*	(Kholmi 2020)	1	3%
13.	Journal of Accounting and Investment	(Iswati & Setiawan 2020), (Hapsoro & Falih 2020).	2	7%
14.	*Jurnal Keuangan dan Perbankan*	(Suharjono 2010)	1	3%
15.	*Jurnal Manajemen Teknologi*	(Zuhrifiyah 2019)	1	3%
16.	The Indonesia Journal of Accounting Research	(Hapsoro, 2020)	1	3%
17.	*Jurnal Ekonomi dan Keuangan Islam*	(Cahya & Hanifah 2017)	1	3%
18.	Corporate Social Responsibility and Environmental Management	(Faisal et al. 2018)	1	3%
	Total		**30**	**100%**

Classification of articles based on research methods

This research classifies the methods in articles on carbon emission disclosure based on research methods, number of articles, and percentages. The author divided research methods into three categories: analytical, survey, and literature review used in 30 research articles on carbon emission disclosure in Indonesia (Table 3).

Table 3. Classification of articles based on research methods

No.	Method	Number of articles	Percentage
1.	Analytical	26	87%
2.	Survey	3	10%
3.	Literature Review	1	3%
	Total	**30**	**100%**

Table 3 provides information that analytical methods dominate in carbon emission research is analytical (87%). Analytical research uses secondary data from financial, sustainability reports, and CDP questionnaires as an assessment indicator. Research methods of analytical dominate using linear regression for data analysis, research example Widiastutik & Khafid (2021); Narsa & Jannah (2021); Allam & Diyanty (2020); Yusuf (2020) discuss the factors that affect carbon emission disclosure in manufacturing companies. Second, the survey method has a portion of 10% (3 articles). The survey method uses questionnaires and interviews. Third, the literature review has a percentage of 3% (1 article).

Article classification based on financial and non-financial factors

The financial factor refers to a factor that influences companies to disclose carbon emission related to company finances. Allam & Diyanty (2020) find that financial slack is part of financial factor. Therefore, research conducted by Chithambo & Tauringana (2014) found that corporations with high financial slack can use excess resources to disclose reporting activities compared to companies with low financial slack. Some non-financial factors, such as type of industry and firm age do not directly affect the company's finances. However, this is a factor in disclosure of carbon emission.

The authors classify variables based on 30 articles on carbon emission disclosure topics. These variables consist of factors influencing and concerning carbon emission disclosure. Tables 3 and 4 show the division of variables into financial and non-financial factors. Financial factors are financial slack, leverage, financial performance, equity ratio, profitability, financial distress, abnormal stock return, ROE, firm value, and earning management. Meanwhile, non-financial factors that social reputation, industry regulation, family ownership, PROPER rating, type of industry, woman on board, environmental management system, environmental performance, corporate governance, ISO 14001, index performance proper, foreign diversity, environmental committee, firm age, military connection, independent commissioners, gender diversity. Financial factors have a percentage of 47% (20 variables), and non-financial factors reached 53% (24 variables) of the total number of variables used in the article (44 variables). This percentage shows that research in Indonesia is more interested in using non-financial factors variables related to carbon emission disclosure.

Table 4. Distribution of articles based on financial determinants

No.	Variable	Variables used in articles	Percentage
1.	Financial slack	1	5%
2.	Leverage	5	24%
3.	Financial performance	1	5%
4.	Equity ratio	1	5%
5.	Profitability	4	19%
6.	Financial distress	2	10%
7.	Abnormal stock return	1	5%

8.	Roe	2	10%
9.	Firm value	2	10%
10.	Earnings management	1	5%
11.	Liquidity	1	5%
	Total	**20**	**100%**

Based on Table 4 above, leverage is the most widely used variable with a percentage of 24% from total variables. The variable in the following carbon emission disclosure is the profitability of 19%. Variable financial distress, ROE, and firm value each have a percentage of 10%. Furthermore, the variables of financial slack, financial performance, equity ratio, abnormal stock return, earning management, and liquidity each have a percentage of 5%.

Table 5. Distribution of articles based on non-financial determinants

No.	Variable	Variables used in articles	Percentage
1.	Social reputation	1	4%
2.	Industry regulation	1	4%
3.	Family ownership	2	8%
4.	Proper rating	2	8%
5.	Type of industry	2	4%
6.	Woman on board	1	4%
7.	Environmental management system	3	13%
8.	Environmental performance	2	8%
9.	Corporate governance	1	4%
10.	ISO 14001	1	4%
11.	Proper performance index	1	4%
12.	Foreign diversity	1	4%
13.	Environmental committee	1	8%
14.	Firm age	2	4%
15.	Military connection	1	4%
16.	Independent commissioners	2	8%
17.	Gender diversity	1	4%
18.	Company size	2	4%
	Total	**24**	**100%**

Table 5 above displays that the environmental management system variable holds the most significant percentage 13% of the total variables. Furthermore, family ownership, proper rating, type of industry, environmental performance, firm age, independent commissioners, and company size each have a percentage of 8%. The variables of social reputation, industry regulation, women on board, corporate governance, ISO 14001, PROPER performance index, foreign diversity, environmental committee, military connection, and gender diversity each have a percentage of 4%.

Mapping cause and effect relationship

Mapping cause and effect in this research is conducting using variables in the carbon emission disclosure as the base. The 30 articles were classified into two groups, namely financial and non-financial determinants (Luft & Shields, 2003). Thus, it is found that there are six models of grouping cause and effect have been indentified, particularly additive models, intervention variables, the interaction of independent variables, the interaction of moderator variables, cyclical recursive and recursive non-recursive (Luft & Shields, 2003). Five articles used moderating variables (Widiastutik & Khafid 2021; Muhammad & Aryani 2021; Gabrielle & Toly 2019; Kelvin, Pasoloran, & Randa 2019; Yendrawati & Asy'ari 2017). The cause and effect relationship and explanation of research mapping of carbon emission disclosure in Indonesia are presented in Figure 2.

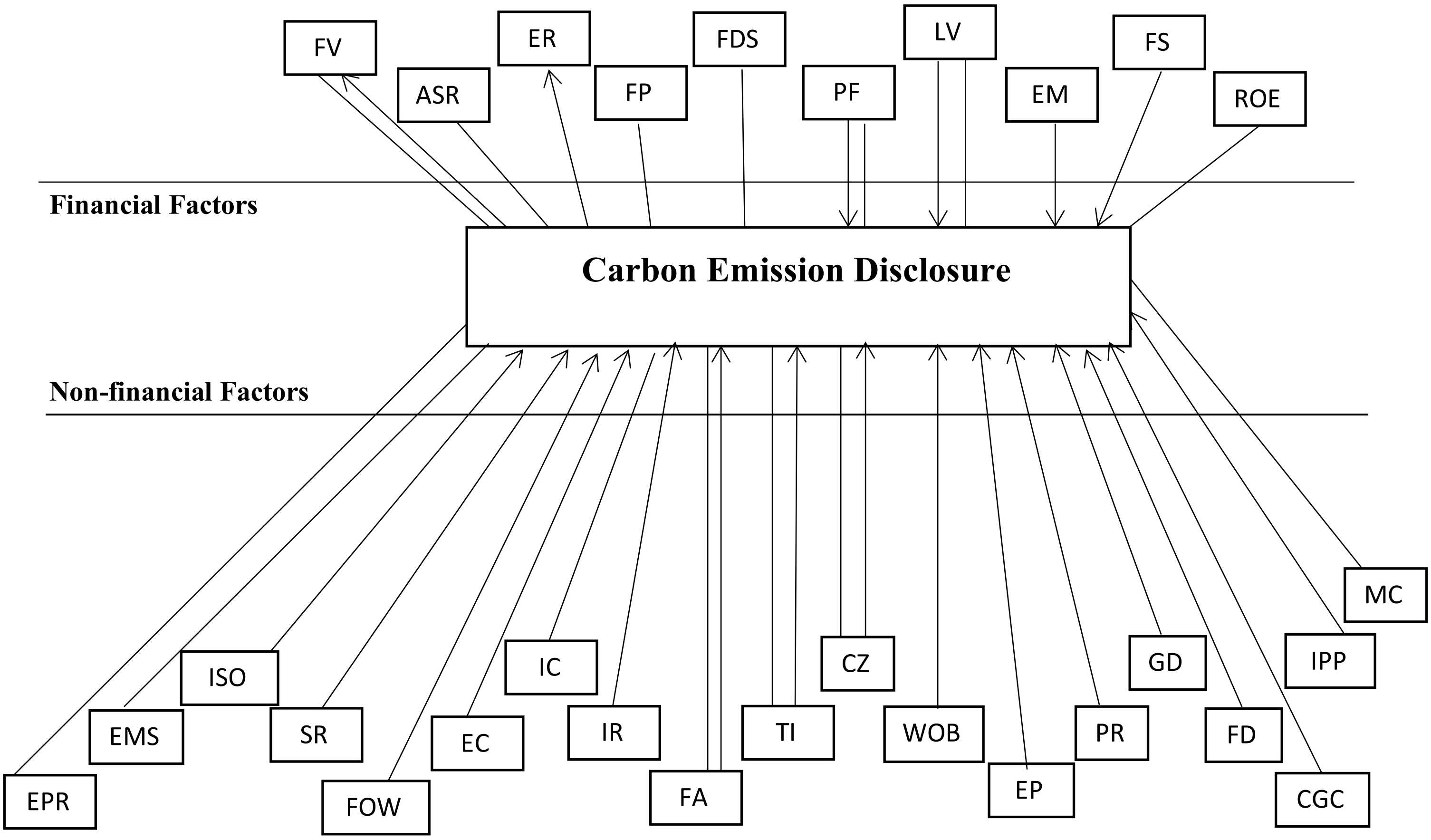

Figure 2. The Map of cause-and-effect relationship

Information:

⟶ = Positive Effect

—— = Negative Effect

Figure 2 displays cause and effect relationship into two groups (financial and non-financial factors) related to carbon emission disclosure. Cause and effect of financial factors there are inconsistent variables is firm value, leverage, and profitability. Meanwhile, non-financial factors there are inconsistent variables is company size and type of industry. The variables used in this research are several variables that affect the carbon emission disclosure that is financial slack, profitability, leverage, financial distress, liquidity, and ROE in the category of financial factors. In addition, the carbon emission disclosure affects several variables: firm value, earnings management, abnormal stock returns, and financial performance.

Table 6 below provides information about the relationship between cause and effect on the research variables used as the preparation of Figure 2. The table describes the positive, negative, positive, and negative effects of carbon emission disclosure.

Table 6. Cause and effect relationship

Positive effect		**Negative effect**		**Positive and negative effects**	
FS	: Financial slack	MC	: Military connection	LV	: Leverage
CGC	: Corporate governance	SR	: Social reputation	PF	: Profitability
IR	: Industry regulation	FP	: Financial performance	IT	: Type of industry
FOW	: Family ownership	ER	: Equity ratio	CZ	: Company size
EP	: Environmental performance	ROE	: Return of equity	FV	: Firm value
ISO	: ISO 14001	FDS	: Financial distress	FA	: Firm age
IPP	: PROPER performance index	EMS	: Environmental management system		
FD	: Foreign diversity	FA	: Firm age		
EC	: Environmental committee	EPR	: Environmental performance		
EM	: Earnings management	IC	: Independent commissioners		
PR	: Proper rating				
GD	: Gender diversity				
WOB	: Women on Boards				
LQ	: Liquidity				
ASR	: Abnormal stock return				

Table 6 contains information about variables that have positive, negative, positive, and negative results from previous studies. The positive effect is dominated by non-financial factors, namely corporate governance, industry regulation, family ownership, environmental performance, ISO 14001, PROPER index, foreign diversity, and gender diversity, while financial factors are financial slack, earning management, liquidity, and abnormal return stock. Negative effects are also dominated by non-financial factors, namely military connection, social reputation, environmental management system, firm age, and committee commissioners, while financial factors are financial performance, equity ratio, return of equity, and financial distress. Cause effect relationship positive and negative effects have the same amount, namely three variables financial factors (leverage, profitability, firm value) and non-financial factors (type of industry, company size, firm age).

Table 7 below provides information about the articles used to compile Figure 2. The table describes the journals, authors of the article, year, and title to find out the articles used in the charting field.

Table 7. A map of causal relationship

No.	**Journals**	**Author(s)**	**Title of articles**
1.	Journal of Economics, Business, and Accountancy Ventura	Allam & Diyanty (2020)	Determine of carbon disclosure
2.	*Jurnal Akuntansi Bisnis*	Widiastutik & Khafid (2021)	*Determinan carbon emission disclosure dengan peringkat proper sebagai variabel mediasi pada perusahaan non keuangan di indonesia tahun 2015-2019*

3.	*Jurnal Akuntansi dan Keuangan*	Irwhantoko & Basuki (2016)	*Carbon emission disclosure: studi pada perusahaan manufaktur indonesia*
4.	*Jurnal Akuntansi dan Auditing*	Yusuf (2020)	*Determinan carbon emission disclosure di indonesia*
5.	*Jurnal Akuntansi*	Narsa (2021)	Factors that can be predictors of carbon emissions disclosure
6.	*AKRUAL: Jurnal Akuntansi*	Rahmadhani & Indriyani (2019)	Impact of emissions intensive industries and financial distress on voluntary carbon emission disclosure
7.	*Jurnal Dinamika Akuntansi*	Prasetya & Yulianto (2018)	Analysis of factors affecting the disclosure of corporate carbon emission in indonesia
8.	*Jurnal Dinamika Akuntansi dan Bisnis*	Astari et al. (2020)	The role of corporate governance as a moderating variable on earnings management and carbon emission disclosure
9.	*Jurnal Dinamika Akuntansi dan Bisnis*	Muhammad & Aryani (2021).	The impact of carbon disclosure on firm value with foreign ownership as a moderating variable
10.	*Jurnal Dinamika Akuntansi dan Bisnis*	Setiawan (2021)	Do board of commissioners characteristic and international environmental certification affect carbon disclosure? Evidence from indonesia
11.	*Jurnal Ilmiah Akuntansi dan Bisnis*	Pratiwi (2018)	*Implementasi carbon emission disclosure di indonesia*
12.	*Jurnal Ilmiah Akuntansi dan Bisnis*	Gabrielle & Toly (2019)	The effect of greenhouse gas emissions disclosure and environmental performance on firm value: indonesia evidence
13.	*Jurnal Ilmiah Akuntansi dan Bisnis*	Kelvin et al. (2019)	*Mekanisme pengungkapan emisi karbon dan reaksi investor*
14.	*Jurnal Ilmiah Akuntansi dan Bisnis*	Monica & Daromes (2021)	Women on boards as a mechanism to improve carbon emission disclosure and firm value
15.	*Jurnal Keuangan dan Perbankan*	Suharjono (2010)	Information gap: demand supply Environmental disclosure Di indonesia
16.	The Indonesia Journal of Accounting Research	Hapsoro (2020)	Relationship analysis of eco-control, company age, company size, carbon emission disclosure, and economic consequences
17.	Indonesia Journal of Sustainability Accounting and Management	Iswati & Setiawan (2020)	Carbon emissions disclosure, environmental management system, and environmental performance:

			evidence from the plantation industries in indonesia
18.	Indonesia Accounting Review	Pratiwi et al. (2021)	Determinants of carbon emission disclosure: an empirical study on indonesian manufacturing companies
19.	Jurnal Review Akuntansi dan Keuangan	Kholmi et al. (2020)	Environmental performance, company size, profitability, and carbon emission disclosure
20.	Accounting Analyze Journal	Kiswanto (2016)	The determinant of carbon emission disclosures

Table 7 shows a map of causal relationships documented from the reviewed articles. Allam and Diyanty (2020) found that financial slack, social reputation, and industry regulations positively affect carbon emission disclosures. Widiastutik and Khafid (2021) unveiled that firm size and leverage positively effect on carbon emission disclosure. Meanwhile, Irwhantoko and Basuki (2016) found that the debt ratio has a positive effect on carbon emission disclosure, but profitability of company has a negative effect. Yusuf (2020) found that profitability, environmental performance, company size, and corporate governance have a positive effect on carbon emission. Narsa and Jannah (2021) documented that ISO 4000, performance index, PROPER environment, environmental committee and foreign diversity have a positive effect on carbon emission disclosure, but company age, leverage, and return of equity have negative effect on carbon emission disclosure.

Furthermore, Rahmadhani and Indriyani (2019) found financial distress has a significant negative impact on carbon emission disclosure. Prasetya and Yulianto (2018) find that PROPER rate, type industry positive effect, profitability leverage, and firm age negatively affect the company's decision to disclose carbon emissions. Astari et al., (2020) found that earnings management has positive effect, but independent commissioners have negative effect on the disclosure of carbon emission. Muhammad and Aryani (2021) find that carbon disclosure negatively affects firm value. Ummah and Setiawan (2021) find that foreign diversity has a negative effect, but gender has a positive effect on carbon emission disclosure.

Moreover, Pratiwi (2018) found that size and profitability has a negative effect on carbon emission disclosures, but that industry regulators has a positive effect. Gabrielle and Toly (2019) revealed that carbon emission positive effect on firm value. Kelvin et al., (2019) documented that disclosure of carbon emissions has a significant positive relationship on abnormal return stock. Monica and Daromes (2021) found that Women on boards have a positive and significant effect on carbon emission disclosure, but negative effect on firm value. Suharjono (2010) unvelied that carbon emission has positive effect on environmental performance.

Hapsoro (2020) found that company age and company size positively affect on carbon emissions. Iswati and Setiawan (2020) found that environmental management system and leverage have a negative effect, but that environmental performance and age of the company in this study have a positive and significant effect on the disclosure of carbon emissions. Pratiwi et al., (2021) found that type of industry, profitability, and company size positively affect the disclosure of carbon emissions, but that environmental performance has a negative effect on carbon emission disclosure. Kholmi et al., (2020) found that the company's environmental performance, size, and profitability have a negative effect on the disclosure of carbon emissions. Kiswanto (2016) found that profitability and audit committee positive affect on carbon emissions disclosure. Meanwhile, environmental performance, financial distress and the proportion of independent commissioners have no significant effect on the carbon emissions disclosure level.

Future research agendas

Variable modification approach

Based on the review results, there are various factors (cause and effect) of carbon emission disclosure. Firm value and carbon emission disclosure variables are interdependent variables. Future research should use moderator variables to test the robustness of the firm value relationship to carbon emissions.

Further research can add moderating variables to the study, for example, the diversity of the board of directors and commissioners. The board of directors has complete control over the company's policies and decisions, while the board of commissioners acts as an adviser and supervisor on the approaches taken by the board of directors. Board diversity can mitigate the negative effects of disclosing carbon emissions and benefit the company. This is possible because the diversity in the board of directors has a variety of thoughts from the senior and junior board of directors that lead to decisions and high environmental concerns.

Methodological approach

The methodological approach is characterized by the level of homogeneity of previous studies. The use of CDP questionnaire (18 assessments) is often used to assess carbon emission disclosures. It includes climate change (risks and opportunities), GHG emission calculations, energy consumption, GHG costs and reductions, and carbon emission accountability. Although indicators are already available from previous studies, this will reduce the novelty of the research. Therefore, it is important to use other assessment indicators to assess carbon emissions, such as GRI 305.

In advances in business research in general, researchers must actively address problems that arise during the research (does not match the hypothesis). Ummah and Setiawan (2021) hypothesis states that nationality has a positive effect on carbon emission disclosure, but the results of nationality research do not affect carbon emission disclosure. Future research should begin to suggest why the proposed hypothesis is not met. This is very interesting for further research, to examine whether the cause of the hypothesis is not fulfilled from previous research and whether it is really caused by this.

The use of moderator variables is still rarely used. The moderator variable is useful for examining the relationship of a variable to carbon emission disclosure. The fact, when this research was conducted, moderator analysis, especially mediators, was not commonly used in empirical carbon disclosure research to date.

The relationship of carbon emission disclosure research mainly uses quantitative methods with secondary data. Future research can provide new perspectives using survey methods or mixed methods (quantitative and qualitative) to cover the shortcomings of the two methods. An appropriate topic for using mixed methods is, for example, testing investors' concerns about disclosing carbon emissions. Data were obtained from questionnaires and interviews with investors.

Research on carbon emission disclosure is dominated by the sample in the form of manufacturing companies, while companies that produce carbon emissions are not only manufacturing companies. Evidence from international, carbon emission disclosure studies typically uses a sample of companies that top 100 produce carbon emissions (Kumari, et. al., 2022). Furthermore, the research sample can expand to the formation of non-financial industries. More interesting, future research can examine carbon emissions in corporate of finance.

5. Conclusions

This study provides evidence regarding Indonesia's carbon emission disclosure research, especially in the Sinta 2 accredited journal from 2010-2021, with thirty articles from eighteen journals. The journals that publish the most research on carbon emission disclosure are Indonesia Journal of Sustainability Accounting and Management, *Jurnal Ilmiah Akuntansi dan Bisnis,* and *Jurnal Dinamika Akuntansi dan Bisnis* (4 articles per journal).

The analytical method is the method that dominates the carbon emission disclosure research by 87% using secondary data from annual reports and sustainability reports. Furthermore, the 10% survey method is sourced from questionnaires and interviews, while the literature review method is 3%.

Carbon emission disclosures research included in the financial factors variable has a percentage of 47%, for example, the variables of leverage, firm value, and profitability. In contrast, 53% use non-financial factors in the form of firm age, type of industry. In addition, the results of this study also show the inconsistency of the results of previous studies using variables firm value, profitability, leverage, type of industry, and company size.

The limitation of this research is that journals published after December 2021 also affect the number of articles obtained when the authors make observations because only abstracts are available. Furthermore, the authors did not analyze it. Due to limited literature, the researcher has not carried out the community analysis that is part of bibliographic research (Hesford et al. 2007). Community analysis helps determine the frequency of research used as a reference for further research. The authors hope this research can provide an overview of research on carbon emission disclosures in Indonesia. In addition, future research could use this as a basis for research evolution.

This research implies that there are still inconsistencies in the variables of previous studies, which becomes an excellent opportunity for further research. Further research can consider broader literature and use community analysis in reputable international journals or research that examines global carbon emission disclosure, aiming to determine the comparison of carbon emission disclosure in industrial countries. This research can be helpful for companies to encourage the transparency of carbon emissions through research benefits.

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