DEPARTAMENT DE COMPTABILITAT
DOCTORADO EN CONTABILIDAD Y FINANZAS CORPORATIVAS

La estrategia empresarial para la gestión de emisiones de gases efecto invernadero

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The business strategy for managing Greenhouse Gas Emissions

PhD Thesis

En memoria de mi amada Madre.

"La sostenibilidad dentro de los límites del planeta requiere la acción concertada de los individuos, los gobiernos, la sociedad civil y los actores privados".
(Folke, et al., 2019)

"*la **interdependencia** es una cruda realidad de la que depende la supervivencia de la especie humana*" (Barber, 2004).

"Al utilizar los humanos su poder para contrarrestar las fuerzas de la naturaleza y subyugar al ecosistema a sus necesidades y caprichos, pueden causar cada vez más efectos colaterales no previstos y peligrosos"
(Harari, 2014)

"Los efectos perjudiciales del cambio climático afectan a todos los derechos humanos. El calentamiento global no solo incide en el derecho a la salud, a la alimentación, al agua, a la cultura, al desarrollo o a una vivienda adecuada, sino que amenaza la supervivencia misma de las personas y su derecho a la vida y a la integridad física".
(Comisión Económica para América Latina y el Caribe/Alto Comisionado de las Naciones Unidas para los Derechos Humanos (CEPAL/ACNUDH), 2019)

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Siglas y Acrónimos

C40	Alianza de megaciudades del mundo
CAR	Corporación Autónoma Regional
CDP	Carbon Disclosure Project
CMNUCC	Convención Marco de las Naciones Unidas sobre el Cambio Climático.
CMS	Carbon Management Strategy
CO_2	Dióxido de carbono
CSR	Corporate Social Responsibility
ECDBC	Estrategia Colombiana de Desarrollo Bajo en Carbono
ECLAC	Economic Commission for Latin America and the Caribbean
GEI	Gases Efecto Invernadero
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
GWP	Global Warming Potential
IPCC	Panel Intergubernamental sobre Cambio Climático
$MtCO_2e$	Tonelada métrica de dióxido de carbono equivalente
ODS	Objetivos del Desarrollo Sostenible
OLS	Ordinary Least Squares
ONG	Organización No Gubernamental
PNACC	Plan Nacional de Adaptación al Cambio Climático
RSC	Responsabilidad Social Corporativa
SCOPE 1	Direct Emissions
SCOPE 2	Indirect Emissions

SCOPE 3	Other Emissions
SDG	Sustainability Development Goals
UNCTAD	United Nations Conference on Trade and Development

Capítulo 1: PLANTEAMIENTO GENERAL DE LA INVESTIGACIÓN

1. Planteamiento General de la Investigación

1.1. Introducción

El aumento de la temperatura global ha tenido un impacto significativo desde finales del siglo XIX. La concentración de CO_2 atmosférico se ha intensificado desde la revolución industrial en un 47% como lo indica la NASA en su estudio sobre cambio climático global (NASA Global Climate Change, 2020). En los últimos 40 años se ha registrado de manera acelerada el efecto de las emisiones de gases de efecto invernadero (GEI) y los años 2016 y 2020 se consideran los periodos más cálidos registrados (NASA SCIENCE, 2021). El riesgo generado por estos cambios refleja la intensificación de los ciclos hidrológicos, el deterioro de los ecosistemas y el derretimiento de los glaciales, entre otras afectaciones para la supervivencia humana. Los elementos que lo explican están relacionados, principalmente, con factores vinculados con actividades industriales como la deforestación, los cambios del uso de la tierra y la quema de combustibles fósiles (IPCC, 2014).

De acuerdo con lo anterior, los impactos humanos en los ecosistemas terrestres han generado un punto de inflexión en el cambio climático y en la pérdida de biodiversidad dejando secuelas que se reflejan en la inestabilidad de los sistemas a escala planetaria en la denominada era del Antropoceno (Bebbington, et al., 2019). Asimismo, desde la perspectiva del concepto "*Biosphere stewardship*" las empresas dominantes a nivel mundial influyen desproporcionadamente en el cambio climático y esto evidencia que las regulaciones ambientales son insuficientes para contrarrestar el poder político de las grandes corporaciones (Folke, et al., 2019; Schaltegger, 2018). Estos cambios generados a nivel planetario implican un desafío mayor para afrontar los retos establecidos para la Agenda 2030 y la descarbonización prevista para el año 2050. Por consiguiente, el desarrollo de acciones conjuntas por parte de los gobiernos, las organizaciones y la sociedad civil son determinantes para enfrentar los escenarios futuros en relación con la "frontera planetaria" (Bebbington & Unerman, 2018; Hoffman & Jennings, 2018).

En esta lógica de esfuerzos conjuntos y con el propósito de garantizar el futuro de las actuales y futuras generaciones, las Naciones Unidas en la Agenda 2030 ha establecido los Objetivos del Desarrollo Sostenible (ODS), enmarcados en tres dimensiones: (i) económicas, (ii) ambientales y (iii) sociales. Su planeación y ejecución se fundamentan en el alcance de 17 objetivos y 169 metas. Desde su promulgación en el año 2015 se han adoptado diferentes iniciativas a partir de un enfoque integral de sostenibilidad. Sin embargo, la puesta en marcha de esta iniciativa global no ha logrado equilibrar los intereses incompatibles de las diferentes partes interesadas (Fisher, et al., 2021). Los ODS han puesto en escena a las organizaciones y han permitido cuestionar y analizar sus actuaciones con respecto a los problemas ambientales. Al respecto, las empresas por intermedio de sus gestores y agentes realizan acciones para adaptar la información no financiera a los nuevos modelos de sostenibilidad y de esta manera divulgan información relacionada con sus logros en el marco de la Agenda 2030. En este sentido, van Zanten, & van Tulder (2021b) señalan que las empresas tienen un papel decisivo en la consecución de los ODS y tienen la capacidad de poder mitigar sus impactos negativos en el desarrollo de sus actividades.

Desde una perspectiva más amplia, el avance y seguimiento de los ODS a nivel regional es fundamental para establecer una relación directa entre el sector público y privado y de esta manera analizar las características del contexto y las complejidades que subyacen en cada territorio. Al respecto, Lange Salvia, et al., (2019) señalan que el avance de la Agenda 2030 muestra un grado de cumplimiento disímil en las distintas regiones del mundo, especialmente por características relacionadas con el desarrollo industrial y económico. Por ejemplo, América Latina es considerada una de las regiones más desiguales del planeta con problemas agudos como la pobreza, el conflicto social, la concentración del poder y la riqueza en unos pocos empresarios de la región (Cárdenas, 2016; Jiménez & Podestá, 2019). En esta área geográfica, los indicadores ODS muestran que después de la crisis provocada por el COVID-19, se han producido tendencias de estancamiento o regresión

(United Nations, 2022). Este retroceso también tiene efectos profundos en las problemáticas asociadas al cambio climático. Stern (2007) señala que el cambio climático puede considerarse como una externalidad negativa y requiere del uso de instrumentos económicos para garantizar la mitigación de sus efectos. Precisamente, en esta región se han desarrollado algunos instrumentos desde la política fiscal entre los que es posible mencionar el impuesto al carbono[1]. Sin embargo, este mecanismo fiscal ha sido utilizado como una estrategia de compensación que no cumple el papel de mitigar y restaurar los daños ocasionados al medio ambiente.

En algunas regiones específicas como Colombia, se han establecido diferentes estrategias para afrontar la política nacional del cambio climático y de esta forma garantizar los compromisos señalados en el acuerdo de París. Algunas de ellas son: (i) Estrategia Colombiana de Desarrollo Bajo en Carbono (ECDBC), (ii) el Plan Nacional de Adaptación al Cambio Climático (PNACC), (iii) la Estrategia Nacional REED+, (iv) Estrategia fiscal mediante el impuesto al carbono para "financiar la paz y apoyo a los ecosistemas" (Disclousure Insight Action, 2019). Si bien, estas estrategias y acciones gubernamentales permiten establecer una ruta para afrontar los problemas ambientales relacionados con las emisiones de CO_2, estas iniciativas pueden resultar insuficientes si no se regula y se controla adecuadamente a las empresas y sectores industriales con alta incidencia en el cambio climático.

En este contexto, resulta importante establecer el comportamiento del sector empresarial frente a las problemáticas que se derivan del cambio climático. Para lograr este propósito es fundamental determinar cuál es la estrategia ambiental diseñada por la organización y como sus esfuerzos pueden llegar a ocuparse de una estrategia de gestión de carbono o "Carbon Management Strategy (CMS)". La estrategia de gestión de carbono o CMS es un constructo teórico y conceptual que permite identificar si las empresas contribuyen con las

[1] Por ejemplo: Argentina, la tarifa total del impuesto es basada en la moneda local que es equivalente a US$10/tCO2e. En Chile La tasa del impuesto en la moneda local equivale a US$5/$tCO_2e$. (Disclousure Insight Action, 2019)

metas establecidas en el ODS 13- Acción por el clima, mediante acciones de mitigación, control y reducción de emisiones de carbono (Yunus, Elijido-Ten, & Abhayawansa, 2019).

De acuerdo con lo anterior, esta tesis doctoral plantea en primer lugar analizar la calidad y nivel de divulgación de información sobre la acción climática en las empresas colombianas mediante una análisis regional y sectorial. Para desarrollar este propósito este trabajo se centra en el Objetivo de Desarrollo Sostenible 13 (ODS 13) el cual llama a tomar medidas urgentes para luchar contra el cambio climático y sus impactos. Este estudio se enfoca principalmente en la meta 13.2 la cual establece la incorporación de medidas relacionadas con políticas, estrategias y planes de cambio climático. Este objetivo incluye información relacionada con las estrategias de adaptación al cambio climático (información cualitativa), y las emisiones de gases de efecto invernadero y sus alcances (Scope 1, 2 y 3 - información cuantitativa).

En segundo lugar, a lo largo de esta tesis doctoral realizamos un análisis para determinar si la presión ejercida por el contexto empresarial (el gobierno colombiano con la implementación del impuesto al carbono y el gobierno local con acciones específicas de cambio climático) y las características inherentes de la empresa (empresas más grandes y empresas pertenecientes a industrias sensibles) mejoran la calidad de la divulgación de una estrategia de gestión de carbono en las empresas colombianas. Asimismo, diseñamos un índice de divulgación de la estrategia de gestión de carbono (Carbon Management Strategy) utilizando un marco teórico y análisis de contenido de los informes de sostenibilidad de las empresas. Lo anterior, permite analizar este comportamiento en una economía emergente no regulada en emisiones de GHG y en informes de sostenibilidad. En tercer lugar, buscamos establecer una relación entre la adopción de una estrategia de gestión de carbono y la divulgación de emisiones; así como la eficiencia de emisiones directas, indirectas y otro tipo de emisiones cuando se establece una Carbon Management Strategy.

En consideración con los planteamientos anteriores, este capítulo de la tesis se estructura de la siguiente manera: La primera sección corresponde a la presente introducción que sitúa el tema objeto de estudio, la segunda sección presenta la motivación y el contexto de la investigación, la tercera sección presenta el objetivo general y los objetivos específicos perseguidos con esta investigación, la cuarta sección transita por las principales teorías abordadas en la tesis; (i) teoría de la legitimidad, (ii) teoría de los stakeholders, (iii) teoría de la señalización y (iv) los concepto de greenwashing y SDG-Washing. La quinta sección esquematiza la estructura de la tesis por capítulos. La sexta sección extracta el diseño metodológico de los estudios empíricos realizados.

1.2. Motivación y contexto de la investigación

Desde los años 60 del siglo pasado, se han establecido tres olas o tendencias del ambientalismo corporativo. La primera de ellas se centra en el cumplimiento de la regulación, en esta etapa el manejo ambiental de las compañías se consideró externamente para cumplir asuntos técnicos y legales. La segunda ola se ocupó del ambientalismo estratégico, en esta etapa se estableció la relación entre los negocios y el medioambiente como respuesta a los diferentes desastres ambientales generados por las industrias a nivel mundial (planta química Hoffman- la Roche´s en Italia - caso de Bhopal en India – Chenobyl, entre otros) y por último se genera la ola de la sostenibilidad, que aún se encuentra en progreso y contempla la expansión del enfoque del ambientalismo corporativo en torno a los puntos vulnerables que ponen en riesgo la estabilidad ambiental global en la que se destaca el cambio climático (Bansal & Hoffman, 2012).

Desde la incorporación de los ODS y la perentoria necesidad de mitigar el cambio climático, diversos estudios han señalado la importancia de estudiar los procesos de divulgación de emisiones por parte de las empresas y el impacto de las políticas climáticas regionales (Hoffmann & Weinhofer, 2010). Desde esta perspectiva, algunos estudios se sitúan en la interacción entre la política pública y privada para generar medidas proactivas de

divulgación y gestión del riesgo de emisiones de carbono. También, evidencian que las divulgaciones ambientales continúan en aumento y tienen un efecto de influencia en políticas públicas para desarrollar estrategias de mitigación y reducción de emisiones (Dhanda, Sarkis, & Dhavale, 2022; Reid & Toffel, 2009). Lo anterior, ratifica la importancia de asociar el comportamiento organizacional con la necesidad urgente de enfrentar los problemas ambientales globales desde la incorporación del concepto del límite planetario (Schaltegger, 2018).

La temporalidad de los ODS (Agenda 2030) ha llevado a las empresas a incorporar rápidamente información sobre el ODS 13 (Acción por el clima - adoptar medidas urgentes para luchar contra el cambio climático y sus efectos) para mostrar su acción estratégica vertiginosa frente a los desafíos ambientales (Broadstock, et al., 2018). En consecuencia, los informes de esta década presentan nuevas categorías analíticas en los informes de sostenibilidad que incluyen: (i) descarbonización, (ii) eficiencia energética, (iii) reducción de la huella de carbono, (iv) aumento de la inversión en productos y servicios innovadores bajos en carbono (GRI, Un Global Compact, WBCSD, 2015). Estas categorías de divulgación se asocian directamente con el concepto de estrategia ambiental de una empresa mediante un proceso de integración funcional con la estrategia de gestión de carbono (Radu, Caron, & Arroyo, 2020). Este proceso de integración estratégica requiere mayor grado de exploración y conexión con la realidad ambiental de la organización. De acuerdo con lo expuesto anteriormente, Mintzberg (1998) plantea el concepto de estrategia como:

> *"[]..un diseño con criterio, imaginación intuitiva y aprendizaje emergente, es transformación y perpetuación; debe comprender el conocimiento individual y la interacción social, la cooperación al igual que el conflicto; tiene que analizar antes, programar después y negociar durante; y todo esto debe ser en respuesta a un entorno que puede ser exigente*" (p. 468).

Siguiendo el planteamiento de Mintzberg, y puesto que el entorno de las organizaciones es complejo, se requiere que los lideres fijen una perspectiva alrededor de las demandas que

generan el desarrollo de sus operaciones. Esto implica dimensionar una estrategia ambiental que sea coherente con el contexto para responder a los impactos que puedan derivar sus actividades industriales. Por consiguiente, el desarrollo de una estrategia de gestión de carbono se basa en diferentes variables que presentan fluctuaciones en torno a factores internos y externos en los que se desenvuelve una organización (Lemaire, 1997). Ante esta complejidad del entorno organizacional a continuación se presentan las principales motivaciones de este estudio.

1.2.1. Primera Motivación.
Incorporar características contextuales e inherentes de las empresas en el debate sobre emisiones de GEI.

Características contextuales:

Hoffmann & Weinhofer (2010) consideran que la región geográfica en la que se ubica la empresa es determinante para establecer el componente empresarial y de negocios en el que opera la compañía. Este factor es considerado principalmente por la desigualdad de emisiones internas y externas de un país y por las grandes emisiones que generan los territorios con mayor industrialización (Kartha, et al., 2020). Estas circunstancias propician que, la evaluación, monitoreo y seguimiento de planes y acciones enfocados a mitigar y limitar el calentamiento global requieran de un análisis desagregado regionalmente y de esta manera contrarrestar los efectos climáticos generados por las actividades industriales desarrolladas en los territorios. Por consiguiente, esta característica contextual es fundamental para analizar la adaptación y articulación de los gobiernos nacionales, autoridades locales y regionales a través de una estrategia participativa e integrada para superar las barreras socioeconómicas, institucionales, tecnológicas, financieras y ambientales entre las regiones vulnerables (IPCC, 2019).

Otra característica relevante, forma parte de las presiones regulatorias que ejercen los gobiernos a través de mecanismos fiscales como los implementados a través del impuesto

al carbono. El impuesto al carbono es un impuesto Pigoviano (Pigou & Aslanbeigui, 2017), el cual se ha considerado como un incentivo para reducir las emisiones de GHG. Por ejemplo, en países regulados como Australia la presión ejercida por el impuesto al carbono obligó a las empresas con altas emisiones a tomar medidas urgentes sobre su gestión de emisiones (Jayanthi, 2017). En contraste con estos resultados, en países emergentes como Colombia este tipo de impuesto fue creado con la finalidad de "financiar el proceso de paz y apoyar los ecosistemas" (Disclousure Insight Action, 2019). También la creación de este impuesto se ha considerado un mecanismo para promover que las empresas se certifiquen como gestoras de carbono neutral e incentiva a los sectores público y privado a invertir en tecnologías bajas en carbono y fomentar prácticas más sostenibles (Goulder, 2013). Esta presión regulatoria también se asocia con la política de cambio climático y tiene relación directa con el cumplimiento del ODS 13. Esto motiva a incorporar su análisis en este trabajo para relacionar los resultados de esta iniciativa reguladora en el campo de la gestión empresarial de emisiones de GEI.

Características Inherentes de las empresas:

Para el análisis de las emisiones de GEI, consideramos principalmente dos características vinculadas a las empresas: (i) el tamaño y (ii) empresas pertenecientes a industrias sensibles. Estos factores han sido considerados ampliamente por la literatura académica para analizar el efecto de las grandes corporaciones y el impacto de sus actividades industriales en la degradación del medio ambiente, particularmente por el incremento de las emisiones de GEI. Al respecto, algunos autores (Choi, Luo, & Shrestha, 2020; Dhanda & Malik, 2020; Hoffmann & Weinhofer, 2010; Luo & Tang, 2020) señalan que el tamaño de la empresa es relevante en el análisis de la estrategia de carbono y la divulgación de emisiones. Entendiendo que, las grandes empresas están sujetas a una mayor presión regulatoria y esto converge a una tendencia de divulgación mayor en comparación con empresas pequeñas. Por su parte, las empresas ubicadas en sectores sensibles o intensivas en carbono tales como; energía eléctrica, minería y extracción, gas natural (Kolk y Pinkse, 2004; Okereke y Russell, 2010) han generado una tendencia de mayor de

escrutinio por parte de diferentes stakeholders. Principalmente por su incidencia directa en el calentamiento global y por su gestión en los alcances de las emisiones directas, indirectas y otro tipo de emisiones (Comyns, 2016; Lindblom, 1994). Lo anterior, permite focalizar en este trabajo el comportamiento de las empresas intensivas de carbono y de esta manera agrupar las actividades industriales que se consideran altamente sensibles en emisiones de GHG.

1.2.2. Segunda motivación.

Proporcionar evidencia de la divulgación de emisiones de CO_2 en una economía emergente, no regulada en emisiones de GEI y en informes de sostenibilidad.

El análisis de la divulgación y la estrategia de gestión de carbono en países regulados se realiza con el apoyo de información estructurada como la encuesta Carbon Disclosure Project (Dhanda & Malik, 2020; Yunus, Elijido-Ten, & Abhayawansa, 2019), entrevistas a stakeholders (Okereke & Russel, 2010) y bases de consulta pública. En países de economías emergentes y no regulados en emisiones de GEI y en informes de sostenibilidad existe una brecha de información importante para analizar el comportamiento empresarial en relación con la gestión y divulgación de emisiones de GHG. Esta brecha se genera al no encontrar fuentes de consulta pública que permitan integrar el comportamiento de las empresas con la gestión de emisiones. Por consiguiente, nuestra motivación es brindar un punto de partida para países de América Latina e incorporar nuevas metodologías de análisis que permitan percibir de forma concreta la problemática generada por el cambio climático en la región. También esta motivación del estudio se enfoca en el planteamiento de diferentes acciones que pueden ser incorporadas en las discusiones de la agenda 2030 y el proceso de descarbonización de los territorios latinoamericanos, considerando que en países más desarrollados se ha detectado que no se tienen la mejor puntuación de eficiencia de control de emisiones de CO_2, y esto es un indicador importante para identificar las brechas de países que controlan sus emisiones frente a países que no lo hacen y no se encuentran regulados (Lu, Chiu, Shyu, & Lee, 2013).

Desde nuestra perspectiva, es posible solventar esta brecha de información en países emergentes no regulados identificando las características del contexto y las características inherentes a las empresas con el objetivo de analizar la divulgación de emisiones de carbono y la eficiencia de emisiones a partir de la incorporación de las estrategias de gestión y su impacto en el ODS 13.

1.2.3. Tercera motivación.

Proporcionar resultados útiles para que los gobiernos nacionales y regionales comprendan cómo sus acciones pueden alinear el comportamiento del sector privado. Adicionalmente, brindar resultados que ayuden a las empresas a incorporar y difundir estrategias de gestión de carbono - CMS- para operacionalizar y mejorar los indicadores relacionados con la acción climática (ODS 13) en la Agenda 2030.

En la última década el gobierno colombiano inició un programa denominado "Estrategia Colombiana de Desarrollo Bajo en Carbono (ECDBC)" desarrollado por el Ministerio de Ambiente y Desarrollo Sostenible. En la primera etapa de este proyecto se presentan resultados relativos a la caracterización de mitigación a nivel sectorial y se fija una meta de reducción de emisiones del 20% para el año 2030. En la segunda fase de esta estrategia nacional se expide la ley de cambio climático Colombia (Ley 1931 de 2018) con el propósito de gestionar el cambio climático en sectores y territorios (Ministerio de Medio Ambiente, 2022). En este escenario, el gobierno central ha incorporado diferentes objetivos para cumplir con los compromisos establecidos en el acuerdo de París: (i) Facilitar la toma de decisiones entre instituciones públicas y privadas a nivel nacional y regional, (ii) Coordinar y articular esfuerzos para la mitigación y adaptación de gases de efecto invernadero. (iii) Fortalecer las capacidades institucionales nacionales frente al cambio climático. (iv) Promover la formulación e implementación de políticas, planes, programas e incentivos, etc. (v) Promover la inclusión de variables climáticas para diseñar y planificar proyectos en desarrollo (Gobierno de Colombia, 2020). A una década del inicio de esta estrategia, las

emisiones de GEI no están reguladas y esto crea una brecha importante para establecer cambios en el comportamiento organizacional para cumplir con la meta de descarbonización para el año 2050. Ante este panorama, toma relevancia incorporar resultados útiles que contribuyan a interpretar el avance del sector privado en temas de cambio climático y brindar un contexto analítico que permita al gobierno nacional y regional buscar alternativas y alinear sus políticas para afrontar esta problemática global.

También, resulta importante el análisis del ODS 13 cambio climático desde la perspectiva empresarial. Por consiguiente, nuestra motivación en este aspecto es generar resultados que puedan facilitar la relación entre las entidades públicas y privadas y propiciar sinergia de conocimiento y acciones tendientes a mejorar los indicadores de mitigación del cambio climático.

1.2.4. Contexto Colombiano

Este estudio se desarrolla en Colombia un país catalogado como uno de los países "megadiversos" del mundo, albergando cerca del 10% de la biodiversidad del planeta (United Nations, 2019). El país cuenta con áreas de alta diversidad biológica en los ecosistemas andinos caracterizados por una importante variedad de especies endémicas. Su ubicación geográfica es única ya que se encuentra entre el Océano Pacífico y el Mar Caribe. Posee parte de la selva amazónica y los ecosistemas húmedos del área biogeográfica del Chocó (United Nations, 2020). Se ubica al norte de sur América, cuenta con una población que se acerca a los 50.000.000 de habitantes y una extensión de 1.141.748 km² (DANE, 2020). Se caracteriza por su diversidad geográfica y climática y ha sido seleccionado como el país anfitrión del día mundial del medio ambiente para el año 2020 (United Nations, 2019).

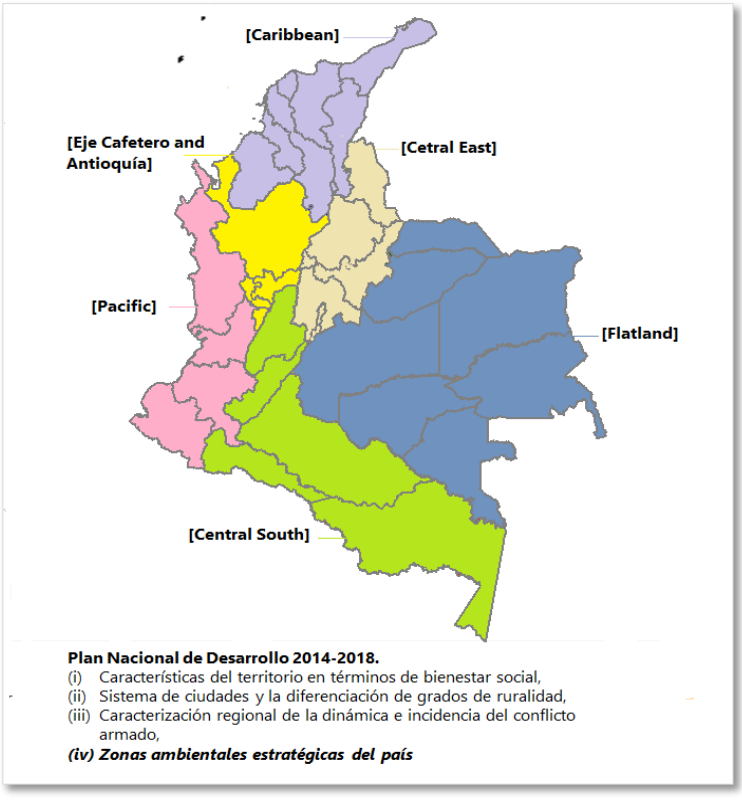
Este panorama biodiverso se ve afectado por la desigualdad social y la división regional. Se caracteriza por desarrollar el "conflicto armado más largo del hemisferio occidental". Este conflicto tiene mayor incidencia y escalada en algunas regiones del país (Rettberg, et al., 2018). En 2016 se firmó el acuerdo de paz con la guerrilla de las FARC, pero su implementación se ha visto afectada por factores directamente relacionados con la gobernabilidad (violencia, voz y rendición de cuentas, estabilidad política y ausencia de violencia, efectividad gubernamental, calidad regulatoria, estado de derecho, control y corrupción) (Worldbank Governance, 2020). En los últimos años se ha incrementado el asesinato de líderes sociales que defienden el medio ambiente, ocupando el primer lugar en este indicador catastrófico en relación con otros países del mundo (Global Witness, 2020). Colombia está catalogada como un país emergente (MSCI, 2020) y su economía depende de los combustibles fósiles para la exportación y para uso doméstico. Su política climática requiere cambios estructurales ya que las actuales no conducen a cero emisiones netas para el año 2050 (Delgado, et al., 2020).

Desde el punto de vista ambiental, se han evidenciado fuertes consecuencias a causa del cambio climático, los principales nevados colombianos han sufrido un retroceso glaciar (Monterroso-Tobar, et al., 2018), el cambio de temperatura en la Amazonía muestra un incremento de 0,5 °C con respecto a los promedios históricos de la primera década de este siglo, afectando a las comunidades indígenas que albergan esta región (Echeverri, 2009). Adicionalmente, el desarrollo de conflictos socioambientales en todas las regiones por actividades industriales que degradan el medio ambiente vulnera los derechos e impactan la aplicabilidad de las normas y la función regulatoria del estado en esta problemática. (Munévar-Quintero & Valencia Hernández, 2020). Ante este panorama, en Colombia, desde la última década se han establecido diferentes estrategias para enfrentar la política nacional de cambio climático y así garantizar los compromisos establecidos en el Acuerdo de París. Asimismo, las regiones colombinas han agrupado una serie de políticas y estrategias para dar respuesta a los desafíos territoriales. No obstante, este comportamiento puede ser

asincrónico dadas las características económicas y sectoriales que difieren de un territorio a otro.

De acuerdo con lo anterior, el plan nacional de desarrollo 2014-2018, agrupó seis regiones (Caribbean, Central-East, Central-South, Eje Cafetero and Antioquía, Pacific and Flatland) relacionando características geográficas, sociales, económicas y culturales similares. Esta segmentación regional se elaboró mediante el análisis metodológico de cuatro dimensiones: (i) características del territorio en términos de bienestar social, (ii) sistema de ciudades y la diferenciación de grados de ruralidad, (iii) caracterización regional de las dinámicas e incidencia del conflicto armado (iv) zonas ambientalmente estratégicas del país. (Departamento Nacional de Planeación, 2015). (ver Mapa 1)

Mapa 1. Segmentación regional plan nacional de desarrollo 2014-2018



Posterior al proceso de planeación nacional, en el año 2015 Colombia presentó su compromiso de reducción de emisiones en el marco del Acuerdo de París que establece una meta de reducción del 20% para el año 2030 y con una posible extensión del 10% considerando el apoyo internacional (García Arbeláez, et al., 2015). Con la reforma tributaria de 2016 (Ley 1819 de 2016) se creó el impuesto nacional al carbono para desalentar el uso de combustibles fósiles que generan emisiones de GEI. Mediante este mecanismo fiscal, las empresas tienen la opción de adoptar proyectos de reducción y compensar emisiones y así reducir el pago de este impuesto. En el año 2017, de acuerdo con el Decreto 926, se reglamentó el procedimiento para hacer efectiva la no causalidad del impuesto nacional al carbono. En cumplimiento de esta normatividad, las empresas deben certificar que son carbono neutral.

Para hacer efectiva la no causalidad del impuesto nacional al carbono, es necesario que las empresas adapten el uso de metodologías reconocidas de la siguiente manera: (i) Mecanismo de Desarrollo Limpio (MDL) (ii) Metodologías desarrolladas por la certificación o estándares de carbono que deben ser verificables por un organismo acreditado por un tercero independiente -ONAC-IAF o por la Convención Marco de las Naciones Unidas sobre el Cambio Climático (CMNUCC), o cumplir con los requisitos de registro de iniciativas establecidos por el registro del Programa de las Naciones Unidas para la Reducción de Emisiones por Deforestación y Degradación de Bosques (REDD +) (Aristizábal Alzate y González Manosalva, 2019). Al respecto, el sector empresarial en Colombia ha adoptado diferentes mecanismos de compensación en proyectos MDL y esquemas voluntarios, los cuales se concentran y se desarrollan en países de economías emergentes (Klagge & Reimer, 2016). Entre ellos se destacan; (i) BancO2 que es una estrategia de pagos por servicios ambientales a través de la cual se unen empresas, gobiernos, comunidades campesinas y étnicas en torno a la conservación de los ecosistemas naturales en Colombia. (Banco2, 2020). (ii) Estrategias de carbono neutral adoptando estándares como ISO 14064. (iii) Lineamientos de organizaciones internacionales específicas en su sector industrial.

Otro factor importante en el contexto colombiano corresponde a la expedición de ley 1931 de 2018 que establece los lineamientos para la gestión del cambio climático. Esta ley proyecta el desarrollo de planes integrales para la gestión del cambio climático sectorial y territorial, así como el establecimiento de nodos regionales para implementar y asegurar que esta política se desarrolle de manera organizada. Asimismo, la política nacional de cambio climático establece una relación con el sector empresarial para buscar sinergia pública y privada que incorpore el desarrollo de estrategias sectoriales, para la apropiación, desarrollo y transferencia de tecnologías bajas en carbono. (Ministerio de Medio Ambiente y Desarrollo Sostenible, 2017).

1.3.Objetivos de la Investigación

En consideración con los elementos contextuales y las motivaciones de este estudio, se presenta en este apartado el objetivo general y los objetivos específicos de la tesis doctoral.

1.3.1. Objetivo general y objetivos específicos

Esta tesis doctoral tiene como objetivo general analizar el nivel y calidad de divulgación del ODS 13 así como la divulgación y eficiencia de emisiones de GEI a través de una Carbon Management Strategy, incorporando características contextuales e inherentes a las empresas colombianas.

Para el desarrollo de este objetivo se desarrollan los siguientes objetivos específicos.

i. El primer objetivo específico se centra en determinar el nivel y calidad de divulgación del ODS 13 en los informes de sostenibilidad en el periodo 2019, mediante un análisis del sector empresarial a nivel regional e industrial.

Este objetivo se lleva a cabo mediante la incorporación de dos índices de calidad de divulgación para el ODS 13. El primero, corresponde al índice ODS 13 – Cualitativo; el cual incorpora acciones de mitigación y adaptación al cambio climático, metas de reducción de emisiones, mecanismos de gobernanza y gestión del riesgo y mecanismos de compensación de emisiones. El segundo, corresponde al índice ODS 13 cuantitativo; el cual integra datos para la medición y seguimiento de la huella de carbono (emisiones de gases efecto invernadero, alcances 1, 2 y 3 y datos de compensación de emisiones) Lo anterior, mediante un análisis de contenido de los informes de sostenibilidad de las empresas cotizadas en Colombia. Para el desarrollo de este objetivo incorporamos características de contexto que integran un análisis regional y sectorial. Este objetivo se enmarca en la teoría de la legitimidad y los conceptos de greenwashing y SDG-Washing.

ii. El segundo objetivo específico se centra en analizar el impacto de las características de contexto e inherentes a las compañías en la adopción y divulgación de una Estrategia de Gestión de Carbono (Carbon Management Strategy - CMS).

El desarrollo de este objetivo permite comprender si las acciones tomadas por el gobierno, la presión regulatoria ejercida sobre las industrias clasificadas como sensibles al cambio climático y los factores internos de las empresas impactan en las divulgaciones que las empresas hacen sobre la gestión de emisiones de carbono. De acuerdo con lo anterior, diseñamos un índice de divulgación denominado “CMS-Index” utilizando un marco conceptual y teórico para clarificar el significado y aplicación de una Carbon Management Strategy – CMS. Utilizamos análisis de contenido y un modelo de regresión MCO robusto basado en datos de panel balanceado de 60 empresas colombianas que cotizan en bolsa para el período 2016-2018.

iii. El tercer objetivo específico permite identificar la relación entre la divulgación de una CMS y la eficiencia de emisiones directas, indirectas y otras emisiones en las empresas colombianas en el periodo 2016-2019.

Este objetivo incluye variables en relación con el contexto de las empresas (estrategia fiscal a través de impuestos al carbono y ubicación geográfica) y características propias de la empresa (tamaño y sector industrial sensible). A partir del índice de divulgación desarrollado en el objetivo (ii) de esta tesis "CMS-Index", este objetivo específico se centra en la relación que existe en la adopción y divulgación de una CMS y la divulgación de emisiones para los alcances 1, 2 y 3. Incorpora el análisis de las industrias sensibles y el nivel de divulgación en las tres categorías de emisiones. También analiza la eficiencia de emisiones incluyendo aspectos financieros de las empresas colombianas y su efecto en la gestión de las emisiones de CO_2. Usamos análisis de contenido y una regresión MCO para el modelo de divulgación de emisiones y un MCO robusto en el modelo de eficiencia de emisiones con base en un panel de datos balanceado de empresas cotizadas colombianas para el período 2016-2019. Tomamos submuestras para analizar el alcance 1, alcance 2 y alcance 3.

1.4. Marco Conceptual en que se desarrolla y se enmarca la Tesis doctoral

El sustento conceptual en el que se desarrolla la tesis involucra el concepto estratégico de gestión de carbono o denominado "Carbon Management Strategy – CMS". Este concepto se aborda de forma transversal en el desarrollo de los objetivos de esta tesis y en consecuencia en los estudios empíricos. Este concepto, permite establecer una conexión con la estrategia ambiental de una organización y los efectos de la Responsabilidad Social Corporativa RSC desde una perspectiva que involucra el cambio climático. También, incorporamos la teoría de la legitimidad, la teoría de los stakeholders, la teoría de la señalización y los conceptos de greenwashing y SDG-washing.

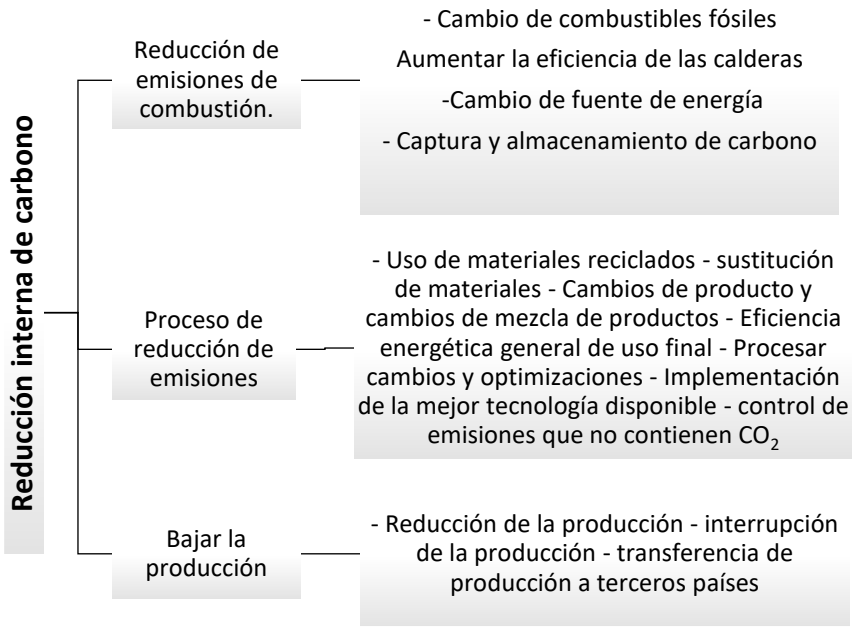
1.4.1. Carbon Management Strategy – CMS

La gestión del carbono es crucial en la transición hacia un futuro bajo en carbono (Yunus, Elijido, & Abhayawansa, 2016). En términos generales una Carbon Management Strategy-CMS implica monitorear, controlar y reducir las emisiones de carbono para mitigar el calentamiento global (Yunus, Elijido-Ten, & Abhayawansa, 2019). Al respecto, en la última década se han desarrollado algunas tipologías para diseñar y definir la estrategia de carbono. En este sentido, Cadez & Czerny (2015) identifican tres elementos fundamentales para priorizar este tipo de estrategia:

(i) Reducción interna de carbono

Los elementos internos para la reducción de carbono dependen de la naturaleza de las emisiones de CO_2 de la empresa. Por ejemplo, las emisiones de combustión ocurren en el sector energético y manufacturero por el uso de combustibles fósiles. También, el proceso de emisiones surge de las industrias por el uso de materiales a base de carbono en la fabricación de cemento hierro acero, cal, vidrio etc., liberando de esta forma grandes cantidades de dióxido de carbono a la atmosfera. Situación que debe controlarse mediante tres estrategias internas; (i) reducción de emisiones de combustión, (ii) proceso de reducción de emisiones y (iii) manejo de la producción, tal y como se indica en la figura 1.

Figura 1. Estrategias internas Cadez y Czerny (2015)



Fuente: (Cadez & Czerny, 2015)

(ii) Reducción externa de carbono

La reducción externa de carbono enfatiza las acciones en la cadena de suministro mediante procesos de integración vertical y horizontal. Esto con el propósito de remplazar insumos con alto potencial de emisiones como un aporte adicional a los procesos internos de la organización.

(iii) Compensación de carbono.

La estrategia de compensación no es consistente para mitigar el cambio climático, esta acción se traduce en un comportamiento disfuncional que opera con el pago de impuestos y contribuciones bajo el esquema del comercio de carbono con derechos de emisión[2] en un marco político de negociaciones gubernamentales. (Cadez & Czerny, 2015).

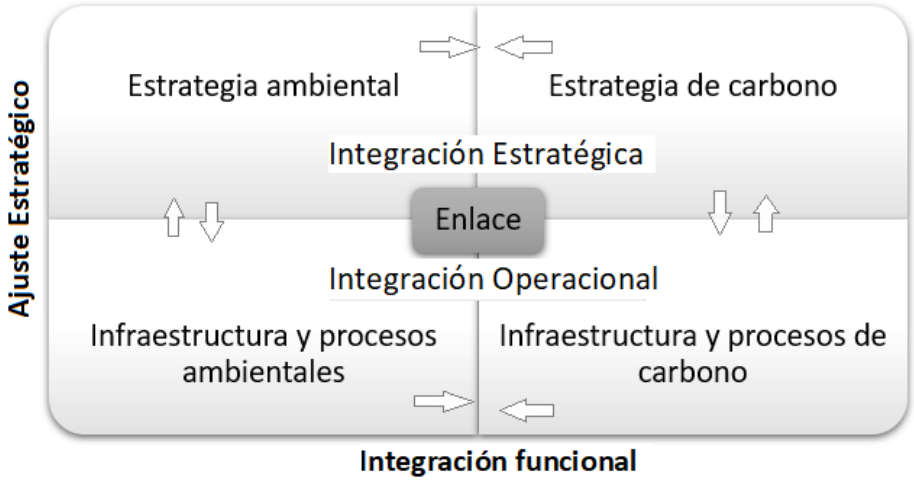
[2] Por ejemplo, en Europa opera el (EU ETS) Régimen de comercio de derechos de emisión de la Unión Europea. Funciona estableciendo los derechos de emisión para un periodo determinado de los países miembros. Esto para establecer una política climática en la EU.

Por otra parte, autores como Damert, Paul, & Baumgartner (2017) han identificado otro tipo de estrategias de carbono mediante la consolidación de tres objetivos fundamentales (i) reducción de carbono, (ii) gobernanza del carbono (iii) competitividad del carbono. El primer objetivo se centra en actividades corporativas relativas a la medición y política de carbono, mejoras del producto, mejora de procesos y compensación del carbono. La gobernanza hace parte de actividades de participación organizacional y gestión del riesgo. El tercer objetivo busca obtener ventajas competitivas y legitimidad para hacer los negocios respectivos en el contexto de la mitigación del cambio climático. De acuerdo con el planteamiento de estos autores, es posible mencionar múltiples factores que pueden determinar la adopción de una estrategia de CO_2. En tal sentido, "[]..la estrategia de CO_2 de una empresa se puede conceptualizar como un enfoque en uno o una combinación de varios tipos de estrategias de CO_2" (Hoffmann & Weinhofer, 2010, p. 80).

De acuerdo con lo anterior, Hoffmann & Weinhofer (2010) destacan tres variables que modifican el modelo de aplicación estratégica del carbono; (i) la región geográfica en la que opera la empresa, (ii) el tamaño de la empresa y su relación con el uso de los recursos, es decir, la aplicación de estrategias simultáneas para grandes empresas y estrategias de carácter selectivo para las pequeñas. (iii) el manejo de las operaciones comerciales con base en recursos de carbono, utilizando mecanismos de compensación en el corto plazo, pero ajustando continuamente su estrategia a partir de posibles presiones de los stakeholders.

Otros autores recientemente han centrado sus expectativas de investigación en el análisis de integración en la estrategia ambiental y la estrategia de carbono. Por ejemplo, Radu, Caron, & Arroyo (2020) mediante un análisis de conglomerados presentan una agrupación de estrategias ambientales y cinco tipos de estrategias de carbono para establecer la integración y alineación a partir del modelo de integración plateado por Henderson & Venkatraman (1999) el cual se detalla en la figura 2.

Figura 2. Elementos de análisis para la integración de la estrategia ambiental y la estrategia de carbono.



Fuente: Radu, Caron, & Arroyo (2020), a partir de Henderson & Venkatraman (1999)

Las estrategias de carbono adoptadas por Radu, Caron, & Arroyo (2020) se centran en tres categorías fundamentales; (i) la reducción de emisiones basada en emisiones de GEI, (ii) el rendimiento del carbono y su esquema de divulgación "lenguaje", (iii) la participación de la organización en un enfoque sistémico (mecanismos de gobernanza, innovación, integración de carbono en decisiones de inversión).

En concordancia con estos mecanismos de integración de la gestión ambiental y la estrategia de carbono, existen firmas profesionales de consultoría que buscan alinear los intereses económicos, sociales y ambientales de una organización. Es así como, desde la perspectiva de una CMS estas firmas centran sus esfuerzos en áreas de negocios donde es posible lograr una reducción de costos en el uso de energía, consumo de materia prima y manejo de residuos. Por ejemplo, Carbon Solutions Global (2020) describe algunas actividades fundamentales para el desarrollo de su consultoría entre las cuales destacan tres: (i) medir el impacto de las emisiones de carbono de todas las actividades comerciales para establecer la huella de carbono del negocio, (ii) identificar e implementar una estrategia

de reducciones, (iii) comunicar los logros finales a las partes interesadas". Todo lo expuesto anteriormente, indica que emprender una iniciativa de gestión de carbono requiere de un alto compromiso por parte de la empresa y sus líderes para gestionar sus GEI.

De acuerdo con los conceptos señalados por algunos autores (Carbon Solutions Global, 2020; Radu, Caron, & Arroyo, 2020; Damert, Paul, & Baumgartner, 2017; Cadez & Czerny, 2015), en la Tabla 1, se consolidan las principales estrategias de carbono y las actividades que se derivan de estas estrategias.

Tabla 1. Planteamientos conceptuales de una CMS

Autor – Año	CMS	Actividades derivadas de una CMS	Aplicación
Cadez & Czerny (2015)	Reducción interna de carbono	Reducción de emisiones de combustión	**Hoffmann & Weinhofer (2010):** "[]..la estrategia de CO_2 de una empresa se puede conceptualizar como un enfoque en uno o una combinación de varios tipos de estrategias de CO_2" Sin embargo, se deben considerar tres variables fundamentales: (i) la región geográfica en la que opera la empresa, (ii) el tamaño de la empresa. (iii) el manejo de las operaciones comerciales con base en recursos de carbono
		Manejo de la producción	
	Reducción externa de carbono	Remplazar insumos con alto potencial de emisiones	
	Compensación de carbono.	Comercio de carbono con derechos de emisión	
Damert, Paul, & Baumgartner (2017)	Reducción de carbono	Medición y política de carbono, mejoras del producto, mejora de procesos y compensación del carbono	
	Gobernanza del carbono	Participación organizacional y gestión del riesgo	
	Competitividad del carbono	Ventajas competitivas y legitimidad para hacer los negocios respectivos en el contexto de la mitigación del cambio climático	
Radu, Caron, & Arroyo (2020)	La reducción de emisiones basada en emisiones de GEI	Reducciones internas de carbono	
	El rendimiento del carbono y su esquema de divulgación	"Lenguaje"	
	La participación de la organización en un enfoque sistémico	Mecanismos de gobernanza, innovación, integración de carbono en decisiones de inversión	
Carbon Solutions Global (2020)	Alinear los intereses económicos, sociales y ambientales de una organización. Lograr una reducción de costos en el uso de energía, consumo de materia prima y manejo de residuos	Medir el impacto de las emisiones de carbono de todas las actividades comerciales para establecer la huella de carbono del negocio	
		Identificar e implementar una estrategia de reducciones	
		Comunicar los logros finales a las partes interesadas	

Fuente: Elaboración a partir de (Cadez & Czerny, 2015; Carbon Solutions Global, 2020; Damert, Paul, & Baumgartner, 2017; Radu, Caron, & Arroyo, 2020)

1.4.2. Teoría de la legitimidad

Las prácticas de divulgación de GEI han cobrado relevancia principalmente por los problemas derivados del calentamiento global y los escenarios futuros que enfrenta la humanidad en relación con la "frontera planetaria" (Hoffman & Jennings, 2018). Estas preocupaciones han generado un mayor escrutinio de las empresas, fundamentalmente aquellas que están adscritas a un sector sensible (Comyns, 2016; Lindblom, 1994). Ante esta presión constante por adaptarse a diferentes exigencias sociales, económicas, políticas y ambientales, las organizaciones se ven obligadas a desarrollar estrategias de legitimación permanente para enfrentar las expectativas sociales y así evitar vacíos que puedan poner en riesgo la forma de adquirir y salvaguardar su legitimidad (Dowling & Pfeffer, 1975; Lemaire, 1997; Lindblom, 1994).

De acuerdo con lo anterior, las organizaciones buscan mecanismos de comunicación para justificar sus acciones corporativas "responsables" y así articular sus motivaciones para informar (Bebbington, et al., 2008). Por consiguiente, las características asociadas con la gestión y el proceso comunicativo de una CMS toman relevancia para identificar aquellos compromisos implícitos en el "contrato social" (coherencia entre el sistema de valores establecido para el funcionamiento y continuidad de una organización) (Patten, 1991) y de esta forma analizar si existe un posible déficit de legitimidad por parte de las empresas (Baboukardos, et al., 2021). Es importante mencionar que, la información relacionada con una estrategia de gestión de carbono CMS, involucra elementos de medición cuantitativa y cualitativa que se convierten en una fuente de información que permite identificar una estrategia real a partir de una evaluación sistemática del desempeño corporativo relacionado con la estrategia ambiental y su conexión con la estrategia global de la organización. Al respecto, Deegan (2002) destaca el interés de los gerentes de revelar información voluntaria para legitimar las acciones que realiza la empresa.

Diversos estudios de carácter organizacional han utilizado la teoría de la legitimidad para identificar aquellas conductas derivadas de la noción de "contrato social" (Dowling & Pfeffer, 1975) en el que empresas establecen valores sociales de acuerdo con sus actividades, para garantizar su adaptación al sistema en el que se desenvuelven. En este sentido, el comportamiento de la organización es determinante para su funcionamiento y supervivencia y su ciclo de legitimación se transforma permanentemente con el cambio de las expectativas sociales, dando lugar a un concepto relativo de "legitimidad" (Deegan C, 2019). La legitimidad ha sido definida por Suchman (1995, p. 574) como:

> "[].. una percepción o suposición generalizada de que las acciones de una entidad son deseables, propias o apropiadas dentro de algún sistema socialmente construido de normas, valores, creencias y definiciones"

La teoría de la legitimidad se basa en la idea que la empresa opere bajo los límites de lo que la sociedad identifica como un comportamiento socialmente aceptable (O'Donovan, 2002). Recientemente los enfoques estratégicos de las empresas están orientados a cumplir las metas propuestas para el año 2030 a través de metodologías adaptativas a su entorno económico e industrial. Estos cambios generan nuevas dinámicas de gestión que en tiempos de transición se adhieren a diferentes enfoques de Responsabilidad Social Corporativa RSC. Entre los enfoques determinantes para identificar la intención comunicativa de la empresa (Valenzuela, et al., 2015) se pueden desatacar los siguientes: (i) Enfoque instrumental; promueve acciones favorables con el cambio climático para obtener beneficios económicos con el objetivo de garantizar la supervivencia de la empresa y simplificar brechas con los accionistas (Datt, Luo, & Tang, 2019; Drucker, 1983; Porter & Kramer, 2006). (ii) Enfoque integrativo; en este caso la empresa presenta información positiva relacionada con el cambio climático como mecanismo de legitimación de sus acciones y de esta forma protege su reputación social (Ackerman, 1973; Lyon & Maxwell, 2011). (iii) Enfoque ético; permite reconocer estrategias claras y contundentes para garantizar el porvenir de la empresa y de otros grupos de interés diferentes a los accionistas,

con el apoyo de la contabilidad de carbono para la mejora permanente del desempeño relacionado con el clima y la gestión de emisiones (Freeman, 1984; Rietbergen, Rheede, & Blok, 2015).

Por otra parte, en países emergentes las políticas de cambio climático están asociadas con políticas fiscales en consideración con las condiciones económicas de rentabilidad, equidad distributiva y viabilidad para aplicar transformaciones políticas. Desde la perspectiva socioeconómica y regulatoria, los gobiernos implementan instrumentos como el impuesto al carbono para obtener resultados que les permitan cumplir objetivos sociales e incentivar a los sectores público y privado a invertir en tecnologías bajas en carbono y prácticas más sostenibles (Goulder, 2013). Por consiguiente, los gobiernos también desarrollan diferentes estrategias y planes de acción en sus territorios para mitigar el cambio climático y así buscan legitimar las decisiones políticas desde la perspectiva de la moralidad del poder político (Buchanan, 2002).

1.4.3. Teoría de los stakeholders

La teoría de los stakeholders ha transitado por diferentes escenarios desde el siglo pasado. En los años 70, el premio nobel de economía Milton Friedman, enfatizó que la única responsabilidad social de las empresas se reflejaba en la maximización del valor para el accionista (Friedman, 1970). Esta postura económica generó reacciones y contradicciones. Las contradicciones fueron decisivas para entender el papel de las empresas y sus obligaciones morales, sociales, éticas y ambientales. Estas nuevas posturas desencadenaron diferentes cuestionamientos acerca de los enfoques de la responsabilidad social empresarial dejando como precedente que las empresas no deben limitarse al beneficio exclusivo de los accionistas (Andrews, 1977; Cortina, 2000; García Marzá, 2004; Freeman, 1984; Rose, 2007), La teoría de los stakeholders asocia a los participantes externos e internos de las organizaciones para que en el libre ejercicio de sus derechos ejerzan influencia para que las empresas cumplan con sus demandas sociales y

ambientales (Freeman, 1984). De acuerdo con lo anterior y desde una perspectiva tradicional, el concepto de stakeholders es definido de la siguiente manera:

> *"cualquier grupo o individuo que puede afectar o es afectado por el logro de los objetivos de la organización"* (Freeman, 1984, p. 46)

Esta definición involucra a múltiples actores sociales que pueden tener diferentes intereses en una organización. Al respecto, Clarkson (1995) clasifica las partes interesadas en dos grupos: (i) Stakeholders primarios; "un grupo sin cuya participación continua la corporación no puede sobrevivir como un negocio en marcha" y (ii) Stakeholders secundarios; "aquellos que influyen o afectan, o son influenciados o afectados por la corporación, pero, no están involucrados en transacciones con la corporación y no son esenciales para su supervivencia" (p. 106-107). Aunque, esta clasificación presenta un nivel jerárquico de poder de los stakeholders en relación con la organización, las empresas son interdependientes para sobrevivir en el sistema en el que operan y no pueden estar al margen del desequilibrio que genera la pérdida de biodiversidad y la exposición que tienen a desastres naturales generados por el incremento de las emisiones de GEI. Por lo que, Luo & Tang (2016) señalan que las empresas con una orientación hacia las partes interesadas tienen más probabilidades de tener sistemas de gestión de carbono de alta calidad que aquellas con una orientación hacia los accionistas.

De acuerdo con lo anterior, Cotter & Najah (2011) reconocen a gobiernos, inversionistas, clientes, ONG, proveedores y competidores como participantes cruciales en los procesos de reducción de GEI. El gobierno por ejemplo es un actor fundamental para presionar a las empresas para reducir emisiones de GEI a través de regulación y política pública. En este sentido, desde los años 90 del siglo pasado, diferentes gobiernos incorporaron el impuesto al carbono como un mecanismo de regulación para reducir emisiones (Sprengel & Busch, 2011). No obstante, en países de economías emergentes la implementación de este

mecanismo tardó aproximadamente dos décadas y aún se encuentra en proceso de reglamentación (véase por ejemplo Colombia).

Desde el punto de vista de los accionistas, es trascendental determinar la influencia que ejercen estos participantes en las prácticas corporativas ambientales y en la implementación de acciones concretas para mejorar el desempeño ambiental (Bueno-García, et al., 2020; Kim et al., 2020). Estudios como los de Flammer, Toffel, & Viswanathan (2021) analizan el activismo de los accionistas y los efectos de divulgación de las empresas en relación con los riesgos del cambio climático. Al respecto, sugieren que los inversores evalúan y aprecian la transparencia de la empresa frente a la exposición de estos riesgos. No obstante, la evaluación por parte de la comunidad inversora se encuentra en una etapa muy germinal y se espera que estos participantes alienten a las empresas a reducir sus emisiones mediante una transición a una economía sin emisiones de carbono. Con respecto a este proceso de transición, se estima que se ejerza una presión de mayor envergadura, mediante mecanismos legales como por ejemplo "un fallo judicial sobre las obligaciones de los inversores fiduciarios para controlar el riesgo climático sistémico" (Covington, Thornton, & Hepburn, 2016).

Por otra parte, los clientes pueden ejercer presión para que se generen respuestas corporativas al cambio climático (Reid & Toffel, 2009). Estas presiones externas obligan a las empresas a reconocer cada vez más la presión que ejercen los consumidores al seleccionar productos y servicios amigables con el medio ambiente y que evidencien menos consumo de emisiones de GEI. Es decir, las empresas se enfrentan a un consumidor informado que ejecuta sus decisiones de compra con fundamento a sus criterios medioambientales (Clarkson, 1995; Zameer, Wang, & Saeed, 2021). Las ONG, también incorporan medidas que influyen y presionan a las organizaciones para que ejerzan un compromiso real con el medio ambiente y con el cambio climático. Principalmente mediante mecanismos externos (conferencias, influencia de activistas por ejemplo en protestas pacíficas, influencia en decisiones de la agenda gubernamental). Estos mecanismos

generan un nivel de influencia diferente de acuerdo con: (i) Claridad del mensaje, (ii) una cobertura mediática favorable, (iii) una masa crítica que represente a la mayoría de los votantes y (iv) una protesta pacífica (Rietig, 2011). De acuerdo con lo anterior, Hoque (2017) destaca que al mejorar los procesos de participación de los stakeholders se produce un cambio en el comportamiento organizacional. Por su parte, Buysse & Verbeke (2002) argumentan que las estrategias ambientales más proactivas se asocian con una cobertura más profunda y amplia de los stakeholders.

En síntesis, la teoría de los stakeholders permite establecer "'qué' hace la organización para generar un compromiso activo de las partes interesadas, con miras a crear distintas formas de valor social en cada una de ellas" (Baboukardos, Beddewela, & Soobaroyen, 2021, p. 722). También, permite identificar si las empresas gestionan sus emisiones por presiones regulatorias, por la gestión de sus costos y reputación o por el cumplimiento de su responsabilidad social (Jayanthi, 2017).

1.4.4. Teoría de la señalización – Greenwashing y SDG-washing

La Teoría de la señalización tiene relación directa con la asimetría de la información que se genera entre diferentes actores sociales como individuos u organizaciones (Moratis, 2018; Stiglitz, 1985). Esta teoría es útil para describir el comportamiento de estos participantes desde la perspectiva de la intención y "calidad" de la información que se genera del remitente al receptor. Por una parte, el remitente toma la decisión de cómo informar (señalar) y por otra, el receptor toma la elección de cómo interpretar la señal o la comunicación (Connelly, et al., 2011; Yasar, Martin, & Kiessling, 2020). Al respecto, Friske, Hoelscher, & Nikolov (2022) establecen que la teoría de la señalización tiene cinco componentes esenciales "el emisor de la señal, la señal, el receptor, la retroalimentación del receptor y el entorno de señalización". La teoría aborda la intención de la organización por medio de su agente (director – gerente) de compartir o divulgar información que le permita recibir señales del mercado, los stakeholders y de la sociedad y de esta manera

reducir la brecha comunicativa que puede afectar su reputación y su relación directa con sus partes interesadas (Bae, Masud, & Kim, 2018; Connelly, et al., 2011; Taj, 2016).

La teoría de la señalización vista desde la RSC puede explicar la necesidad de divulgar información voluntaria para reducir la asimetría de la información con los stakeholders y de esta manera construir señales positivas que favorezcan a la empresa y mantener su legitimidad. También se puede utilizar para mostrar información selectiva y de esta manera limitar información que pueda ser interpretada como una señal negativa dando paso a posibles prácticas de Greenwashing (Hetze, 2016; Luo, Zhang, & Zhang, 2021).

El Greenwashing, es el término utilizado para referirse a: (i) "comportamiento o actividades que hacen creer a las personas que una empresa está haciendo más para proteger el medio ambiente de lo que realmente es" (Cambridge Dictionary, 2022), (ii) el Greenwashing es (1) una decisión de divulgación de información, (2) deliberada, (3) iniciada por las empresas y (4) beneficiosa para las empresas y costosa para la sociedad (Bowen & Aragon-Correa, 2014, p. 108).

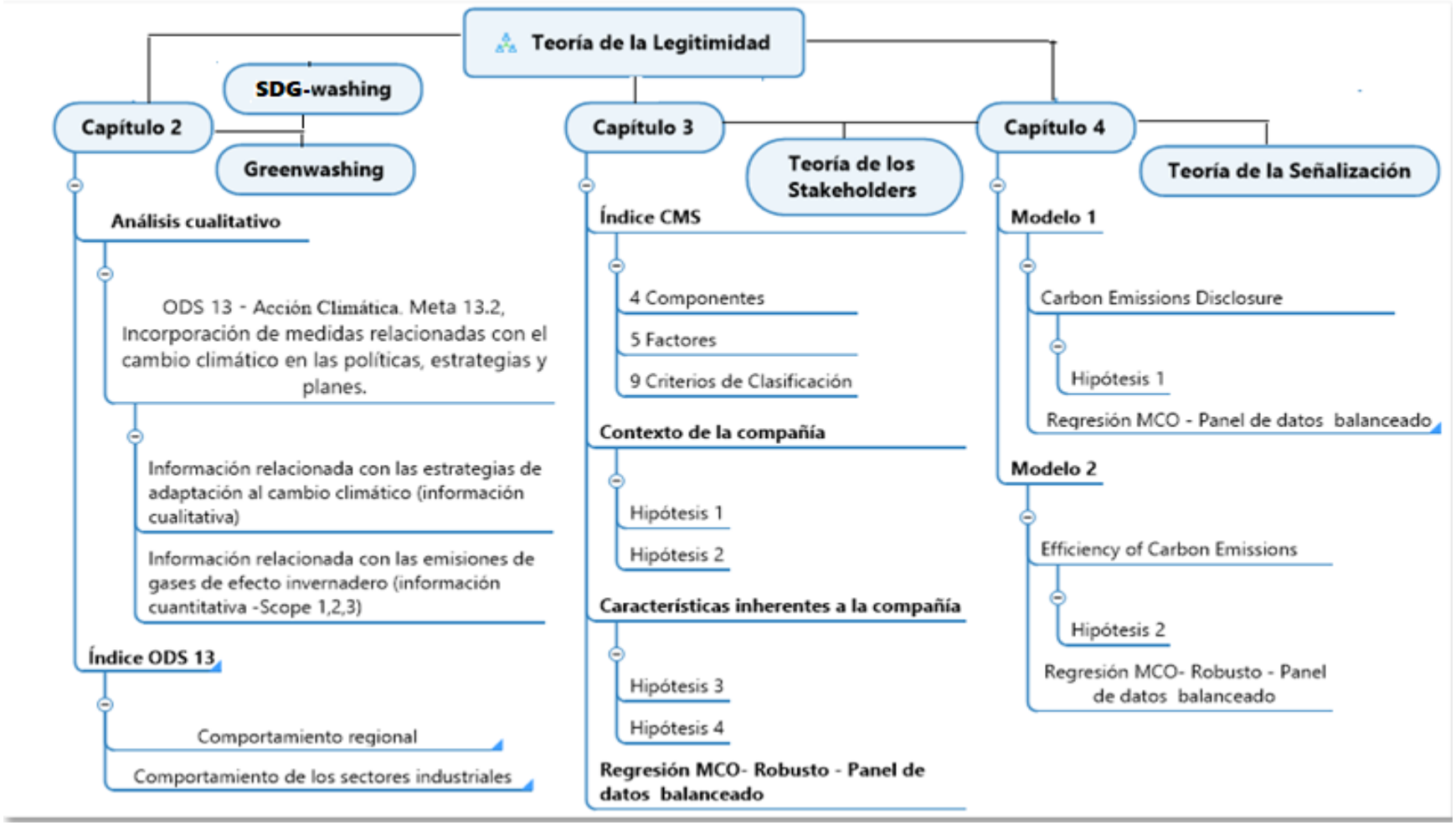
Las divulgaciones de GEI también han tenido referencias de investigación en la teoría de la señalización o conocida como la "teoría de la divulgación voluntaria" (Luo & Tang, 2014, p.193). Esta teoría también se utiliza para comprender aquellas prácticas organizacionales derivadas de las estrategias de carbono y su impacto en las prácticas de divulgación de emisiones como una señal de gestión positiva hacia las partes interesadas. En este caso, las empresas con mejor desempeño o eficiencia en términos de carbono tienden a divulgar más información voluntaria como estrategia para diferenciarse de la competencia y como una señal positiva dirigida a los inversionistas (Datt, et al., 2019). También, las "empresas pueden optar por informar a "nivel de proyecto" o "nivel de entidad". La primera modalidad le permite a una empresa informar solo sobre los resultados de proyectos exitosos, mientras permanece en silencio sobre su desempeño agregado" (Lyon & Maxwell, 2011, p. 10).

La divulgación voluntaria relacionada con el cambio climático y emisiones de GHG puede estar mediada por diferentes estrategias comunicativas por parte de los emisores de información; por ejemplo, mecanismos de "Divulgación selectiva" o "Manipulación expresiva" que incluyen elementos simbólicos que se producen a través de una simple descripción cualitativa (Luo, Zhang, & Zhang, 2021). Como respuesta países como Estados Unidos han incorporado recientemente una serie de medidas y mecanismos para la presentación de informes climáticos con requisitos de auditoría y certificación. Esto permite identificar la materialidad de los riesgos a través del análisis de información cualitativa y cuantitativa (KPMG, 2022). Precisamente, cuando se presentan brechas de información cualitativa y cuantitativa en la información que soporta las acciones relacionadas con el cambio climático y que tienen relación directa con el ODS 13, podemos referirnos al concepto denominado SDG-washing. Este término se ha incluido en la literatura para hacer referencia al compromiso simbólico más que sustantivo con los ODS (Heras-Saizarbitoria, Urbieta, & Boiral, 2022; Kornieieva, 2020). El SDG-washing se relaciona con una brecha entre lo que se informa y lo que la empresa logra en realidad, dejando al descubierto problemas estratégicos para poner en práctica acciones corporativas reales que contribuyan directamente a las metas establecidas en los ODS (van Zanten, & van Tulder, 2021a).

1.5. Estructura de la Tesis por capítulos

Esta tesis está compuesta por cinco capítulos. El primer capítulo se ocupa del planteamiento general de la investigación. Incorpora la introducción, las tres principales motivaciones del estudio y presenta el contexto en el cual se desarrolla la investigación. Para orientar el planteamiento de la tesis se presentan los objetivos y las teorías que fundamentan la investigación y que se desarrollan en los capítulos dos, tres y cuatro. El diseño metodológico se estructura de acuerdo con cada una de las fases estructurales de los capítulos. Finalmente, el capítulo 5 presenta las conclusiones y las contribuciones del estudio. Tal y como se muestra en la figura 3.

Figura 3 Estructura de la Tesis Doctoral



1.5.1. Capítulo 2: Climate action information disclosure in Colombian companies: a regional and sectorial analysis

Este estudio se centra en el Objetivo de Desarrollo Sostenible 13 (ODS 13) que llama a tomar medidas urgentes para luchar contra el cambio climático y sus impactos. Este estudio se enfoca principalmente en la meta 13.2 que establece la incorporación de medidas relacionadas con políticas, estrategias y planes de cambio climático. Este objetivo incluye información relacionada con las estrategias de adaptación al cambio climático (información cualitativa), y las emisiones de gases de efecto invernadero y sus alcances 1, 2 y 3 (información cuantitativa). Por ello, analizamos este tipo de información a través de un análisis del sector empresarial colombiano incorporando características del contexto.

Este estudio se enmarca en la teoría de la legitimidad y los conceptos de Greenwashing y SDG-washing. Diseñamos dos índices de calidad de divulgación para el ODS 13 (índice SDG13 cualitativo – índice SDG13 cuantitativo) a través del análisis de contenido de los informes de sostenibilidad de 60 empresas colombianas listadas para el año 2019. Nuestros hallazgos sugieren que existe una brecha significativa entre la calidad de divulgación de información cualitativa y cuantitativa en las empresas de la muestra en relación con la acción climática a nivel regional y sectorial. Las empresas muestran un comportamiento de divulgación simbólico más que sustantivo. Los sectores con mayor calidad de divulgación se encuentran en sectores ambientalmente sensibles. A nivel regional se evidencia un comportamiento heterogéneo que obedece a las características sociales, económicas y políticas de las regiones y su poca conexión con los planes gubernamentales de cambio climático.

Los resultados de este capítulo son útiles para comprender e identificar el contexto territorial a través de factores de comportamiento empresarial relacionados con el cambio climático. La contribución de este estudio tiene implicaciones que van más allá del ámbito

empresarial ya que los resultados deben ser entendidos como un aporte a la estrategia colombiana para encaminar al país hacia un desarrollo económico bajo en emisiones de gases de efecto invernadero, así como alcanzar la carbono neutralidad al año 2050.

1.5.2. Capítulo 3: Carbon management strategy quality in Colombian companies: the influence of the national and regional public sector and company - inherent characteristics

Este capítulo permite comprender si las acciones tomadas por el gobierno, la presión regulatoria ejercida sobre las industrias clasificadas como sensibles al cambio climático y los factores internos de las empresas impactan en las divulgaciones que las empresas hacen sobre la gestión de emisiones de carbono. El objetivo principal de este apartado es identificar los determinantes de la calidad de las divulgaciones de la Estrategia de Gestión del Carbono (CMS) en los informes de sostenibilidad de las empresas colombianas durante el período 2016-2018. Diseñamos un índice de divulgación de CMS utilizando un marco teórico y análisis de contenido del informe de sostenibilidad de las empresas. Se utiliza un modelo de regresión de Mínimos Cuadrados Ordinarios MCO robusto basado en datos de panel balanceado.

Nuestros hallazgos sugieren que la presión ejercida por el contexto empresarial (el gobierno colombiano con la implementación del impuesto al carbono y el gobierno local con acciones específicas de cambio climático) y las características inherentes de la empresa (empresas más grandes y empresas pertenecientes a industrias sensibles a cambio climático) mejoran la calidad de la divulgación de una CMS en las empresas colombianas. Nuestros resultados son útiles para que los gobiernos nacionales y regionales comprendan cómo sus acciones pueden alinear el comportamiento del sector privado. Asimismo, el índice CMS es un indicador útil para que las empresas entiendan si están haciendo negocios incorporando acciones de mitigación del cambio climático.

1.5.1. Capítulo 4: Carbon Management Strategy effects on the disclosure and efficiency of carbon emissions: a study of Colombian companies' context and inherent characteristics

El propósito de este capítulo es identificar la relación entre: A) la adopción de una estrategia de gestión de carbono (CMS) y la divulgación de las emisiones de carbono y B) la eficiencia de una CMS en la gestión de emisiones directas, indirectas y de otro tipo por parte de las empresas colombianas. Utilizando la metodología basada en una regresión MCO para el modelo *Divulgación de emisiones de carbono* y una regresión MCO robusta en el modelo *Eficiencia de una Estrategia de Gestión de Carbono,* utilizando un panel de datos balanceado de empresas cotizadas colombianas para el período 2016-2019. Tomamos submuestras para analizar el alcance 1, alcance 2 y alcance 3. El estudio incluye variables en relación con el contexto de las empresas (estrategia fiscal a través de impuestos al carbono y ubicación geográfica) y características propias de la empresa (tamaño y sector industrial sensible).

Los resultados del modelo *Divulgación de emisiones de carbono* sugieren que, en las grandes empresas existe una relación positiva entre la adopción de un CMS y su divulgación de emisiones para los alcances 1 y 2. Las industrias sensibles divulgan las tres categorías de los alcances. En algunas regiones, la información cuantitativa es escasa y sugiere que las empresas no están dispuestas a divulgar información que envíe una señal negativa de sus acciones ambientales a las partes interesadas. Los resultados del modelo *Eficiencia de una Estrategia de Gestión de Carbono* muestran una importante conexión con el desempeño financiero de las empresas colombianas. El endeudamiento es uno de los mecanismos de apalancamiento para adquirir tecnología o gestionar proyectos de innovación para una gestión más eficiente de las emisiones de CO_2. Los accionistas también tienen un impacto en la eficiencia. Esto está asociado a un creciente interés por incorporar criterios ambientales en sus decisiones de inversión y al efecto de obtener información sobre emisiones a través de informes voluntarios. El índice CMS es positivo para la eficiencia de las emisiones indirectas controladas (alcance 2). Este hallazgo sugiere

que las estrategias de reducción de emisiones se centran en la gestión del consumo de electricidad o el uso de fuentes renovables para mejorar los costos financieros y los indicadores de emisiones.

1.6. Diseño Metodológico de la Tesis

En los capítulos de esta tesis doctoral hemos desarrollado un análisis cualitativo descriptivo y un enfoque empírico explicativo para cumplir con los objetivos propuestos. Desde la perspectiva del análisis cualitativo, este representa "una combinación ecléctica pero razonable de muestreo y técnicas de recopilación, análisis y representación de datos", la elección de este método es clave cuando "se desean descripciones directas de los fenómenos" (Sandelowski, 2000, p. 334). Al respecto, este estudio se estructura para realizar una descripción del fenómeno asociado al cambio climático mediante el análisis de contenido de los informes de sostenibilidad de las empresas colombianas bajo tres ejes fundamentales: (i) La divulgación que realizan las empresas con relación a su acción climática ODS 13 en sus informes no financieros. (ii) La divulgación que realizan las empresas con relación a la estrategia de gestión de carbono – Carbon Management Strategy- CMS y (iii) La divulgación que realizan las empresas con relación a la divulgación de las emisiones de GEI. Este método de investigación se utiliza en la investigación social y ambiental y también ha sido utilizado para analizar las divulgaciones de GEI (Matisoff, Noonan, & O'Brien, 2013).

El análisis de contenido es un proceso de investigación que requiere dos mecanismos básicos. "El primero se refiere a la revisión de la documentación existente y disponible sobre la realidad que va a ser objeto de análisis, la segunda toma como referente una observación de la realidad en cuestión" (Sandoval Casilimas, 1996 p.118). Por su parte, Bardin (2002) señala que, "el análisis de contenido es un conjunto de técnicas de análisis de comunicaciones, []… su descripción analítica funciona por procesos sistemáticos y objetos de descripción del contenido de los mensajes" (p. 25). También, el análisis de

contenido es utilizado como "un método para clasificar el texto (o el contenido) de una obra escrita en varias categorías mediante criterios de selección" (Krippendorf, 2012, p. 21). De acuerdo con estos parámetros, cada uno de los capítulos de la tesis incorporó una serie de fases para sistematizar el contenido de la información. (ver Tabla 2)

Tabla 2 Fases del Análisis de Contenido

***Fase (I):* organización y selección de categorías**	
Capítulo II	Categorías analíticas: (i) la empresa presenta información cualitativa sobre sus acciones de mitigación y adaptación al cambio climático en sus políticas, estrategias y planes y (ii) la empresa presenta información cuantitativa sobre su medición acciones de mitigación de la huella de carbono y compensación de las emisiones derivadas de sus operaciones.
Capítulo III	Categorías analíticas (i) Medición de la huella de carbono, (ii) reducción de emisiones internas y externas, (iii) gobernanza del carbono y (iV) mecanismos de compensación. Mediante los constructos teóricos desarrollados por (Cadez et al., 2015; Carbon Solutions Global, 202; Damert et al., 2017; Radu et al., 2020),
Capítulo IV	Categorías analíticas (i) Alcance 1- Divulgación de Emisiones Directas: de actividades controladas por la organización. (ii) Alcance 2 - Divulgación de Emisiones Indirectas: generadas por plantas de producción de energía eléctrica como resultado del consumo propio de la empresa. (iii) Alcance 3 - Divulgación de otras emisiones: son actividades que ocurren en fuentes que no son propiedad de la empresa y que no están controladas directamente. Lo anterior de acuerdo con el Estándar de Informes y Contabilidad Corporativa del Protocolo de GEI (WRI y WBCSD, 2010)
***Fase (II):* Categorización de los informes de sostenibilidad:**	
Capítulo II	Categorización cualitativa: (1) Acciones de mitigación y adaptación al cambio climático, (2) Metas de reducción de emisiones (3) Mecanismos de gobernanza y gestión del riesgo, en este caso se incluye información relacionada con procesos generales de gestión del riesgo, riesgos físicos que puedan afectar el negocio como posibles sequías, incendios, inundaciones, entre otros. Riesgos de transición para pasar a una economía con menos emisiones de carbono. (4) Mecanismos de compensación de emisiones. Categorización cuantitativa: Información sobre el alcance de las emisiones a través del Reporting and Corporate Accounting Standard del GHG Protocol (WRI y WBCSD, 2010). Los alcances se definen de la siguiente manera: Alcance 1- Revelación de Emisiones Directas, Alcance 2 - Revelación de Emisiones Indirectas, Alcance 3 - Revelación de otras emisiones. También se incorpora en la categorización la información cuantitativa relacionada con la compensación de emisiones

Capítulo III	La categorización incorpora cinco elementos y nueve actividades: Elemento 1: Impacto de las emisiones de carbono de todas las actividades comerciales (A1-Medición de la huella de carbono del negocio). Elemento 2: Reducción interna de carbono (A2-Proceso de reducción de emisiones, A-3 Gestión de la producción) Elemento 3: Reducción de carbono externo (A4-Reemplazar insumos con alto potencial de emisión) Elemento 4: Mecanismos de gobernanza (A5 -Participación organizacional y gestión de riesgos, A6-Innovación, integración del carbono en las decisiones de inversión, A7-Identificar e implementar una estrategia de reducción) Elemento 5: Mecanismos de compensación: (A8-Comercio de derechos de emisión de carbono, A9-Otros mecanismos de compensación)
Capítulo IV	La categorización incorpora la divulgación de GEI de las empresas mediante los alcances 1, 2 y 3 en CO_2 equivalente. En algunos casos, realizamos la conversión de los cálculos para unificar la información en esta medida.
Fase (III): Análisis	El equipo de investigación discute los resultados, dos investigadores auditan los resultados producidos por un miembro del equipo.

De acuerdo con el proceso metodológico desarrollado en cada una de las fases nos fue posible establecer los índices y subrogados en cada uno de los capítulos. Es importante destacar que en la literatura ambiental y específicamente la literatura de gestión y eficiencia de emisiones de GEI ha recurrido a diferentes índices para indagar acerca del comportamiento en regiones e industrias del mundo (Neagu, 2019; Zhang, Zhou, & Kung, 2015; Zhou, Ang, & Han, 2010). En este sentido, hemos desarrollado índices que permitan indagar y analizar el comportamiento de las empresas ubicadas en Colombia, desde una mirada regional y de sus actividades industriales. En el capítulo II incorporamos el índice denominado “SDG13-Index” el cual se compone de dos índices: (i) Índice ODS 13- información cualitativa y (ii) Índice ODS 13- información cuantitativa. El capítulo III incluye en índice denominado “CMS-Index” para analizar la estrategia de gestión de carbono de las empresas colombianas y este mismo índice es referente de análisis para indagar acerca de la eficiencia de las emisiones de GHG tal y como se aprecia en el capítulo IV.

La estructuración, diseño y desarrollo de los índices permitieron establecer la fase explicativa de los capítulos:

El capítulo II proporciona respuestas a las siguientes preguntas de investigación: (i) ¿Las empresas colombianas divulgan información cualitativa y cuantitativa relacionada con el ODS 13? (ii) ¿Cuál es el nivel de calidad de divulgación cualitativa y cuantitativa del ODS 13 en las empresas colombianas? (iii) ¿Cuál es el nivel de divulgación relacionado con el ODS 13 en regiones e industrias ambientalmente sensibles? (iv) ¿La calidad de la divulgación de la información cualitativa y cuantitativa del ODS 13 depende de la región o de los sectores ambientalmente sensibles? Estas preguntas se asocian con el objetivo específico de investigación 1.

Este capítulo se desarrolla en el periodo 2019. Este periodo transcurre luego de la segunda fase de implementación de la estrategia de desarrollo bajo en carbono de Colombia (ECDBC) que comenzó en 2018 y la emisión de la ley de cambio climático (ley 1931-2018). Metodológicamente, seleccionamos este periodo al no verse alterado por cuestiones relevantes como las generadas en 2020 por la pandemia (COVID-19). Este capítulo se relaciona con el comportamiento y calidad de divulgación del ODS 13 desde la perspectiva empresarial y sus resultados se analizan desde una perspectiva regional y sectorial para estudiar este comportamiento desde el contexto colombiano.

El capítulo III se relaciona con los determinantes de la calidad de las divulgaciones de la Estrategia de Gestión del Carbono (CMS) en los informes de sostenibilidad de las empresas colombianas durante el período 2016-2018. Se desarrolla mediante un modelo de regresión basado en datos de panel balanceado. En este capítulo utilizamos el modelo de regresión de mínimos cuadrados ordinarios (MCO) y se utiliza la estimación robusta para mejorar el modelo al establecer normalidad mediante pruebas de bondad de ajuste (Francia y Shapiro, 1972, Shapiro & Wilk, 1965). Incorporamos dos tipos de variables: (i) Variables explicativas: que corresponden a la región, tamaño, impuesto al carbono, industrias ambientalmente sensibles. (ii) Variables de control: que corresponden al endeudamiento, ROA, accionistas (ver Tabla 3). Los datos se obtuvieron primero de los

informes de sostenibilidad de la base de datos GRI y del sitio web de la empresa para construir la información del Índice CMS, la variable dependiente. Los datos de la empresa se obtienen de la base de datos ORBIS. Los resultados de este capítulo se asocian con las hipótesis (H1, H2, H3, H4) que concuerdan con el objetivo 2 de la investigación.

Tabla 3 Variables – Capítulo III

Variables explicativas		Hipótesis
Región	Variable categórica. Este analiza cinco regiones (Caribe, Centro-Oriente, Centro-Sur, Eje Cafetero y Antioquia, Pacífico) Rango de 1 a 5.	(H1)
Tamaño:	Es el logaritmo natural de los activos totales.	(H2)
Impuesto:	Una variable dicotómica equivalente a 1 para el periodo de tributación del impuesto al carbono en Colombia. De lo contrario es equivalente a 0	(H3)
Indsens:	Variable dicotómica que equivale a 1 si la empresa pertenece a una industria ambientalmente sensible*, y 0 en caso contrario. (Energía eléctrica, Minería y Extracción, Gas natural y petróleo).	(H4)
Variables de control		
Endeudamiento:	Ratio de endeudamiento total entendido como la deuda total dividida el activo total	
ROA:	La relación entre los ingresos y los activos totales.	
Accionistas:	Es el número de accionistas de la empresa.	

El capítulo IV, se fundamenta en dos modelos: i) *Divulgación de emisiones de carbono:* Este modelo se desarrolla para establecer la relación entre la adopción de una estrategia de gestión de carbono y la divulgación de las emisiones de carbono. Para este modelo utilizamos una regresión de Mínimos Cuadrados Ordinarios (MCO) con base en un panel de datos balanceado. Los resultados de este modelo se asocian con la hipótesis (H1). *ii) Eficiencia de una Estrategia de Gestión de Carbono:* Este modelo se relaciona con la eficiencia de una estrategia de gestión de carbono en la gestión de emisiones directas, indirectas y otras emisiones por parte de las empresas colombianas para el periodo 2016-2019. Usamos una regresión de Mínimos Cuadrados Ordinarios (MCO) robusta con base

en un panel de datos balanceado. En este modelo utilizamos submuestras para analizar el alcance 1, alcance 2 y alcance 3. Los resultados de este modelo se asocian con la hipótesis (H2). El capítulo incluye variables en relación con el contexto de las empresas (estrategia fiscal a través de impuestos al carbono y ubicación geográfica) y características propias de la empresa (tamaño y sector industrial sensible) (ver Tabla 4). Los datos se obtuvieron primero de los informes de sostenibilidad de la base de datos GRI y de los sitios web de las empresas para construir la información relacionada con la divulgación y eficiencia de las emisiones de CO_2 en las empresas colombianas para elaborar la variable dependiente. Los datos financieros de las empresas se obtuvieron de la base de datos ORBIS. Este capítulo de relaciona con el objetivo de investigación 3.

Tabla 4. Variables Capítulo IV

Variables explicativas	
Índice CMS	El puntaje del índice se establece consolidando la presencia o ausencia de cada una de las dimensiones (Medición, Reducción de Carbono, Gobernanza de Carbono, Compensación de Carbono) cada dimensión puntúa 1 punto, por lo que el Índice CMS va de 0 a 4
Tamaño: Indsens:	Es el logaritmo natural de los activos totales. Variable dicotómica que equivale a 1 si la empresa pertenece a una industria ambientalmente sensible*, y 0 en caso contrario. (Energía eléctrica, Minería y Extracción, Gas natural y petróleo).
Impuesto:	Una variable dicotómica equivalente a 1 para el periodo de tributación del impuesto al carbono en Colombia. De lo contrario es equivalente a 0
Región	Variable categórica. Este analiza cinco regiones (Caribe, Centro-Oriente, Centro-Sur, Eje Cafetero y Antioquia, Pacífico) Rango de 1 a 5.
Variables de control	
Endeudamiento:	Ratio de endeudamiento total entendido como la deuda total dividida el activo total
ROA:	La relación entre los ingresos y los activos totales.
Accionistas:	Es el número de accionistas de la empresa.

CAPÍTULO 2: CLIMATE ACTION INFORMATION DISCLOSURE IN COLOMBIAN COMPANIES: A REGIONAL AND SECTORIAL ANALYSIS

2. Climate action information disclosure in Colombian companies: a regional and sectorial analysis

2.1. Introduction

The strategies to guarantee the future, of current and future generations worldwide, have been established in the Sustainability Development Goals (SDG). Their implementation focuses on three dimensions; economic, environmental, and social, and their execution is established within 17 objectives and 169 goals. The 2030 Agenda has set goals to be achieved through an integrated approach to sustainability since its official enactment in 2015. However, these agreements have failed to balance the incompatible interests of different stakeholders (Fisher, et al., 2021). The progress of the agenda shows a dissimilar degree of compliance in different regions of the world, mainly due to characteristics related to the industrial and economic development of each territory (Lange Salvia, et al., 2019) affecting the commitments agreed upon for this decade. Despite this, some emerging economies are making efforts to meet these goals although their financial restrictions prevent them from successfully achieving their initiatives.

Latin America is considered one of the most unequal regions on the planet with problems that are exacerbated apart from poverty, social conflict, and the concentration of power and wealth in a few entrepreneurs in the region (Cárdenas, 2016; Jiménez & Podestá, 2019). In this geographical area, the SDG indicators show that after the crisis caused by (COVID-19), trends of stagnation or regression have taken place (United Nations, 2022). This problem generates a greater degree of confrontation for governments with an urgent requirement for intervention in public policies to guarantee compliance with the goals established in the 2030 agenda. According to ECLAC (2022), this is a decisive decade for active and solidary strife so that different social actors face challenges proposed in the aforementioned agenda. Companies must especially increase their efforts and align their

strategies with the public sector to contribute to sustainable development. Likewise, Gambetta, et al., (2021) underscore that the private sector in Latin America must make greater contributions to comply with the 17 SDGs. Also, PwC (2019) reveals that there are differences in the disclosure of the SDGs in corporate reports worldwide and this generates a gap that limits the analysis of the progress of each one of the SDGs indicators.

In accordance with these regional problems, and from the perspective of SDG 13, countries such as the United States have recently incorporated a series of measures and mechanisms for climate reporting with audit and certification requirements. By means of such requirements, it is possible to identify the materiality of the risks through the analysis of qualitative and quantitative information (KPMG, 2022). Although this initiative creates a starting point to reduce the asymmetry of non-financial information in developing countries, it does not transcend due to lack of regulation. Therefore, voluntary reporting by companies from non-regulated countries creates uncertainty about the true outcomes of climate change. In accordance with the above, the objective of this study is to analyze the disclosure of information related to SDG 13, characterizing the quality and level of disclosure through the sustainability reports of 60 Colombian companies listed for the year 2019. This study is based on the legitimacy theory to identify whether, from the perspective of SDG 13-related information disclosure, companies carry out their activities within the boundaries of socially accepted behavior (O'Donovan, 2002). Also, in accordance with greenwashing and SDG-washing concepts, we assess whether the sustainability reports present gaps between what is disclosed and what companies y actually achieves (van Zanten, & van Tulder, 2021b). According to Johnsson, et al., (2020), we consider it important to evaluate SDG 13 by taking into account mitigation and adaptation actions to climate change. This is done by means of qualitative and quantitative disclosures that establish the degree of progress of this objective or to identify possible gaps that limit business results.

According to the above, this study focuses on SDG 13 which calls to take urgent action to fight climate change and its impacts. We mainly focus on goal 13.2 which establishes the

incorporation of measures related to climate change policies, strategies, and plans. This goal includes information related to climate change adaptation strategies (qualitative information) and greenhouse gas emissions (quantitative information). Therefore, we associate this type of information with our study's scope through a business analysis at regional and industrial levels to incorporate the characteristics of the Colombian context. This study is novel because it aims to contribute with new analytical features as one of the megadiverse countries in the world. Another novel aspect of this study is the usefulness of results as a contribution to Colombian low-carbon strategies.

By monitoring the scientific activity specifically related to SDG 13, our results suggest that this field of study is in a germinal stage[3], and the existing publications have diverse characteristics because it is a topic that involves diverse fields of knowledge. Some studies are related to actions to reduce emissions in food systems and focus on innovation processes in agriculture as a fundamental element to face climate change through agroforestry practices (Bruce, et al., 2018; Fajardo, 2020). Also, international cooperation mechanisms are analyzed to protect ecosystems through space programs that allow the detection of floods and possible risks generated by climate change (Alvarado, Guida, & Lervolino, 2016). Other studies develop topics related to land management, understanding changes in vegetation and impacts on forests and people (Albanito, Fitton, & Smith, 2018; Louman, et al., 2019; Yang, et al., 2020). There are also studies related to accounting knowledge and the challenges of measuring and reporting from the meta-governance approach, the COVID-19 problem, and its connection with SDG13 in the financial context, and knowledge of social awareness on climate change (Charnock & Hoskin, 2020; Doni & Johannsdottir, 2021; Hwang, et al., 2021).

In accordance with the aforementioned studies, we find that the SDGs provide a comprehensive understanding of sustainability. However, the local approach is relevant for

[3] The Scopus and Web of Science databases were used. The following search algorithm was applied: "TITLE (sdg 13)" we found 11 documents directly related to SDG 13 in the Scopus and Web of science of which 5 documents are found in the two databases. The documentary typology is as follows: [4] articles [5] book chapters [1] review [1] conference paper.

prioritizing context features in challenging environments (e.g., unregulated territories) (Hacking, 2019). Another fundamental element for the development of this study focuses on the scarce information from public sources in relation to the challenges of the business sector regarding climate change. As a matter of fact, it is important to indicate that a Colombian government report (NDC- Nationally determined Contributions) approved at the ninth session of the Intersectoral Commission on Climate Change, on December 10, 2020, states: "The contribution of territorial and business measures are not included in the mitigation scenario for that update, they are included qualitatively, with the exception of those referring to the Bogotá Metro and the Cundinamarca Regio tram " (Gobierno de Colombia, 2020). In this scenario, the global information contained in the advances presented by the Colombian government does not provide detailed evidence of territorial and business matters. Therefore, the results of this study provide comprehensible features on the behavior of companies in each of one of the regions. This has the purpose of not only studying organizations (companies), but also studying their interaction in a broader social environment (Ahrens, 2022).

In accordance with the above, our analysis focuses on the business sector to study its relationship between its actions and its compliance with SDG 13 framed in a specific country and its regions. Likewise, we developed a regional and industrial sector analysis to explore the territorial context and thus generate results to improve the implementation of concrete actions by companies, public, social, and governmental groups. The structure is as follows: Section two presents the Colombian context. Section three discusses the literature review. Section four shows the research design. Section five presents and discusses the results. Section six presents the conclusions.

2.2. Colombian Context

Colombia is a country of contrasts; its environmental richness has been cataloged as one of the mega-diverse countries in the world. Its geographical location is unique because it is

located between the Pacific Ocean and the Caribbean Sea. It has part of the Amazon jungle and the northern end of the Andes Mountain range (United Nations, 2020). It is also a country with a society fractured by conflict, social inequality, and regional division. It is characterized by developing the "longest armed conflict in the Western Hemisphere". This conflict has greater incidence and escalation in some regions of the country (Rettberg, Leiteritz, Nasi, & Prieto, 2018). In 2016, the peace accord with the FARC guerrillas was signed but implementation has been affected by factors directly related to governance (violence, voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, control, and corruption) (Worldbank Governance, 2020). In recent years, the murder of social leaders who defend the environment has increased, occupying first place in this catastrophic indicator in relation to other countries in the world (Global Witness, 2020). Colombia is classified as an emerging country (MSCI, 2020) and its economy depends on fossil fuels for export and for domestic use. Due to its demographic and biodiverse characteristics, it is an attractive country for foreign direct investment (FDI), nonetheless, these investments depend on oil prices[4] (UNCTAD, 2021). Since the economic liberalization of markets in the 1990s, the participation of multinational companies has increased in Colombia. These companies have aligned with national extractive economic policies, fostering a new economy that generated different environmental conflicts in the territories, mainly, conflicts related to: mineral extraction, fossil fuels, climate/energy justice, biomass and land conflicts[5] (EJAtlas, 2022; Pérez Rincón, 2014).

Historically, regional development in Colombia has subsequently been configured with the development of predominant business elites, sectors, and guilds (Dávila Ladrón de Guevara, 2003). As a result, the settlement of the population has been concentrated over time mainly in the most industrialized regions (Bogotá DC, Medellín and Cali). Nevertheless, some companies are also located on the Colombian coast due to maritime port control issues and their customs activities. The Colombian regions differ widely from

[4] For the year 2020, FDI plummeted 46% (7.7 billion dollars), as a result of the fall in oil prices (UNCTAD, 2021, p. 14).

[5] At the time of the consultation, 134 environmental conflicts were registered in Colombia.

each other due to their geographical, climatic, social, and economic differences, but mainly due to their ancestral customs derived from the indigenous peoples that still survive despite the conflict over the territory. Given this regional diversity, the 2014-2018 National Development Plan categorized six regions[6] (Caribbean, Central-East, Central-South, Eje Cafetero and Antioquia, Pacific and Flatlands) to homogenize territorial problems based on the consolidation of four dimensions: (i) characteristics of the territory in terms of social welfare, (ii) system of cities and the differentiation of degrees of rurality, (iii) regional characterization of the dynamics and incidence of the armed conflict (iv) the strategic environmental zones of the country (Departamento Nacional de Planeación, 2015). These regions embrace to 32 departments and 1,102 municipalities. As per the political constitution, Colombia is a unitary and decentralized state. This implies that the territorial entities from the subnational governments have powers for the implementation and management of climate change and the SDG goals registered in the government agenda (DNP Departamento Nacional de Planeación, 2019).

From the point of view of environmental management, in 2012 the Colombian government initiated a program called "Colombian Strategy for Low Carbon Development (ECDBC)" developed by the Environment and Sustainable Development Ministry. In its first stage, this strategy made progress with the characterization of mitigation at the sector level and a reduction goal was established for the year 2030 (20% of emissions). It was not until 2018 that the start of the second stage of this national strategy was established, and in the same year the climate change law was issued in Colombia (law 1931) with the purpose of managing climate change in sectors and territories (Ministerio de Medio Ambiente, 2022). In this scenario, the central government has incorporated different objectives to comply with the commitments established in the Paris agreement: (i) Facilitate decision-making between public and private institutions at the national and regional levels, (ii) Coordinate and articulate efforts for the greenhouse gas mitigation and adaptation. (iii) Strengthen

[6] (1) Caribbean (Atlántico, Bolívar, Cesar, Córdoba, La Guajira, Magdalena, San Andrés Providencia y Santa Catalina, y Sucre) - (2) Central- East (Bogotá, DC, Cundinamarca, Boyacá, Santander y Norte de Santander) (3) – Central- South - Amazonía de Colombia (Tolima, Huila, Caquetá, Putumayo y Amazonas) - (4) Eje Cafetero and Antioquia (Risaralda, Caldas, Quindío y Antioquia) - (5) Pacific (Chocó, Cauca, Valle y Nariño (6) Flatland.

national institutional capacities facing climate change. (iv) Promote the formulation and implementation of policies, plans, programs, and incentives, etc. (v) Promote the inclusion of climatic variables to design and plan projects under development (Gobierno de Colombia, 2020). A decade after the beginning of this strategy, GHG emissions are not regulated and this creates a significant gap to establish changes in organizational behavior to meet the decarbonization goal for the year 2050, emphasizing that climate policy proposal requires an important transformation process (Delgado, et al., 2020). Also, from the perspective of the goals of SDG 13, the sectoral climate change plans have taken place to solve the diverse needs of the communities in the territories. However, the national and international political situation related to the SDGs is at a stage that attempts to raise historical awareness. Nonetheless, the current state of its implementation reaffirms the needs of the territories after the crisis generated by COVID19. This geopolitical issue affects the context of organizations and forces companies to strategically adapt their relationships with the local, national, and international environment.

2.3. Literature review

2.3.1. Legitimacy theory - Greenwashing and SDG-washing

The incorporation of the SDGs through the 2030 agenda has generated new ways of understanding sustainability in all the hemispheres of the world through different dialogic elements. These new global commitments have been imperative for companies to show an interest in presenting information that allows them to safeguard their legitimacy (Deegan, 2002). Particularly, due to the disclosure of information, actions related to SDG 13-Climate Action have been incorporated into the environmental communications of companies due to the pressure exerted by different stakeholders (Government, NGOs, environmental leaders, communication media, suppliers, and customers) (Silva, 2021). Since there is a constant pressure to adapt to the demands of the social, economic, political, and environmental regulations, organizations are forced to develop permanent legitimation strategies to face social expectations and thus avoiding gaps that could put at risk the way

of acquiring and safeguarding their legitimacy (Lemaire, 1997; Lindblom, 1994: Dowling & Pfeffer, 1975).

From the "social contract" perspective (Patten, 1991), the behavior of the organization is decisive for its functioning and survival. Consequently, communication practices about climate change are considered sensitive regardless of the management carried out by the company to comply with optimal environmental performance. Also, this type of disclosure requires information attributes associated with the context of the social system in which the company operates based on coherent agreements “constructed of norms, values, beliefs and definitions” (Suchman, 1995, p. 574). Likewise, the new strategic approaches of companies are aimed at meeting the goals proposed for the year 2030 by means of adaptive methodologies to their economic and industrial environment. Also, these changes generate new disclosure dynamics that, in times of transition, adhere to corporate social responsibility approaches which are key to identifying the company's communicative intention (Valenzuela, et al., 2015). We underscore the following approaches: (i) Instrumental approach; promotes favorable actions with climate change to obtain economic benefits with the aim of guaranteeing the survival of the company and simplifying gaps with shareholders (Datt, Luo, & Tang, 2019; Drucker, 1983; Porter & Kramer, 2006). (ii) Integrative approach; the company presents positive information related to climate change as a mechanism for legitimizing its actions and thus, protecting its social reputation (Ackerman,1973; Lyon & Maxwell, 2011) (iii) The Ethical approach allows clear and forceful strategies to guarantee the future of the company and that of other interest groups other than shareholders. This approach requires the support of carbon accounting for the permanent improvement of performance related to climate and emissions management (Freeman, 1984; Rietbergen, Rheede, & Blok, 2015).

According to the CSR approaches mentioned above, organizations' search for legitimacy in relation to sustainability can comprise different scenarios. On the one hand, symbolic

demonstrations of commitment without real strategic implementation. On the other hand, companies can adopt mechanisms to be consistent with their values and sustainable management practices (Baboukardos, Beddewela, & Soobaroyen, 2021). Given these approaches and scenarios, the theory of legitimacy allows establishing an analysis of business contributions within the framework of sustainability as long as the disclosure and communication of corporate actions to the different stakeholders aim to manage the legitimacy and minimize information asymmetry (Silva, 2021). In accordance with the above, the incorporation and temporality of the SDGs (goals set out in the 2030 agenda) has led companies to quickly include information about the SDGs and thus show their rapid strategic action regarding environmental challenges, mainly with sensitive issues such as climate change (Broadstock, Collins, Hunt, & Vergos, 2018)

The presentation of information related to SDG 13 in sustainability reports may include different motivations by the business sector. In accordance with (Bebbington, Larrinaga - González, & Moneva - Abadía, 2008; Talbot & Boiral, 2018) one motivation would be related to using this information as a public relations tool to improve the company's reputation. Furthermore, this information can be used to hide information about its actual climate performance. From the perspective of emissions management in voluntary reports, the "firms can choose to report at the "project level" or the "entity level." The first one allows a firm to report only on the outcomes of successful projects, while remaining silent about its aggregate performance" (Lyon & Maxwell, 2011, p. 10). This way of managing or influencing disclosure is also associated with not including detailed information about its emissions reduction performance "Selective Disclosure" or "Expressive Manipulation" through symbolic disclosures that are produced in a simple qualitative description (Luo, Zhang, & Zhang, 2021). In this way, reports related to climate change management that are limited to the presentation of qualitative information can generate an indication of greenwashing or "SDG-washing". greenwashing is a term used to refer to: (i) "behaviour or activities that make people believe that a company is doing more to protect the environment than it really is" (Cambridge Dictionary, 2022) and (ii) greenwashing is (1) an information

disclosure decision, (2) deliberate, (3) initiated by companies, and (4) beneficial to firms and costly to society (Bowen & Aragon-Correa, 2014, p. 108). The SDG-washing concept has been included in the literature to refer to the symbolic rather than substantive commitment to the SDGs (Heras-Saizarbitoria, Urbieta, & Boiral, 2022; Kornieieva, 2020). This concept is related to a gap between what is reported and what the company actually achieves.

To avoid greenwashing and "SDG-washing" it is fundamental that companies support concrete disclosures the effectiveness of their actions to promote achievement of the SDGs (van Zanten, & van Tulder, 2021b). Accordingly, the quality of disclosure of SDG 13 requires two fundamental components: (i) Qualitative information and (ii) Quantitative information. The first component has to do with that information that establishes the description of concrete actions related to mitigation and adaptation to climate change. For example, governance and risk (general risk management processes, physical risks that may affect the business, transition risks to move to a lower carbon emissions economy). Short-, medium-, and long-term goals that have a consistent time scope, incorporating carbon footprint reduction and compensation objectives (Cadez & Czerny, 2015; Damert, Paul, & Baumgartner, 2017; KPMG, 2022; Radu, Caron, & Arroyo, 2020). The second component is related to the GHG report. This information interconnects the management of direct, indirect and other types of emissions (scope 1,2,3). Therefore, the company will have to measure its carbon footprint and clearly report figures that support the level of emissions derived from its industrial activities and the real GHG offsets (Carbon Solutions Global, 2020; WRI and WBCSD, 2010). In other words, the first disclosure component is relevant to argue the climate strategy and its connection with the company's environmental and global strategy. However, the second disclosure component establishes a direct connection with the strategy described by the company and its quantitative informative characteristics establish possible gaps in legitimacy and greenwashing and SDG-washing practices. In this regard, we pose the following research questions:

RQ1. Do Colombian companies disclose quantitative and qualitative information related to SDG 13?

RQ2. What is the quality level of qualitative and quantitative disclosures related to SDG 13 in Colombian companies?

2.3.2. Contextual characteristics of companies and SDG13 disclosure quality.

In emerging economies, the disclosure of GHG emissions requires a deep understanding. This is due to the characteristics of the context and the limitations of regulatory regimes in relation to environmental performance that hold companies responsible (Baboukardos, Beddewela, & Soobaroyen, 2021; Wedari, Jubb, & Moradi-Motlagh, 2021). Consequently, studies related to carbon management have incorporated detailed analyses by region and by industry sector to determine the implications of efficiency in the management of emissions by companies and governments (Bai, Zhang, Wang, Huang, & Xu, 2014; Li, Wei, Zhang, & Tao, 2020) mainly in those regions with high levels of GHG emissions (IPCC, 2019). From this perspective, analyzing business behavior for each of the territories allows establishing the connection of territorial governments in terms of climate change with the productive sector. This analysis is relevant because it can affect the quality of the public information presented by national and territorial governments to justify the progress of their climate policies and their legitimacy management from political power (Buchanan, 2002; Pitrakkos & Maroun, 2019). On the other hand, worldwide corporate reports present significant differences in relation to the SDGs (PwC, 2019). Therefore, it is of the utmost importance to establish whether the behavior of the territories differs according to the economic and industrial characteristics (Lange Salvia, et al., 2019) or if there is any pressure from regional governments to promote better business results in relation to the government agenda.

Climate change requires a global effort since its effects are not limited to most polluting countries, but it affects the most vulnerable regions (WRI, 2022). This means that climate

change does not exclude any country, therefore, this issue needs to be managed by means of joint and coordinated work leading to interdependence among countries worldwide. Interdependence is then understood as "a harsh reality on which the survival of the human species depends" (Barber, 2004). In accordance with this approach, preparing territorial and sectoral analyses lead to understanding problems and possible responses or solutions that impact climate change at a global level. From this perspective, (Gao, Yue and Chen, 2021; Okereke and Russel, 2010) analyze the behavior of industrial sectors to determine the effects of their activities and the commitments that companies, with the highest level of pollution, must assume. This sectoral segmentation makes it possible to establish whether, in effect, the SDGs have been a sustainability transition guide for companies or if, on the contrary, the industrial sectors have been separated from commitment to sustainability and, with a chameleon-like attitude, have presented actions that do not contribute substantially with achieving the 2030 goals (Johnsson, et al., 2020).

The disclosure quality about climate actions has been explored from different perspectives. One of the factors analyzed worldwide corresponds to the contribution made by the regions to mitigate and reduce GHG emissions. For example, Mia, Hazelton, & Guthrie, (2019) explore the quality of GHG disclosures by cities through the Carbon Disclosure Project (CDP) and compare them with user expectations. Their results highlight that "GHG information at the city level is outdated, incomplete, inconsistent, inaccurate and incomparable." Additionally, they mention that “public sector organizations are no better than the private sector in providing information on sustainability” (p.706). Also, Zhang, et al., (2019) carry out studies focused on the regions to interpret the changes derived from migration from rural to urban areas. Also, they focus on policies for the efficiency of resources and the management of GHG emissions in megacities from the perspective of SDG 13., and their interaction with resources such as water SDG 6 and SDG 11 to promote the planning of sustainable cities and communities. De Neve & Sachs, (2020) investigate the SDGs and human well-being from a regional difference perspective. Their study

discusses strong negative correlations with SDG 13 and suggest more academic and political attention to avoid ecological collapse.

From a political view, and in response to the different problems underlying climate change, some regions have come together in the C40, a network of mayors from almost 100 leading cities in the world who collaborate to provide the urgent action that is needed at this time to face the climate crisis" and propose to halve the emissions of their cities within a decade (C40, 2022). To meet these goals, regional leaders must adjust their policies and generate greater pressure on the corporate sector, mainly in industries with environmentally sensitive activities and in territories with higher levels of pollution (Bai, et al., 2014; IPCC, 2019; Li, et al., 2020). These regional initiatives also impact the development of the carbon strategy in the companies and in this case the managers or business leaders must adjust their strategy according to the new expectations of climate progress in the region to respond to the pressures of the stakeholders (Hoffmann & Weinhofer, 2010). Also, companies located in sectors that are environmentally sensitive to GHG emissions are exposed to greater scrutiny (Lindblom, 1994). Several studies have indicated that sensitive industries are positively associated with a higher level of GHG disclosure in order to improve their visibility, credibility and consistency (Faisal, et al., 2018; Patten, 2002; Rankin, Windsor, & Wahyuni, 2011).

The contextual elements such as the region (geographical location of the company) and the business sector in which the company operates are essential to establish possible gaps in the quality of disclosure. In this regard, we formulate the following research questions:

RQ3. What is the level of disclosure related to SDG13 in environmentally sensitive regions and industries?

RQ4. Does the disclosure quality of qualitative and quantitative information on SDG 13 depend on the region or environmentally sensitive sectors?

2.4. Research Design.

This study is developed by means of a qualitative analysis based on the sustainability reports of Colombian companies. In the first place, we focus on the disclosure that companies make in relation to their SDG 13 climate action in their non-financial reports. SDG 13 establishes as a priority to take urgent action to combat climate change and its impacts. We mainly focus on target 13.2, which establishes the incorporation of measures related to climate change policies, strategies, and plans. Secondly, we designed two indexes called SDG 13- qualitative and SDG13- quantitative to determine the quality of disclosure about this objective that includes information related to adaptation strategies to climate change (qualitative information) and includes information related to greenhouse gas emissions (quantitative information). Third, we incorporate a regional analysis to identify differences in business disclosure between territories and a sectoral analysis to contextualize the results obtained, as explained below.

2.4.1. Data sources and sample selection.

The sample comprises Colombian companies listed 2019. This study period is selected because it is considered a year of relevant analysis after the second phase of implementation of the Colombian low-carbon development strategy (ECDBC) which began in 2018 and the issuance of the climate change law (1931-2018 law). Additionally, it is a period that is not altered by relevant issues such as those generated in 2020 by the pandemic (COVID-19). The sample includes a total of 70 companies excluding the financial sector. Ten companies that did not issue a sustainability report are excluded from the sample. The data was first obtained from the GRI database reports and from the companies' websites to build the information related to the disclosure of SDG 13 in Colombian companies. The regions subject to analysis are distributed according to the 2014-2018 national development plan based on the following groups: (i) characteristics of the territory in terms of social welfare, (ii) system of cities and the differentiation of degrees

of rurality, (iii) regional characterization of the dynamics and incidence of the armed conflict and (iv) strategic environmental zones of the country (Departamento Nacional de Planeación, 2015). Table 5 shows the statistics of the companies by business sector according to the Bureau van Dijk (BvD) classification.

Table 5. Distribution of the sample by business sector

Name Industry	Freq	Percent
Agriculture, Horticulture & Livestock	7	11.67
Business Services	1	1.67
Cement, Leather, Stone, Clay & Glass.	3	5.00
Chemicals, Petroleum, Rubber & Plastic	4	6.67
Communications	2	3.33
Construction	3	5.00
*Electrical energy	10	16.67
Food	5	8.33
Leather, Stone, Clay & Glass products	1	1.67
Media & Broadcasting	2	3.33
Metals & Metal Products	2	3.33
*Mining & Extraction	3	5.00
*Natural gas	6	10.00
Printing & Publishing	1	1.67
Retail	2	3.33
Textiles & Clothing Manufacturing	3	5.00
Transport, Freight & Storage	1	1.67
Waste Management & Treatment	1	1.67
Wood, Furniture & Paper Manufacturing	3	5.00
Total	60	100.00

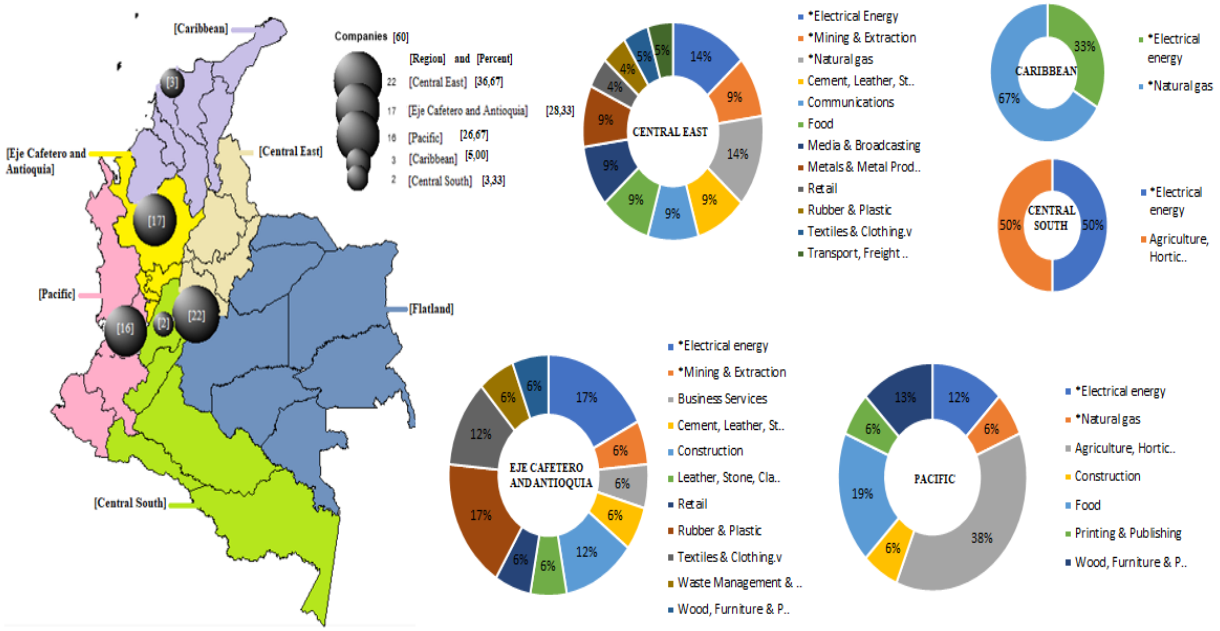
* *Sensitive Industry*

The classification of a sensitive sector is carried out taking carbon-intensive companies and the environmental impact and emissions with high levels of contamination as a reference; electric power, mining and extraction, natural gas (Kolk & Pinkse, 2004; Okereke & Russel, 2010). Also, these industrial sectors are considered in the guidelines of the Colombian carbon tax law and in the Colombian low-carbon development strategy as relevant sectors to avoid the growth of GHG emissions.

According to map 2, the listed companies are distributed in the Colombian regions as follows: (i) Central East, which holds 36.67% of the companies in the sample. This large participation is due to the fact that the companies have their headquarters in the capital city

of Bogotá. These Business activities correspond mainly to: electrical energy 14%, natural gas 14%, mining & extraction 9%, cement & leather 9%, communications 9%, food 9%, media & broadcasting 9%, metals & metal products 9%, retail 4%, rubber & plastic 4%, textiles & clothing 5%, transport & freight 5%. The second region with the highest participation of companies corresponds to Eje Cafetero and Antioquia with 28.33%. The main activities correspond to: electrical energy 17%, mining & extraction 6%, business services 6%, cement, leather 6%, construction 12%, leather, stone 6%, retail 6%, rubber & plastic 17%, textiles & clothing 12%, waste management 6%, wood, furniture 6%. The third region with the highest predominance of companies corresponds to the Pacific region with 26.67% and holds the following activities: agriculture and horticulture 38%, constructions 6%, electrical energy 12%, food 19%, natural gas 6%, printing & publishing 6%, wood and furniture 13%.

Map 2. Distribution of companies by region and industrial sectors.



Source: Own elaboration using (Philcarto, 2021)

2.4.2. SDG 13 Index

In accordance with the purpose of this study, the SDG 13 Index is developed in three phases (Bardin, 2002): Phase (I) Organization and selection of the information compiled from the sustainability reports of Colombian companies through two analytical categories: (i) the company presents qualitative information on its actions to mitigate and adapt to climate change in its policies, strategies and plans and (ii) the company presents quantitative information on its measurement of carbon footprint mitigation actions and compensation of emissions derived from its operations. To specify these analytical categories, two indices are developed (i) SDG13 index - qualitative information, (ii) SDG13 index - quantitative information. Phase (II) Categorization of sustainability reports: The codification of information was carried out manually taking into account the analytical categories identified in Phase 1. For the SDG13 index - qualitative information, four elements are considered: (1) Mitigation actions and adaptation to climate change, (2) Emission reduction goals (3) Governance and risk management mechanisms. This includes information related to general risk management processes, physical risks that may affect the business (such as possible droughts, fires, floods, among others) and, transition risks to move to a lower carbon economy. (4) Emission compensation mechanisms. (Cadez & Czerny, 2015; Damert, Paul, & Baumgartner, 2017; KPMG, 2022; Radu, Caron, & Arroyo, 2020). (see Table 6). To categorize the SDG13-quantitative index, we incorporated information on the scope of emissions through the Reporting and Corporate Accounting Standard of the GHG Protocol (WRI and WBCSD, 2010). The scopes are defined as follows: Scope 1- Disclosure of Direct Emissions which are directly controlled by the company (e.g., emissions associated with fuel combustion in boilers, furnaces, and vehicles). Scope 2 - Disclosure of Indirect Emissions: generated by electric power production plants as a result of the company's own consumption. Scope 3 - Disclosure of other emissions: these are activities that occur in sources that are not owned by the company and that are not directly controlled. Quantitative information related to emissions compensation is also included in the categorization (see Table 7). The index score is established by consolidating the presence or absence of each of the index elements (each

element score is equivalent to 0.25 and they are cumulative, so each SDG 13 Index ranges between 0 and 1). The quality ratings of the indices are consolidated from the following scales (0 = Null, 0.25 = Insufficient, 0.5 = Acceptable, 0.75 = Good, 1 = Outstanding). Phase (III) Analysis: the research team discusses the results; two researchers audited the results produced by one member of the team.

Table 6. SDG 13 Index- qualitative information

Analytical category	Elements	Score
Qualitative Information	Climate change mitigation and adaptation actions	0,25
	Emission reduction goals	0,25
	Governance and risk management mechanisms	0,25
	Emission compensation mechanisms	0,25

Table 7. SDG 13 index- quantitative information

Analytical category	Elements	Score
Quantitative information	- Scope 1 – Direct Emissions	0,25
	- Scope 2 – Indirect emissions	0,25
	- Scope 3 – Other Emissions	0,25
	- Emission compensation data	0,25

2.5. Results

First, the results present the companies´ disclosure in relation to their SDG 13 climate action in their non-financial reports. Secondly, we present the results on the disclosure quality of the business sector based on two indexes called: SDG 13-qualitative and SDG13-quantitative. They are compared to show the information gaps related to climate change. Thirdly, the results shown above discuss the analysis of the regional and sectoral context to establish Colombian businesses´ quality and disclosure level in relation to SDG13.

2.5.1. Level and disclosure quality of SDG 13

2.5.1.1. SDG 13 disclosure

Phases I and II of this study show our first findings. In the search for the analytical categories, these were scattered throughout the sustainability reports. This may be the direct effect of the multiple interactions of SDG 13 with other SDGs. However, this segmented information throughout the sustainability report leads to SDG 13 being mentioned without sufficient clarity about business actions and strategies for climate change. We found that some companies located in the same industrial sector present their GHG indicators similarly. This can be derived from the materiality characteristics of the industry sector and the use of standards, initiatives and certifications that require accurate information that fits the needs of the report (Table 8). Comyns (2016) establishes that "companies which adopt voluntary guidelines or codes of conduct are likely to adopt similar reporting practices mimicking those of peer firms who adopt the same standards" (p. 354). One of our findings indicates that the dominant standard in the companies analyzed is the GRI (Global Reporting Initiative). This result is associated with the fact that Colombia is one of the countries chosen by GRI in Latin America to become part of the Competitive Business Program and focus on global initiatives to take advantage of the countries of the region (Pacto Global Red Colombia, 2019). Nonetheless, due to the requirements of the certifiers and the use of standards, the voluntary disclosure of information continues to be very heterogeneous, and this limits the analysis.

Moreover, in accordance with our research question, *RQ1. Do Colombian companies disclose quantitative and qualitative information related to SDG 13?* Our findings reveal that 40% of the companies analyzed do not include or report on SDG 13 in their sustainability reports. 60% report on their climate action. This percentage difference directly reveals the implications of not establishing a regulatory framework in relation to non-financial information and the regulation of GHG emissions. This suggests that, in the Colombian case, there is little regard with SDG 13 at the corporate level. Likewise, the results

presented below are key to inquiring about the quality of disclosure and the corporate sector impacts on the decarbonization process in Colombia. Also, they are associated with the research question *RQ2. What is the quality level of qualitative and quantitative disclosure of SDG 13 in Colombian companies?*

Table 8. Voluntary information reporting by standards used

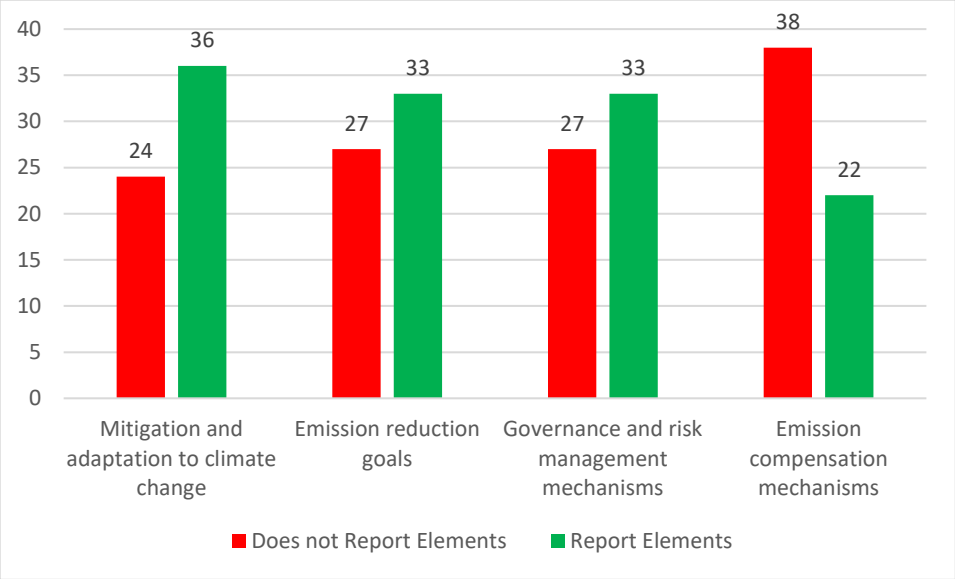
Name Industry	Total	Companies reporting GHG emissions		Standards / Initiatives / Certifications								
	Companies	Companies	Percentage	Global Reporting Initiative	SASB	GREEN-DU.SE GAS PROTOCO	Dow Jones Sustainability Index		ipcc	CDP	IPIECA	ISO 14064
Agriculture, Horticulture & Livestock	7	1	14%	●								
Cement, Leather, Stone, Clay & Glass	3	2	67%	●			●					
Chemicals, Petroleum, Rubber & Plastic	4	1	25%	●								
Communications	2	2	100%	●		●		●				
Construction	3	1	33%	●								
Electrical energy	10	6	60%	●	●	●						●
Food	5	4	80%	●	●					●		
Mining & Extraction	3	3	100%	●	●			●			●	●
Natural gas	6	5	83%	●			●	●				
Retail	2	2	100%	●		●			●			●
Transport, Freight & Storage	1	1	100%						●			●
Wood, Furniture & Paper Manufacturing	3	2	67%	●								
Total Companies	**60**	**30**										

Source: Own elaboration

2.5.1.2. Qualitative Disclosure Quality SDG 13

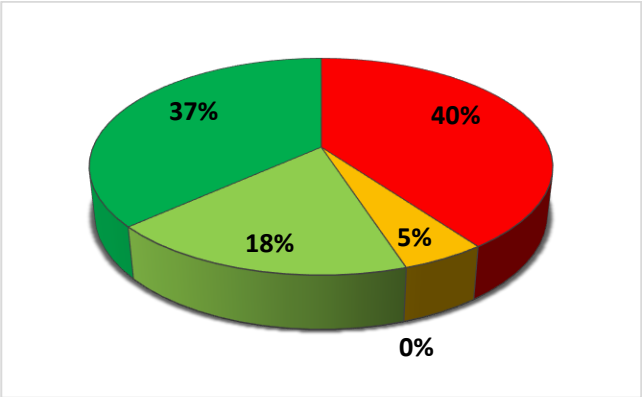
Qualitative information presents relevant disclosure features in which companies describe their actions related to climate change. In this regard, we find that companies focus on actions related to mitigation and adaptation to climate change (60% - 36 companies). Secondly, two elements are reported with the same degree of participation (55% - 33 companies). This corresponds to emission reduction goals and governance and risk management mechanisms. The element with the least disclosure corresponds to specific actions to offset emissions (37% - 22 companies). (See graphic 1).

Graphic 1. Elements SDG 13 - Qualitative



According to the composition of these elements, the qualitative disclosure index "Index SDG13- qualitative" is established (see graphic 2) with the following findings: 37% of the companies have a disclosure quality index with a level outstanding. 18% of the companies present a good disclosure quality level. 5% of the companies present insufficient information and 40% of the companies do not disclose information. This indicates that the assessment items are satisfactory, and companies respond to this analytical category to report their climate strategy. In this category, we do not find a progressive behavior. It goes from null disclosure level (40% of the companies) to a good or excellent disclosure level (55%). Only 5% report an acceptable disclosure level. In other words, Colombian companies that report qualitative information include descriptive and symbolic information to inform about their "responsible climate" actions.

Graphic 2. SDG 13 – Index Qualitative

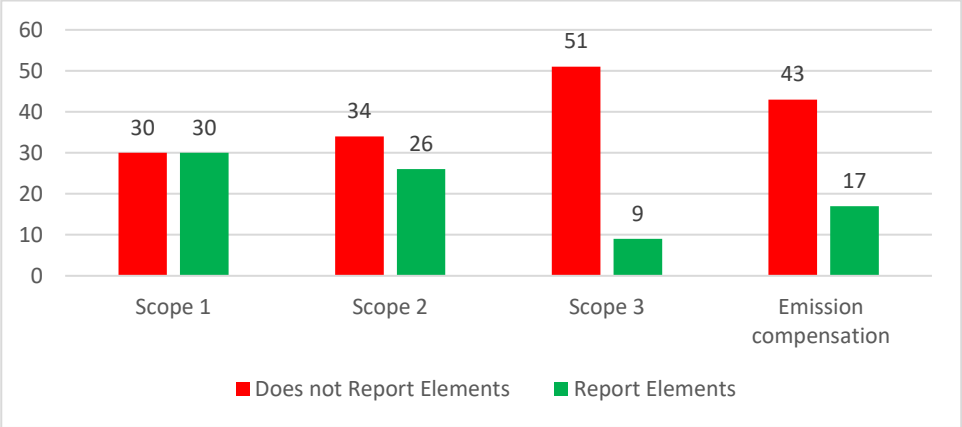


Null	Insufficient	Acceptable	Good	Outstanding
0	0,25	0,5	0,75	1
40%	5%	0%	18%	37%

2.5.1.3. Quantitative disclosure quality SDG 13.

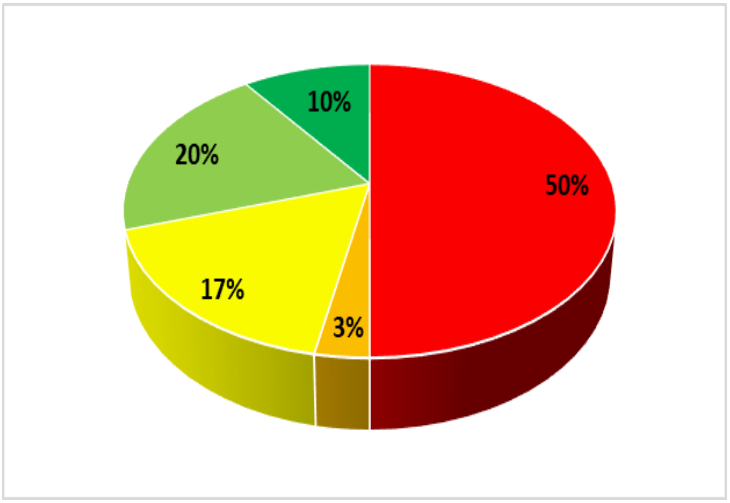
The quantitative information is obtained from the data registered by the companies through scopes 1, 2 and 3 and the emission compensation data. These data support the real commitments of adaptation, reduction, and compensation to fight climate change. Respectively, we have found that scope 1 is the element that is most disclosed 50% (30 companies). Scope 2 presents a disclosure of 43% (26 companies) and scope 3 is the least disclosed 15% (9 companies). Additionally, the carbon footprint compensation report is only mentioned by 17 companies (28%). (See graphic 3)

Graphic 3. Elements SDG 13 – Index Quantitative



According to the composition of these elements, the quantitative disclosure index "Index SDG13-quantitative" is established (see graphic 4). In this index show the following findings: Only 10% of companies have an outstanding disclosure quality level. 20% of the companies present a good level of disclosure quality. 17% of the companies present an acceptable disclosure level. Mainly, in this category the companies disclose only scopes 1 and 2. Lastly, 3% of the companies present an insufficient disclosure level and 50% have a null disclosure level.

Graphic 4. SDG 13 – Index Quantitative



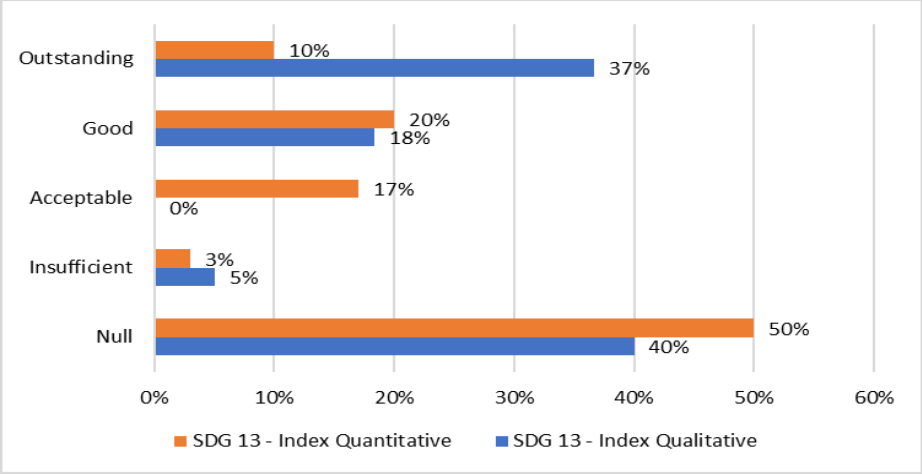
Null	Insufficient	Acceptable	Good	Outstanding
0	0,25	0,5	0,75	1
50%	3%	17%	20%	10%

This second disclosure quality component reveals a heterogeneous disclosure level in the quality categories. Its low percentage participation in the high categories of the index reveals a low connection with the qualitative strategies set by companies. This can be interpreted as a significant gap in quality between the discourse and the actual contribution to measuring, reducing, and offsetting the carbon footprint.

2.5.1.4. Analysis and comparison of SDG 13 indexes.

According to the quality level of the qualitative and quantitative SDG 13 indexes, we can observe a gap between the quality of disclosure of qualitative and quantitative information. Graphic 5 establishes that the sustainability reports of Colombian companies reflect a higher quality of qualitative than quantitative disclosure in actions related to climate change. When we analyze the higher levels of quality, only 37% of the companies reveal qualitative quality information, but only 10% present quantitative quality information. This result indicates that the measurement of the carbon footprint and the control of its effects requires greater control by business managers. The findings suggest that companies measure scope 1 and scope 2 but scope 3 does not have the same impact. This phenomenon is not exclusive to Colombian companies, it has been shown worldwide that scope 3 emissions are not measured satisfactorily, and this implies "distorting a company's GHG estimates, since scope 3 emissions often they constitute an important part of their overall GHG footprint" (Downie & Stubbs, 2013, p. 157). Emission offsets also present very limited information. The companies do not quantitatively express specific compensation data, and this does not allow confirming the actions revealed at a qualitative level.

Graphic 5. Comparison of SDG 13 indexes



These comparative results reflect that Colombian companies require a greater commitment to climate change. The results show that the reports are presented with descriptive or symbolic rather than substantive disclosure categories and this would be associated with possible practices of greenwashing and SDG-washing (Lyon & Maxwell, 2011; van Zanten, & van Tulder, 2021b). This selective disclosure, and with greater emphasis on qualitative aspects, has as a relevant factor the company's need to report on its climate strategy as a mechanism to safeguard its legitimacy (Deegan, 2002). Also, it reveals that business strategies related to climate change and carbon management in some companies are not designed with short, medium, and long-term goals (Johnsson, et al., 2020). Mainly, because measuring the carbon footprint sets quantitative and actual goals to mitigate climate change.

2.5.2. Disclosure quality level analysis based on the contextual characteristics of the company

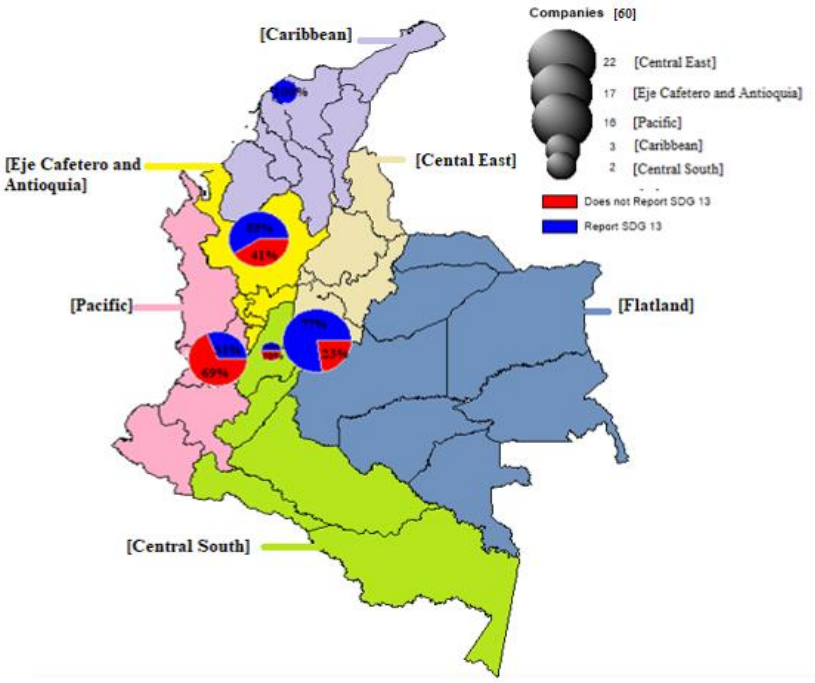
This section presents the RQ3 research questions. *What is the disclosure level related to SDG13 in environmentally sensitive regions and industries?* and RQ4. *Does the quality of disclosure of qualitative and quantitative information on SDG 13 depend on the region or environmentally sensitive sectors?*

2.5.2.1. Regional Analysis

2.5.2.1.1. Regional disclosure of SDG 13

The regions show a heterogeneous behavior in the disclosure of their climate actions. Map 3 shows that one of the regions with the highest disclosure of companies in relation to SDG 13 is the Central East region with a 77% share. In the Eje Cafetero region and Antioquia, 59% of the companies disclose information on SDG 13. In the Pacific region, only 31% of their companies report SDG 13-related information.

Map 3 Disclosure behavior of SDG 13 at the regional level



Region	Does not report SDG 13	Report SDG 13	Total Companies
Caribbean	0	3	3
Central South	1	1	2
Central East	5	17	22
Eje Cafetero And Antioquia	7	10	17
Pacific	11	5	16
Total	24	36	60
%	40%	60%	100%

Source: Own elaboration using (Philcarto, 2021)

This regional difference is also associated with the social, economic, and environmental interactions of the region´s government and its progress in the development of plans focused on climate change. As to the Central East region, progress has been made related to the Integral Regional Plan for Climate Change of Bogotá - Cundinamarca (PRICC - acronym in Spanish in the Colombian context-), which is "one of the global pilot models promoted by the United Nations to strengthen the capacity of regional governments to build resilient territories that face the challenges of climate change" (IDEAM, 2020). In Eje Cafetero and Antioquia, actions are being taken by means of PAC (Climate Action Plan 2020-2050) which is the result of regional initiatives promoted by the "Department of

Antioquia, the Metropolitan Area of the Valle de Aburrá - AMVA and the Regional Autonomous Corporation of the Center of Antioquia - CORANTIOQUIA through the Antioquia Integral Climate Change Plan (PICCA), the Climate Change and Variability Action Plan (PAC&VC) and the Regional Climate Change Plan (PRCC)" (Alcaldía de Medellín, 2022). In the Pacific region, the Integral Climate Change Management Plan (PIGCC) 2019-2040 mainly mentions the development of green businesses and cleaner production in the livestock and agricultural sectors (Gobernación Valle del Cauca, 2020).

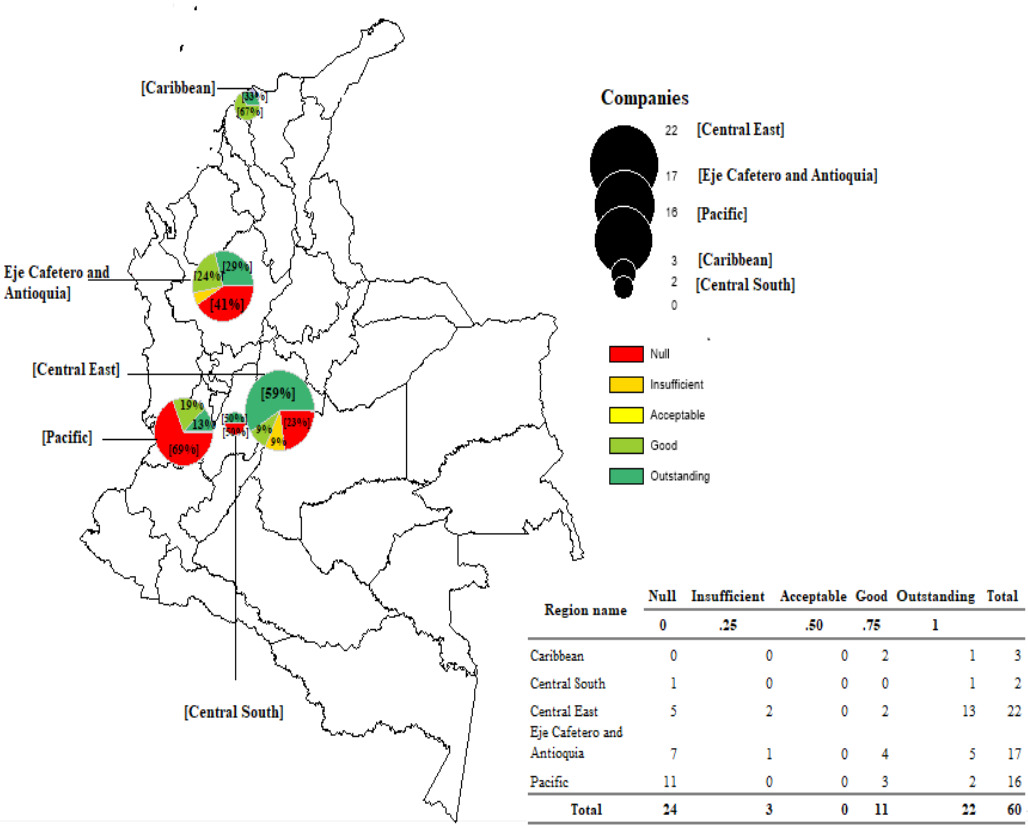
These government actions create direct dialogue with companies. However, the regional context is much more complex for those territories with hostile characteristics. Particularly, the backwardness of the Pacific region in terms of disclosure related to climate actions can have different meanings: (i) in economic terms: it is one of the territories with the highest rate of multidimensional poverty. Almost the entire population lacks access to education, health, social security, housing (González, et al., 2018). These characteristics of the territory interfere directly in the dynamics of social control over companies, and thus, there is a limited response by companies to their closest stakeholders (racial or indigenous communities), (ii) the main industries located in this region are of an agricultural nature. Although this economic sector is prioritized in the region's climate plan, the results show that the implementation of these sectoral and regional policies are still incipient, (iii) the lack of regulation at the national level for GHG emissions also leads to a lack of interest in disclosing actions related to climate change by companies. Mainly, in those regions that, due to their context, territorial stakeholders do not present immediate demands to companies.

2.5.2.1.2. Regional disclosure quality of SDG 13

The quality of qualitative disclosure with outstanding rating is observed with greater preponderance in the Central East regions (59%) and the Eje Cafetero and Antioquia region (29%) as shown in map 4. The quality of disclosure with outstanding rating in quantitative

terms for these regions it only represents 14% for Central East and 6% for Eje Cafetero and Antioquia (see map 5). The Central East region presents a percentage of 32% in the good disclosure category which places this region with better levels of information quality compared to other regions. The Pacific region shows poor quality performance in qualitative and quantitative disclosure.

Map 4. SDG13- Index qualitative

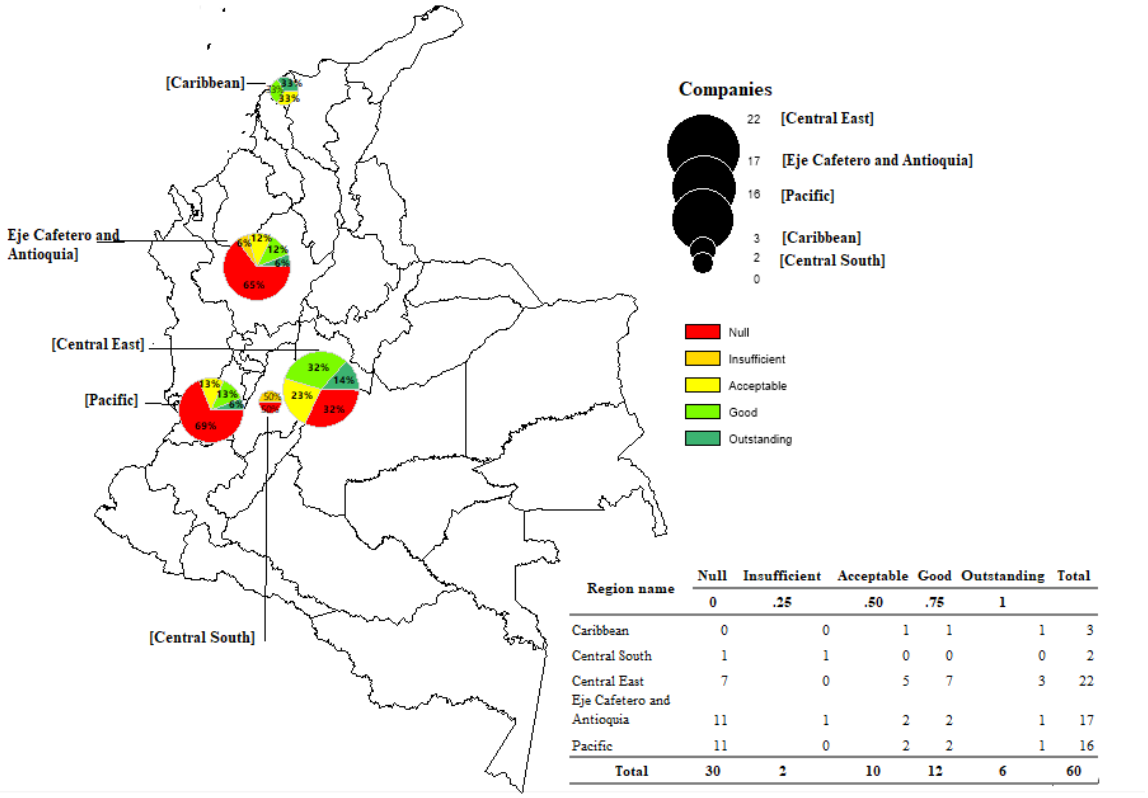


Region name	Null	Insufficient	Acceptable	Good	Outstanding	Total
	0	.25	.50	.75	1	
Caribbean	0	0	0	2	1	3
Central South	1	0	0	0	1	2
Central East	5	2	0	2	13	22
Eje Cafetero and Antioquia	7	1	0	4	5	17
Pacific	11	0	0	3	2	16
Total	**24**	**3**	**0**	**11**	**22**	**60**

The comparison of the qualitative and quantitative SDG indexes in the regions establishes that business commitment is still incipient. The Null category is obviously high in all the regions, and this implies deepening the processes of interdependence with the territories as well as managing key policies that promptly interconnect connect the business sectors. Also, a wide quality gap is observed in the different regions. This gap may be associated with the degree of regional development and the pressure exerted by the governments of the main cities in the regions. In the case of the Central East region, the companies are

located in the Colombian capital (Bogotá). Since 2006, this city that has been part of the C40 (a global network of mayors taking urgent action to confront the climate crisis). Also, the representative (mayor) of the city is part of the C40 board of directors and this may involve rapid improvement in public policy to guarantee that the commitments agreed in the agenda of mayors worldwide to face the climate crisis are fulfilled. Also, this region is included to the comprehensive regional plan which is supported by the United Nations so that governments face and mitigate climate change (OAB, 2022). These initiatives can explain, to a certain extent, that in this region the quality of dissemination is improved. However, from a business perspective, many efforts are required to improve actions to mitigate and adapt to climate change.

Map 5. SDG13- Index quantitative



Region name	Null	Insufficient	Acceptable	Good	Outstanding	Total
	0	.25	.50	.75	1	
Caribbean	0	0	1	1	1	3
Central South	1	1	0	0	0	2
Central East	7	0	5	7	3	22
Eje Cafetero and Antioquia	11	1	2	2	1	17
Pacific	11	0	2	2	1	16
Total	**30**	**2**	**10**	**12**	**6**	**60**

The region with the greatest qualitative and quantitative disclosure gap corresponds to the Eje Cafetero and Antioquia in which the outstanding disclosure level goes from 29% of

qualitative information to 6% of quantitative information. This information gap is representative and raises questions about a conduct of "selective disclosure" or greenwashing, in which companies present qualitative information to give a sense of environmental responsibility with deliberate techniques of information opacity and in this way "minimize the impact of unmeasured emissions" (Bowen & Aragon-Correa, 2014; Luo, Zhang, & Zhang, 2021; Talbot & Boiral, 2018). Additionally, the low level of quantitative information confirms a behavior of SDG- washing by showing that what is reported is greater than what companies actually achieve in relation to climate change (Heras-Saizarbitoria, Urbieta, & Boiral, 2022).

2.5.2.2. Sectorial analysis

2.5.2.2.1. Sector disclosure level of SDG 13

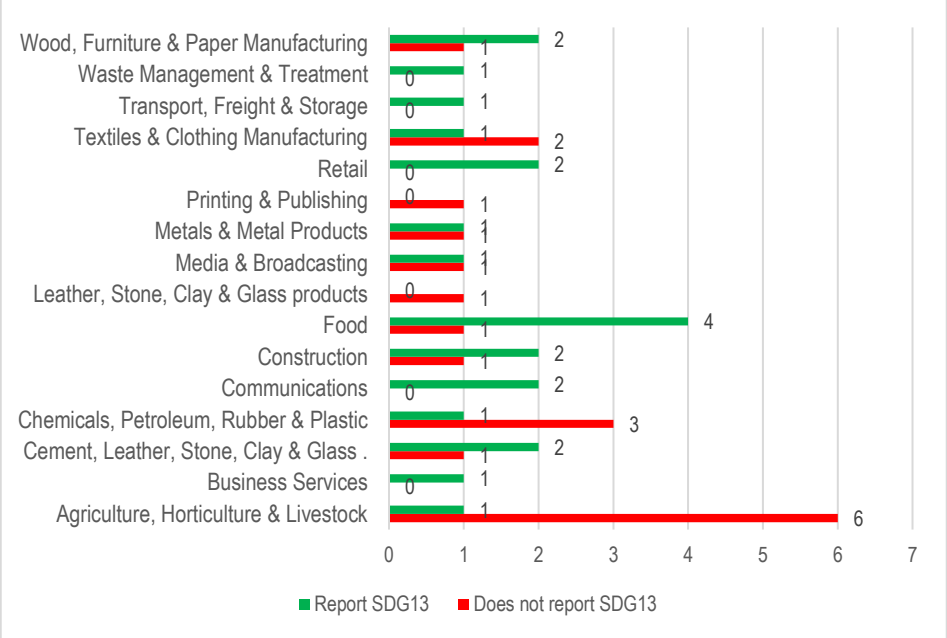
The companies with the highest degree of disclosure are in sensitive sectors. 60% of companies in the energy sector disclose SDG 13 in their sustainable reports. This disclosure response may be related to the fact that a large part of the companies located in this sector have joined the carbon-neutral electricity sector alliance and it is directed by a technical committee of the Ministry of Mines and Energy. This committee establishes strategic goals to achieve carbon neutrality in the year 2050 (Minenergia, 2021). 83% of the gas companies and 100% of the companies located in the mining activity report SDG 13. In the case of other industries, 58% of these companies disclose information about SDG 13 (see Table 9). In this last category, one of the sectors that stands out for its disclosure level is the food sector. The agricultural sector is the one with the lowest disclosure (see graph 6). It is important to note that this sector has the responsibility of providing food security to the world, but it also consumes large resources and degrades habitats with the use of pesticides that pollute rivers and oceans (van Zanten & van Tulder, 2021b). Globally, the agricultural sector generates between 19% and 29% of total emissions (GHG) that can increase substantially if climate-smart agriculture mechanisms are not used (World Bank Group, 2021).

Table 9. Disclosure behavior of SDG 13 at the sectoral level

Name Industry	Does not report SDG13	%	Report SDG13	%	Total Companies
*Electrical energy	4	40%	6	60%	10
*Mining & Extraction	0	0%	3	100%	3
*Natural gas	1	17%	5	83%	6
Non-sensitive sectors	19	50%	22	58%	38
Total	**24**	**40%**	**36**	**60%**	**60**

**Sensitive sector*

Graphic 6. Disclosure behavior of SDG 13 at the Non-sensitive sectors

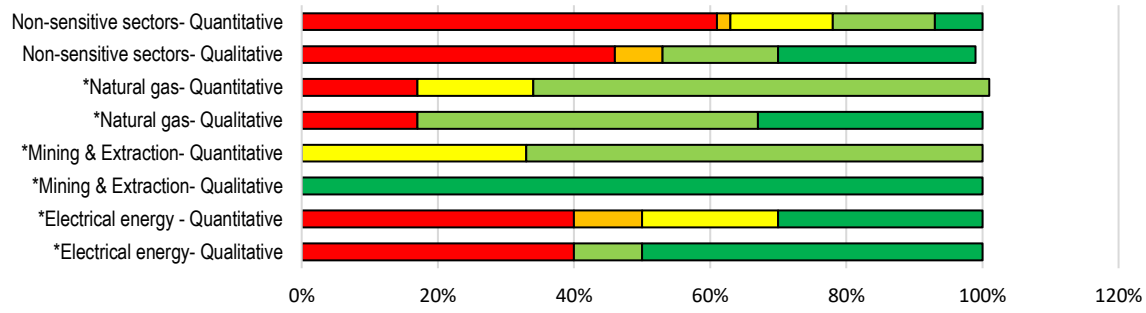


2.5.2.2.2. Sector disclosure quality of SDG 13

We find that companies located in environmentally sensitive sectors (Electrical energy, Mining & Extraction, Natural gas) tend to disclose with higher quality than companies in non-sensitive sectors. Graph (7) shows comparative data of the qualitative and quantitative SDG13 index. At the outstanding disclosure level, we find that for the electrical energy

sector goes from 50% qualitative quality to 30% quantitative quality. In the mining & extraction sector, there is a shift from 100% qualitative quality to 0% quantitative quality. For the natural gas sector, from 33% qualitative quality to 0% quantitative quality. For non-sensitive industries from 29% qualitative quality to 7% quantitative quality. These results are convincing in underscoring mostly symbolic disclosure practices that do not clarify the real contribution of sectors with emission reduction, mitigation, and compensation figures.

Graphic 7. Comparative index ODS 13 qualitative vs quantitative by business sector



	*Electrical energy- Qualitative	*Electrical energy - Quantitative	*Mining & Extraction- Qualitative	*Mining & Extraction- Quantitative	*Natural gas- Qualitative	*Natural gas- Quantitative	Non-sensitive sectors- Qualitative	Non-sensitive sectors- Quantitative
Null	40%	40%	0%	0%	17%	17%	46%	61%
Insufficient	0%	10%	0%	0%	0%	0%	7%	2%
Acceptable	0%	20%	0%	33%	0%	17%	0%	15%
Good	10%	0%	0%	67%	50%	67%	17%	15%
Outstanding	50%	30%	100%	0%	33%	0%	29%	7%

These findings indicate the need for greater efforts to promptly stimulate the participation of all industrial sectors to contribute to the national climate change strategy. Recently, the Ministry of the Environment in Colombia has supported companies regarding the carbon footprint calculation and management (Ministerio de Medio Ambiente y Desarrollo Sostenible, 2022). It is necessary that these processes are reflected through a real commitment of the business sector and that this promptly impact national and global indicators to verify that the efforts and strategies are functional to combat the risks derived from climate change.

2.6. Conclusions

This study was developed based on the legitimacy theory and the concept of greenwashing and SDG-washing. In our study, we analyze the disclosure of SDG 13 information in a sample of Colombian companies from the perspective of goal 13.2, which formulates the need to incorporate measures related to climate change policies, strategies, and plans. This analysis helps to relate business behavior to climate change actions. Additionally, we provide a regional and sectoral analysis. The development of the SDG 13-qualitative and SDG 13-quantitative indices represent a significant contribution to establishing the quality of disclosure and establishing gaps in symbolic information and substantive information that contributes to climate change and the achievement of SDG 13.

Colombia is characterized by being a mega-diverse country, but it is not excluded from the difficulties generated by climate change. Therefore, the analysis of the Colombian context made it possible to establish connections with the social and environmental problems that arise in the territories and how these difficulties are related to business behavior. Also, the analysis of a non-regulated territory in non-financial information and in GHG emissions showed the impact of not exercising control and management in an articulated manner from the central government with the territories to strengthen the results and commitments of the country in the framework of the agenda. 2030. Also, the lack of regulation evidenced the intention of companies to voluntarily disclose and maintain legitimacy, mainly in environmentally sensitive sectors. These sectors generally have a higher degree of scrutiny by stakeholders and, consequently, the greater the external pressure on a company, the greater the level of disclosure of information related to climate action, specifically the disclosure of GHG emissions (He, Shen, Zhang, & Ren, 2019). In this regard, our findings reflect that the highest percentage of disclosure and quality of the SDG is found in industries classified as sensitive (electricity, natural gas, and mining and extraction). Also, we found an important disclosure and quality behavior in companies in the food sector (Alpina productos alimentarios SA, Colombina SA, Grupo Nutresa SA, Riopaila Castilla SA), this disclosure and quality response in companies in the food sector, may be associated with

that these companies have a long tradition in the regions and are valued by Colombian citizens.

At the regional level, the companies located in the Central East region reflect a higher level of quality of qualitative and quantitative disclosure. The Eje Cafetero region and Antioquia present a favorable qualitative disclosure behavior, their quantitative disclosure is limited and requires further progress in carbon footprint measurement and management actions. It is also evident that the companies in the Pacific Region have a significant information lag. This region includes companies in the agricultural sector and these companies have the lowest level of disclosure on issues related to SDG 13. These companies should be immediately considered in an action plan by the territorial and central governments.

After contrasting disclosure quality results of qualitative information and quantitative information, we found that the qualitative disclosure quality was greater than quantitative behavior quality. The quality levels made it possible to demonstrate greenwashing and SDG-washing practices in Colombian companies. Mainly because the communicative action of the sustainability reports reflects an important level of symbolic actions related to climate change and, in contrast, the figures and data that support these actions do not have the expected level of quality. Principally, the quantitative information component was decisive in establishing the disconnection from the strategy described by the company. Its informative characteristics also became a resource that established the regional and sectoral gaps of Colombian companies.

The heterogeneity of the information in the sustainability reports is mainly reflected in the use of different standards, indicators, and information insurers. However, the predominant standard used by companies is the Global Reporting Initiative (GRI). Colombia is considered one of the countries in Latin America with a significant degree of development in environmental matters and management of social responsibility by companies (Pacto Global Red Colombia, 2019). However, the results in terms of climate change reflect a limited performance and these types of findings are fundamental when it comes to

understanding the business scheme and its social scope in the regions. It is necessary to establish much stronger alliances and relationships between the public and private sectors to achieve the objectives of the 2030 agenda and the decarbonization processes for the year 2050.

Colombia has established the Colombian Low Carbon Development Strategy (ECDBC -as it is its acronym in Spanish-), which objective is to facilitate and promote the conditions to guide the country towards economic development low GHG emissions. This is a short- and medium-term project that aims to meet the regional and sectoral challenges to reduce GHG emissions and achieve carbon neutrality by 2050 (Ministerio de Medio Ambiente, 2022). This global definition of the Colombian strategy, developed in a second phase starting in 2018, requires concrete results with the business sector. Our findings are conclusive and show three significant gaps for the fulfillment of this strategy:

I. Gap between the central government and the territories: The Colombian government requires governance mechanisms that allow it to strengthen its interaction with the territories through the regulation of companies, mainly those with higher pollution activities. The national government must also support regional governments with low social, economic and environmental conditions such as the Pacific Region.

II. Gap between the public and private sector: Alliances and territorial plans must be forcefully aligned with the productive sector to encourage and ensure concrete actions against climate change. Public information requires results from the carbon management strategy by the territories and the business sector.

III. Information gap of business actions: The information in the business report limits the configuration of concrete measurable actions under the use of carbon accounting. There is still a great gap regarding the management of GHG emissions. A company that does not include indicators related to the scope of its emissions

will hardly be able to generate tangible goals that allow for a transparent report when facing climate change.

Considering all the above, this research helps to provide evidence of disclosure of SDG 13 in a country with no sustainability reporting regulation and no GHG emissions regulation. From the perspective of the government and environmental monitoring entities in Colombia, this study contributes to contextualize and conjoin actions with companies more closely. In this regard, further guidance may also be required on how companies should manage and report their emissions more accurately and transparently. From a business perspective, this study guides companies in the relevant elements that they must consider in their climate strategy and finds the need to apply elements directly related to carbon accounting to strengthen and contribute to the transparency and quality of the reports. Although there is no obligation to present non-financial information, this information requires verification and assurance processes by independent professionals. From the perspective of investors, this study establishes greenwashing and SDG-Washing behaviors in the regions and in the industrial sectors. This leads to investors to make decisions and generate greater pressure on companies to disclose their environmental impacts more specifically. The limitation of this study is that it focuses only on the Colombian context and therefore the results cannot be generalized.

Lastly, this is an innovative study since this research has implications that go beyond the business field and the results should be understood as a contribution to the Colombian strategy to lead the country towards economic development low in greenhouse gas emissions and obtain carbon neutrality for the year 2050. Additionally, it is the first study that investigates the regional and sectoral behavior related to SDG 13 in Colombia. The development of the SDG 13 index broadens the business analysis criteria in relation to climate change actions. The analysis from the legitimacy theory, greenwashing and SDG-washing contributes to the contextual analysis, especially in unregulated countries such those in Latin American countries.

CAPÍTULO 3: CARBON MANAGEMENT STRATEGY QUALITY IN COLOMBIAN COMPANIES: THE INFLUENCE OF THE NATIONAL AND REGIONAL PUBLIC SECTOR AND COMPANY-INHERENT CHARACTERISTICS[7]

[7] Este documento se encuentra publicado en la revista Environment, Development and Sustainability Fecha de publicación: 18/05/2022
Rodríguez, M. C. L., Gambetta, N., & García-Benau, M. A. (2022). Carbon management strategy quality in Colombian companies: the influence of the national and regional public sector and company-inherent characteristics. *Environment, Development and Sustainability, 1*-28.
https://doi.org/10.1007/s10668-022-02404-5

3. Carbon management strategy quality in Colombian companies: the influence of the national and regional public sector and company-inherent characteristics

3.1. Introduction

Colombia is located in the north of South America, with a population of nearly 50,000,000 inhabitants within an area of 1,141,748 km² (DANE, 2020). It is a "megadiverse"[8] country characterized by its geographical[9] and climatic variety. It was selected as the host country for World Environment Day on Biodiversity for the year 2020 (United Nations, 2019). Its primary economic activities include agriculture, livestock, hunting, forestry and fishing, mining, and quarrying. Secondary activities involve manufacturing and construction industries. Tertiary activities correspond to power, gas and water generation, commerce, transport, storage, accommodation, and services (DANE, 2020). Colombia is classified as an emerging economy country as stated by the Morgan Stanley Capital emerging markets index (MSCI-EM index) (MSCI, 2020). It is included in the CIVETS (Colombia, Indonesia, Vietnam, Egypt, Turkey, and South Africa), as countries part of emerging economies with high development potential meeting the international investment rules and standards promoted by the World Bank (Guerra, 2014). In comparison to other countries at a global level (governance indicators project-WGI) its governance indicators reflect the complexity of the country. Table 10 describes its behavior in the year 2019.

Table 10. Colombian Governance indicators Project-WGI

Governance Indicators Project-WGI	*Percentile Rank 2019	**Rank by Country Colombia-2019	Total number of countries per category
Violence, Voice and Accountability	55,17	92	204

[8] Listed as one of the world's "megadiverse" countries and sustaining close to 10 per cent of the planet's biodiversity, Colombia ranks first in bird and orchid species diversity and second in plants, butterflies, freshwater fish and amphibians.

[9] The country has several areas of high biological diversity in Andean ecosystems, with a significant variety of endemic species. It also has part of the Amazon rainforest and the humid ecosystems of the Chocó biogeographical area.

Political Stability and Absence of Violence	15,71	178	211
Government Effectiveness	55,77	93	209
Regulatory Quality	66,35	71	209
Rule of Law	38,46	129	209
Control of Corruption	48,08	109	209

Source: (Worldbank Governance, 2020)

Note: *Percentile Rank (0-100) indicates rank of country among all countries in the world. 0 corresponds to lowest rank and 100 corresponds to highest rank. **Rank by Country Colombia 2019: Rank in the country list

From the environmental point of view, strong consequences have been evidenced due to climate change. The main Colombian snow-capped mountains have been melting[10] (Monterroso et al., 2018). The temperature in the Colombian Amazon land has increased up to 0.5 ° C with respect to the historical averages from the first decade of this century, thus affecting the indigenous communities that inhabit this region (Echeverri, 2009). Additionally, social and environmental conflicts in all regions, due to industrial activities that degrade the environment, violate rights and impact the applicability of rules and the regulatory role of the state (Munévar et al., 2020).

In accordance with the above, the Colombian government has established strategies to strengthen the national climate change policy for guaranteeing the commitments established in the Paris Agreement[11] as follows: (i) Colombian Strategy for Low Carbon Development (ECDBC)[12,] (ii) the National Plan for Adaptation to Climate Change (PNACC), (iii) the National Strategy REED +, (iv) Fiscal Strategy through Carbon taxation, resources destined to "finance peace and support ecosystems". (Disclousure Insight Action, 2019). Nonetheless, these carbon-taxation resources have not been fully assigned to finance and support the Peace Agreements (Territorios Sostenibles, 2021; Contraloría General de la

[10] Nevado del Ruiz Volcano (VNR), Nevado de Santa Isabel Volcano (VNSI) and Nevado del Tolima Volcano (VNT). Between 2010 and 2015, the ice cap of the volcanoes under study has receded 24%, 42% and 60% respectively. (Monterroso et al., 2018)

[11] Colombia presented its commitment to reduce emissions within the framework of the Paris agreement establishing a GHG emissions reduction goal of 20% for the year 2030 and with a possible extension of 10% considering international support (García et al., 2015).

[12] It focuses on methodologies for evaluating climate change interventions in key sectors.

República, 2021). This has largely affected their compliance, consequently, Colombia ranks first in the murder of social leaders who defend the environment (Global Witness, 2020).

Environmental regional conflicts require a set of policies and strategies to respond to territorial challenges. Colombian regions are asynchronous due to the economic and sectoral characteristics that differ from one territory to another. In accordance with the above, the 2014-2018 National Development Plan gathered six regions (Caribbean, Central-East, Central-South, Eje Cafetero and Antioquia, Pacific and the plain lands) considering geographical[13], social, economic, and cultural characteristics. This regional segmentation was elaborated through a four-dimensional methodological analysis: (i) characteristics of the territory in terms of social welfare, (ii) city system and the differentiation of degrees of rurality, (iii) regional characterization of the dynamics and incidence of the armed conflict (iv) strategic environmental zones of the country. (Departamento Nacional de Planeación, 2015).

Another important factor in the Colombian context is Law 1931 of 2018 which states the guidelines for climate change management. This law projects the development of integral plans for the management of sectoral and territorial climate change, as well as the establishment of regional nodes to implement and ensure that this policy is developed in an organized manner. Likewise, the national climate change policy establishes a relationship with the business sector to seek public-private synergy that incorporates the development of sectoral strategies for the appropriation, development and transfer of low-carbon technologies. (Ministerio de Medio Ambiente y Desarrollo Sostenible, 2017).

From the perspective of the business sector, environmental strategies and Carbon Management Strategies (CMS) must have a level of integration and connection with the global strategy of companies. This allows companies to develop business in a climate

[13] Colombia is a unitary and decentralized State, composed of 32 departments and 1,102 municipalities. Subnational governments play a fundamental role in the implementation and compliance with the SDGs in the territories (Departamento Nacional de Planeación, 2019)

change mitigation context and thus, they reduce environmental impacts and consequently reduce CO_2 emissions. The development of a CMS is based on different variables that present fluctuations around the internal and external factors in which an organization operates (Lemaire, 1997). Therefore, the management of a carbon strategy requires a conceptual, contextual and environmental development to guarantee that the leaders of organizational and governmental processes conceive and measure the importance and need to respect human and environmental rights (Den Hartog, 2015; Greenwood & Freeman, 2017; Knutti & Rogelj, 2015). Studies in other regions have caried out analyzes related to a CMS identifying characteristics of its context. Dhanda & Malik (2020) study the role of a CMS effectiveness regarding the emission disclosure behavior of firms in the United States. Yunus, et al., (2019) study the pressure from stakeholders to adopt a CMS in Australian companies. Cadez & Czerny (2010) carried out a case study of two Slovenian manufacturing companies. Okereke & Russel (2010) analyzed regulatory pressure and competitive dynamic of CMS in UK energy intensive companies. In our literature review[14], we neither find studies related to the development of a CMS in countries of emerging economies, including Latin American and Colombian regions, nor find studies that analyze the behavior of a CMS in countries with non-regulated CO_2 emissions.

Considering the research gap identified, the purpose of this study is to empirically identify the determinants that explain the CMS disclosure quality in Colombian companies' sustainability reports. This article is developed in the context of voluntary and discretionary climate change corporate disclosure. It differs from other studies since we constructed a CMS index through a theoretical framework and content analysis to identify the determinants of the disclosure quality of carbon strategies implemented and developed by Colombian companies. The index is composed of four fundamental components: (i) the

[14] The Scopus database was used. The following search algorithm was applied: "TITLE (carbon **AND** management **AND** strategy) AND (LIMIT-TO (SUBJAREA , "BUSI")**.** This search was limited to "articles" in subject area "Business, Management and Accounting". The WOS database was used too. The following search algorithm was applied: ("carbon management strategy") This search was limited to: (SOCIAL SCIENCES). We analyzed the sample of the studies to identify the region of analysis.

measurement of the carbon footprint, (ii) the internal and external reduction of emissions, (iii) the governance of carbon and (iv) the compensation mechanisms (Cadez et al., 2015; Carbon Solutions Global, 2020; Damert et al., 2017; Radu et al., 2020).

The study is developed in the context of the stakeholders theory and the legitimacy theory. It identifies explanatory variables related to two fundamental dimensions: (i) factors of the context of the company and government's actions (the implementation of a carbon tax) and the social pressures that arise for those companies doing business in sensitive industries that seek to legitimize themselves before the stakeholders and thus avoiding social censorship, and (ii) inherent characteristics of companies such as size and location. Control variables (ROA, Indebtedness, Shareholders) are used to determine, on the one hand, if profitability and leverage affect the adoption of a CMS, and on the other, if shareholders´ pressure have some influence on the governance and disclosure practices of a CMS.

This study contributes to the literature related to GHG emissions management in an emerging economy with voluntary climate change disclosures and orients Colombian organizations to determine the design and implementation of a carbon management strategy. Additionally, the results may be useful for national and regional governments to strengthen their relationships with the business sector to join efforts to address climate change. Also, this study helps companies to generate coordinated actions that contribute to improving the indicators related to climate action (SDG 13) in the 2030 Agenda.

The structure of this study is presented as follows: Section two presents the relevant literature review in which a CMS is developed and poses the research hypotheses. Section three shows the material and study method. Section four presents the results and discusses the empirical results. Section five concludes and presents policy and managerial Implications.

3.2. Literature review

The global temperature has been constantly increasing since the end of the 19th century, being 2016 one of the warmest years. Concretely, the concentration of atmospheric CO_2 has intensified since the industrial revolution by 47% (NASA Global Climate Change, 2020). The risk of these accelerated changes is reflected in the intensification of hydrological cycles, the deterioration of ecosystems and melting glaciers among other effects on humanity. This is generated by factors related to industrial activities such as deforestation, changes in land use and burning fossil fuels (IPCC, 2014). Regarding this issue, the disclosure of CO_2 emissions has become relevant amid the rise of corporate environmentalism. At this stage, theoretical, practical, and regulatory constructs have been established to meet the demands caused by the worldwide environmental crisis.

Considering this new corporate context, it is important to focus on the fact that some organizations present CO_2 reports to meet regulatory requirements, others comply with these disclosures in non-financial information due to pressure from stakeholders, and some others disclose this information by means of voluntary reporting. Consequently, these forms of dissemination are supported by an array of theoretical views; (i) sociopolitical theories of disclosure, (ii) economic theories of voluntary disclosure and (iii) institutional theory (Hahn et al., 2015).

Within this corporate environment approach, the models to follow are decisive for the future of the planet and the well-being of citizens. Therefore, establishing a measurement mechanism to control, mitigate and disclose carbon emissions by companies becomes a challenge for the global academic community, providing a setting to discuss and contrast whether the actions established with respect to global climate change have been sufficient to address the consequences and impacts generated in recent decades. However, these discussions have been restrictive and limited to three general elements: “(i) carbon footprints and legitimation strategies; (ii) carbon reporting and (iii) carbon accounting”.

(Yunus et al., 2016 p.160). This leads to new questions from different members of society with respect to demonstrating whether organizations meet the community's expectations in their social and environmental performance, within a framework of trust and respect for environmental rights.

Currently, appropriate corporate social responsibility (CSR) actions are those that are related to business ethics and care for the environment. These actions include the disclosure of emissions and carbon management strategies (Dhanda & Malik, 2020). In accordance with the above, a CMS concept grows relevant since it aligns the economic, social and environmental interests of an organization with the stakeholders demands and concerns in relation to global climate change.

3.2.1. Carbon Management Strategy- CMS

A CMS involves actions aimed at mitigating climate change through the reduction of carbon emissions (Carbon Solutions Global, 2020). Moreover, Cadez & Czerny (2015) identify three fundamental elements to prioritize this type of strategy: (i) internal carbon reduction (ii) external carbon reduction and (iii) carbon offsetting. Internal reductions are aimed at lessening combustion emissions, emission reduction process and production management. External carbon reductions emphasize actions in the supply chain through vertical and horizontal integration processes. This has the purpose of replacing inputs with high potential for emissions as an additional contribution to the internal processes of the organization. The compensation strategy is related to the payment of taxes and contributions under the carbon trading scheme with emission rights in a political framework of government negotiations.

Damert, Paul, & Baumgartner (2017) set three fundamental objectives to identify other types of carbon strategies: (i) carbon reduction, (ii) carbon governance (iii) carbon

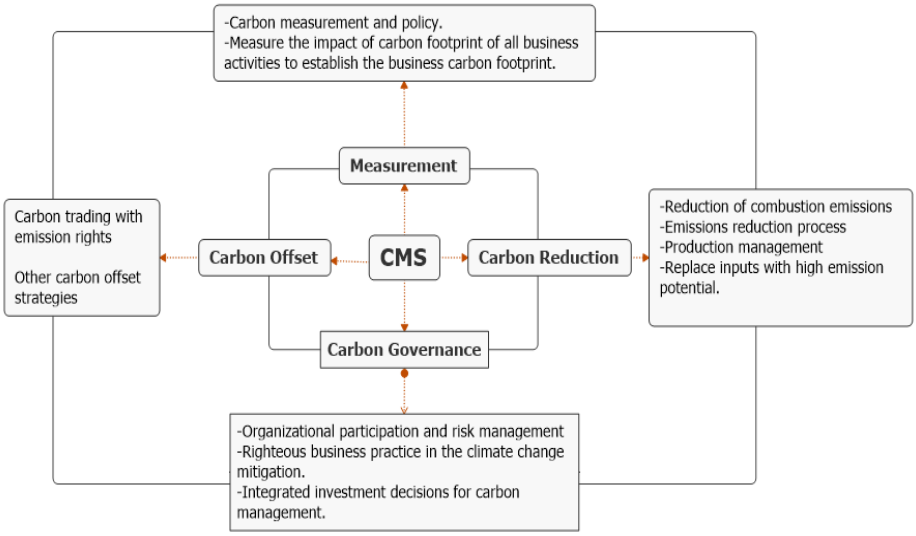
competitiveness. The first objective focuses on corporate activities related to carbon measurement and policy, product improvements, process improvement and carbon offsetting. The second objective underscores governance as part of organizational participation and risk management activities. The third objective aims at obtaining competitive advantages and legitimacy to do business in the context of mitigating climate change.

Radu, Caron, & Arroyo (2020) highlight three fundamental discursive categories to integrate the environmental strategy and the carbon strategy: (i) the reduction of emissions based on GHG emissions, (ii) the improvement of carbon performance through a language that fosters the disclosure credibility (iii) the organization's participation in a systemic approach (governance mechanisms, innovation, integration of carbon in investment decisions). In accordance with these authors, there are multiple factors that can determine the adoption of a CO_2 strategy. Consequently, "a company's CO_2 strategy can be conceptualized as a focus on one or a combination of several types of CO_2 strategies" (Hoffmann & Weinhofer, 2010, pág. 80).

The adoption of an effective and high-quality CMS implies monitoring, controlling and reducing emissions within appropriate management, considering fundamental factors as follows: the nature of the company's CO_2 emissions, the company's competitive dynamics, the legal environment, the pressure of stakeholders, the performance of corporate governance and the leadership of its managers to establish concrete prioritization actions within the framework of a CMS (Buysse et al., 2002; Dhanda et al., 2020; Luo et al, 2020; Okereke et al., 2010; Yunus et al., 2019). In particular, Okereke et al., (2010) underscore that this type of strategies set connections among integrative processes associated with planning, market positioning and power politics as well as an emerging social learning process. Considering this stance, prior studies have proposed different constructs

regarding the corporate development of a CMS (Cadez et al., 2015; Damert et al., 2017; Radu et al., 2020). These constructs associate the measurement of the carbon footprint, the internal and external emissions reduction, carbon governance and offset mechanisms (see Figure 4).

Figure 4. Fundamental elements of a CMS



Source: based on, (Cadez et al., 2015; Carbon Solutions Global, 2020; Damert et al., 2017; Radu et al., 2020)

Additionally, Hoffmann & Weinhofer (2010) address the importance of considering three fundamental variables to prioritize the carbon strategy: (i) the geographical region where the company operates, (ii) the size of the company, and (iii) the management of commercial operations based on carbon resources. In the first place, the behavior of the region and the geographic location are decisive to establish the corporate and business component that pertains to the activities of the region. In their study, (Kartha et al., 2020) state the existence of emissions inequality both between and within countries from an income perspective and the climate crisis exacerbated by the growth of industrialization. Likewise, mitigation to limit global warming to 1.5 °C will depend on the adaptation and articulation of national governments, local and regional authorities through a participatory and integrated strategy

to overcome socioeconomic, institutional, technological, financial, and environmental barriers among vulnerable regions as indicated by (IPCC, 2019). In the second instance, the size of a company is also a criterion to establish some behaviors of greater disclosure. The larger ones, for example, are subject to stronger regulatory pressure and their disclosure probability is much greater than those categorized as small (Dhanda & Malik, 2020).

Considering that prior studies highlight the link between geographical location (country) of the company and the political context with the development of a CMS (Hoffmann et al., 2010; Kartha et al., 2020), we pose the following hypothesis to understand if this holds true within the borders of a country with six regions with diverse geographical, social, economic, and cultural characteristics:

> Hypothesis 1 (H1): There is a positive relationship between the company geographic location and the company CMS disclosure quality in Colombia.

Additionally, as discussed above, prior studies find a relationship between company characteristics and the development of a CMS (Dhanda & Malik, 2020; Luo et al., 2020). Hence, we pose the following hypothesis to understand if this is the case in an emerging economy with voluntary carbon emissions disclosures regulatory environment:

> Hypothesis 2 (H2): There is a positive relationship between the company size and the company CMS disclosure quality in Colombia.

But the implementation of a CMS not only depend on the inherent characteristics of the company, it also depend on the actions taken by the government and the stakeholders' pressure put on industries classified as sensitive to climate change.

3.2.2. Stakeholder theory and legitimacy theory.

In the 70s of the last century, Nobel Prize winner in economics Milton Friedman, emphasized that the only social responsibility of companies was reflected in the maximization of shareholder value (Friedman, 1970). This economic stance generated reactions and contradictions by different authors who highlight the role of corporations and their moral, social, ethical, and environmental obligations which cannot be limited to the financial impact for the sole benefit of shareholders (Andrews, 1977; Cortina, 2000; García Marzá, 2004; Freeman, 1984; Rose, 2007). Currently, the role of shareholders is questioned and studied in greater detail. (Kim et al., 2020) analyze the political values of institutional shareholders, the disclosure and the corporate environmental performance. Likewise, Bueno-Garcia et al., (2020) discuss the origin of shareholders and their influence in the proactive environmental corporate practices.

The stakeholder theory gathers participants who are associated with the direct and indirect impacts of organizations and, therefore, exercise rights that allow them to apply pressure for companies to comply with their social and environmental demands (Freeman, 1984). Equally important, Hoque (2017) highlights that by improving stakeholder participation processes, a change in organizational behavior occurs. Accordingly, other studies recognize governments, investors, clients, NGOs, suppliers and competitors as crucial participants in the GHG reduction processes (Cotter & Najah, 2011; Sprengel & Busch, 2011). Likewise, Buysse & Verbeke (2002) analyze the behavior of stakeholders and argue that more proactive environmental strategies are associated with a deeper and broader coverage of stakeholders. In accordance with the aforementioned, the implementation of environmental practices and strategies are related to the approaches of corporate social responsibility using two key constructs: (i) ethical approach, based on the ethical responsibility of corporations towards stakeholders and (ii) an integrative approach which involves companies meeting social and environmental demands to legitimize business

reputation (Ackerman, 1973; Freeman, 1984; Garriga & Melé, 2004). On the other hand, the theory of stakeholders allows us to identify if companies manage their emissions due to regulatory pressures, due to the management of their costs and reputation or due to compliance with their social responsibility (Jayanthi, 2017).

The dissemination of actions related to social and environmental management of companies is referred to as a social legitimacy mechanism (Deegan C, 2002; Patten, 1991). Moreover, (Dowling & Pfeffer, 1975) discuss the concept of legitimacy from the perspective of a social contract in which companies set social values in accordance with their activities. This guarantees their adaptation to the social system in which they operate. Similarly, (Deegan C, 2002) highlights this process as the managers´ interest to disclose voluntary information to legitimize the actions carried out by the company. Consequently, this process of legitimacy depends on social expectations that transform over time, leading to a relative concept of "legitimacy" (Deegan C, 2019). Additionally, Suchman (1995, pp. 574) defined this concept as:

> "Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions"

Complementing the aforementioned view, the organizations social system is subject to constant changes in the political, regulatory, socioeconomic, technological and environmental aspects (Lemaire, 1997). Therefore, governments develop different strategies and action plans in their territories to mitigate climate change and thus seek to legitimize political decisions from the perspective of the morality of political power (Buchanan, 2002). In emerging countries, climate change policies are associated with fiscal policies given the economic conditions of profitability, distributive equity and viability to apply political transformations. In turn, from the socio-economic and regulatory perspective,

governments implement instruments such as the carbon tax to obtain results that allow them to meet social objectives and encourage the public and private sectors to invest in low-carbon technologies and more sustainable practices (Goulder, 2013). The above is also considered as financial pressure by the government for companies to adopt measures for emissions management. (Jayanthi, 2017).

Although this legitimacy process by the central government is expected to obtain global results, the impacts of climate change are variable and have effects at the local and sectoral levels (Lecocq et al., 1998; Vogel et al., 2020). This is the reason why government policies and institutional pressures affect GHG reporting practices at the sectoral level, particularly, in sensitive industries (e.g. gas and oil). Comyns (2016) suggest that regulation under the EU emissions trading scheme and reporting in accordance with the Global Reporting Initiative (GRI) guidelines leads to better reporting quality. However, this type of regulation is associated with the pressure that regulatory entities exert to promote public policies generated by global environmental commitments.

Companies with activities that are considered environmentally sensitive present disclosure behaviors different from other industries that they do not have as much social and political pressure and, consequently, the results of their environmental performance may present legitimacy gaps due to those negative incidents that occur in these types of organizations (Patten, 2002; Lindblom, 1994). Likewise, the pressure exerted by regulation focused on reducing emissions has a greater risk for the oil and gas, mining, metals and public services industries. Governments are forced to control polluting activities and these Industries due to their nature and volume of commercial operations. Therefore, they require greater intervention (Kolk & Pinkse, 2004; Okereke & Russel, 2010).

In accordance with the above, we pose the following hypotheses:

Hypothesis 3. (H3): There is a positive relationship between the implementation of the carbon tax and a company CMS disclosure quality in Colombia.

Hypothesis 4. (H4): There is a positive relationship between a sensitive industry sector and a company CMS disclosure quality in Colombia.

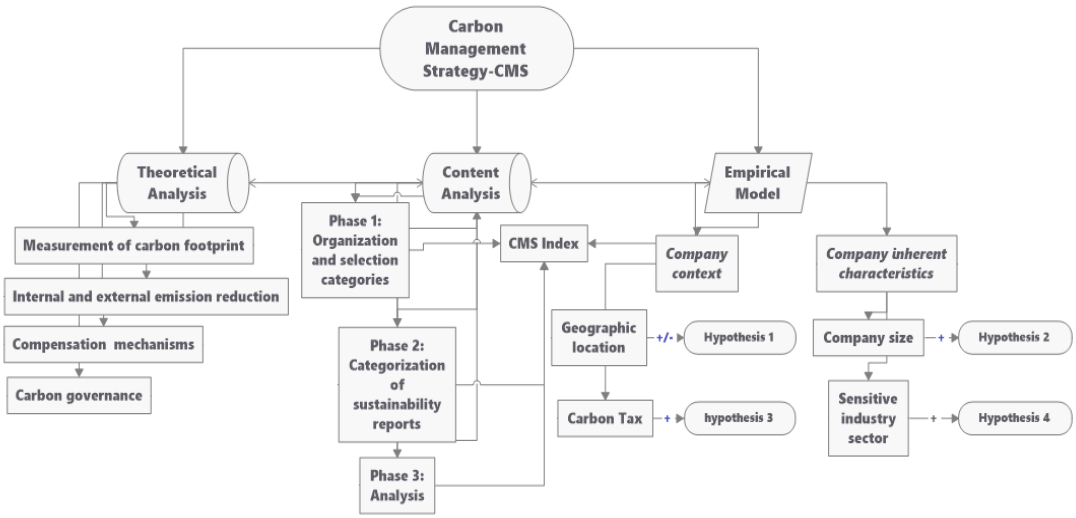
3.3. Material and methods

This section presents the research method, data collection, and the econometric model.

3.3.1. Study Method

In regulated countries this type of research is carried out with the support of structured information such as the Carbon Disclosure Project survey (Dhanda & Malik, 2020; Yunus, Elijido-Ten, & Abhayawansa, 2019), interviews with stakeholders (Okereke & Russel, 2010) and bases of public consultation. Colombia is a country witn non-regulated emissions of CO_2 and does not have this type of information. Therefore, we developed this study through three structured steps to obtain the necessary information to build an index that objectively groups the information disclosed by companies in their sustainability reports. The first step aims to identify a theoretical framework of carbon management strategies. The second step is carried out through content analysis with the purpose of creating a CMS Index with the information contained in the sustainability reports that we link to the carbon management strategy's components identified in the theoretical framework. Finally, using the CMS Index, we develop an empirical model to identify the determinants of the disclosure quality of the carbon strategies implemented and developed by Colombian companies, proxied by the CMS Index. Based on the theoretical framework, we identify company's context and inherent characteristics as potential determinants of the CMS Index (see Figure 5).

Figure 5 Steps Study Method



3.3.1.1. CMS index

The study uses content analysis through three phases implemented as addressed by Bardín (1986): Phase (i) organization and selection of categories; We used the theoretical constructs developed by (Carbon Solutions Global, 2020; Cadez et al., 2015; Damert et al., 2017; Radu et al., 2020) identifying four fundamental dimensions: measurement of the carbon footprint, internal and external emission reduction, carbon governance and compensation mechanisms. Phase (ii) categorization of sustainability reports: Coding the information was carried out manually as follows: five elements are associated to the dimensions and nine activities are associated to the elements (see Table 11). These relationships are used to identify concrete information in the reports disclosures which have heterogeneous characteristics in their presentation. The index score is established by consolidating the presence or absence of each one of the dimensions (each dimension scores 1 point, so the CMS Index ranges from 0 to 4) after determining that each one of them meets at least one activity. Phase (iii). Analysis: the research team discusses the results, two researchers audited the results produced by one member of the team.

Table 11. CMS Index elements

CMS-Index Dimensions	Elements	Activities
Measurement	Impact of carbon emissions from all business activities	Measuring the business's carbon footprint
Carbon reduction	Internal carbon reduction	Emissions reduction process
		Production management
	External carbon reduction	Replace inputs with high emission potential
Carbon governance	Governance mechanisms	Organizational participation and risk management
		Innovation, carbon integration into investment decisions
		Identify and implement a reduction strategy
Carbon compensation	Compensation mechanisms	Emissions-rights carbon trade
		Other compensation mechanisms

Source: based on by (Cadez et al., 2015; Carbon Solutions Global, 2020; Damert et al., 2017; Radu et al., 2020)

3.3.1.2. Explanatory variables

According to prior studies in the field of carbon performance and the disclosure of a CMS, we associate the use of four explanatory variables to our empirical model: (i) (Region), this categorical variable represents the classification of the regions in the Colombian National Development Plan in the 2014-2018 period. This variable explains the Colombian territorial behavior (Dhanda et al., 2020; Hoffmann et al., 2010; Vogel et al., 2020). This comprises five regions (1) Caribbean, (2) Central-East, (3) Central-South Amazon of Colombia, (4) Eje Cafetero and Antioquia (5) Pacific, which takes as reference region (1). We expect to see a positive relationship among regions where the local government has implemented climate change policies and the CMS Index. (ii) (Size), this variable is measured as the natural logarithm of total assets (Luo & Tang, 2020). It is expected that larger companies will have higher quality disclosure than those categorized as small (Dhanda & Malik, 2020). (iii) Carbon tax (Tax), this variable represents the implementation of the carbon tax in Colombia which was created in 2016. It is regulated and applied in the 2017- 2018 period (Rona, 2019). In the model it is represented as a dummy variable equal to 1 and 0 otherwise. We expect a positive relationship between Tax and CMS Index as the implementation of the Carbon tax could increase the need of companies to communicate

their CMS to their stakeholders. (iv) Sensitive industry (Indsens), this variable reflects the behavior of companies that are considered environmentally sensitive (Comyns, 2016: Lindblom, 1994; Patten, 2002). This is a dummy variable that equals 1 if the company belongs to an environmentally sensitive industry (Electrical energy, Mining & Extraction, Natural gas) and 0 otherwise. We expect a positive relationship between Indsens and CMS Index as companies doing business in sensitive industries should disclosure higher quality information regarding the CMS.

3.3.1.3. Control variables

The following control variables are included in the study: (i) (Indebtedness), this variable detects the financial flexibility and, in the Colombian context, possible financial problems of companies in this study (Hatakeda et al., 2012). It is defined as total debt divided into total assets. Companies with higher leverage tend to disclose higher quality information as the stakeholders monitoring is significant. (ii) Return on assets (ROA), this variable is used in empirical studies to determine the financial implications of companies on carbon performance and disclosure (Browers et al., 2018; Velte et al., 2020). It is measured as net income divided into total assets. This indicator is expected to be positively related to the adoption and disclosure of a CMS. (iii) (Shareholders), this variable observes the number of shareholders of the firm that influence the corporate environmental performance and environmental proactivity to adopt a CMS (Bueno-Garcia et al., 2020; Kim et al., 2020). Hence, we expect a positive relationship between Shareholders and CMS Index.

3.3.2. Empirical model

To test the hypotheses, a regression model is used based on balanced panel data to control individual and temporal effects. After implementing the Hausman test, the fixed effects model and the random effects model were compared, and the results indicated that the

most suitable model is fixed effects. The Breusch and Pagan Lagrangian test is used, and the results suggest that the ordinary least squares (OLS) regression model is suitable for this study. The robust least squares estimation was used to improve the estimation of the model. Goodness of fit tests for OLS-robust shows the normality of the model (Francia & Shapiro, 1972; Shapiro & Wilk, 1965). The variables are summarized in Table 12. The equation to estimate the regression is as follows:

$$CMSIndex\ it = \beta 0 + \beta 1\ Region\ it\ + \beta 2\ Size\ it\ + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \varepsilon$$

Table 12. Variables, Hypothesis, Sign.

Variables		Hypothesis	Sign
Explanatory variables			
Region	Categorical variable. This analyzes five regions (Caribbean, Central-East, Central-South, Eje Cafetero and Antioquia, Pacific) Range from 1 to 5.	(H1): There is a positive relationship between the company geographic location and the company CMS disclosure quality in Colombia.	+/-
Size:	It is the natural logarithm of total assets.	(H2): There is a positive relationship between the company size and the company CMS disclosure quality in Colombia.	+
Tax:	A dummy variable equivalent to 1 for period carbon taxation in Colombia. Otherwise it is equivalent to 0	(H3): There is a positive relationship between the implementation of the carbon tax and a company CMS disclosure quality in Colombia.	+
Indsens:	A dummy variable that equals 1 if the company belongs to an environmentally sensitive industry *, and 0 otherwise. (Electrical energy, Mining & Extraction, Natural gas and oil).	(H4): There is a positive relationship between a sensitive industry sector and a company CMS disclosure quality in Colombia	+
Control variables			
Indebtedness:	It is the total debt ratio understood as the total debt divided total assets		?
ROA:	The ratio of income and total assets.		+
Shareholders:	It is the number of shareholders of the firm		?

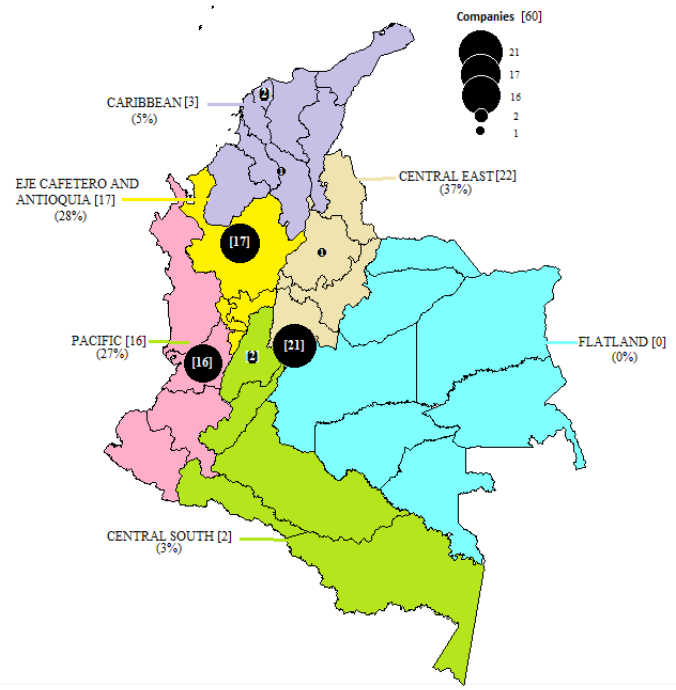
3.3.3. Data sources and sample selection

The sample comprises Colombian listed companies for the period 2016, 2017 and 2018, with a total of 70 company-year excluding the financial sector. Ten company-year that did not issue sustainability report are excluded from the sample. The final sample includes 60 company-year. The data was first obtained from the sustainability reports of the GRI database and from the company website to construct the information of the CMS Index, the dependent variable. The company data is obtained from the ORBIS database.

The regions[15] subject to analysis are distributed according to the national development plan 2014-2018 based on the following groups: (i) characteristics of the territory in terms of social welfare, (ii) city system and the differentiation of degrees of rurality, (iii) regional characterization of the dynamics and incidence of the armed conflict (iv) strategic environmental zones of the country (Departamento Nacional de Planeación, 2015). Map 6 shows the distribution of the companies by region. Table 13 presents the companies classified by business sector according to the Bureau van Dijk (BvD) classification.

Map 6. Distribution by Region

[15] (1) Caribbean (Atlántico, Bolívar, Cesar, Córdoba, La Guajira, Magdalena, San Andrés Providencia and Santa Catalina, and Sucre) - (2) Central-East (Bogotá, D.C., Cundinamarca, Boyacá, Santander and Norte de Santander) (3)- Central-South-Amazon of Colombia (Tolima, Huila, Caquetá, Putumayo and Amazonas) - (4) Eje Cafetero and Antioquia (Risaralda, Caldas, Quindío and Antioquia) - (5) Pacific (Chocó, Cauca, Valle and Nariño)



Source: Own elaboration using Philcarto (2021)

Table 13. Sample distribution by business sector and sensitive industry

Distribution by business sector

Sector	Freq.	Percent
Agriculture, Horticulture & Livestock	7	11,67
Business Services	1	1,67
Cement, Leather, Stone, Clay & Glass	3	5
Rubber & Plastic	4	6,67
Communications	2	3,33
Construction	3	5
*Electrical energy	10	16,67
Food	5	8,32
Leather, Stone, Clay & Glass products	1	1,67
Media & Broadcasting	2	3,33
Metals & Metal Products	2	3,33
*Mining & Extraction	3	5
*Natural gas	6	10
Printing & Publishing	1	1,67
Retail	2	3,33
Textiles & Clothing Manufacturing	3	5
Transport, Freight & Storage	1	1,67
Waste Management & Treatment	1	1,67
Wood, Furniture & Paper Manufacturing	3	5

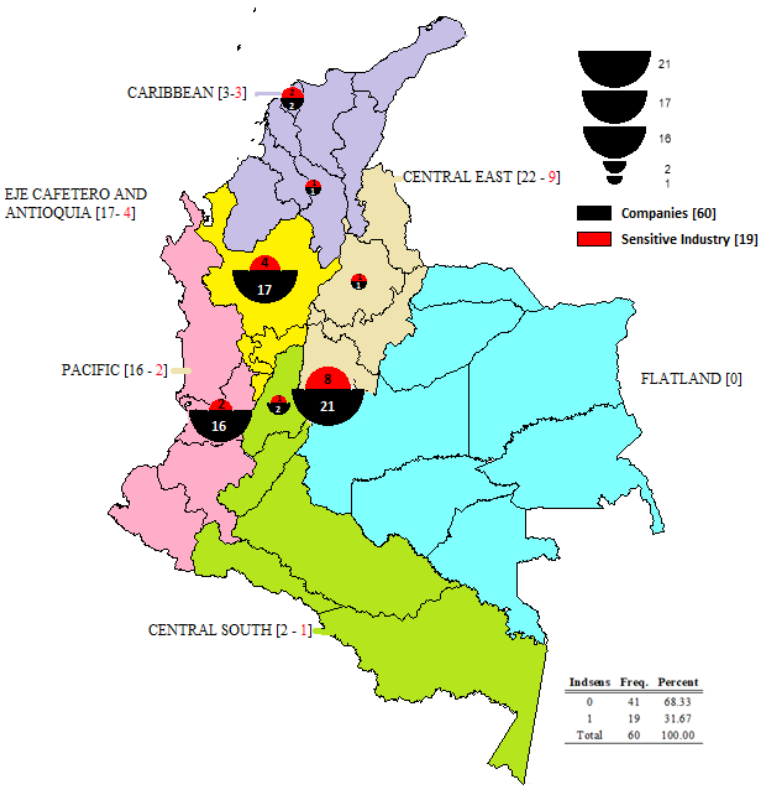
Total	60	100.00

*Sensitive industry

Source: Own elaboration with data from BvD

The classification of sensitive industry is carried out based on the guidelines issued in the Colombian carbon tax law. This law covers activities related to fossil fuels and oil derivatives for energy purposes. This regulation focuses on the control of emissions and has a direct impact on companies in the oil, gas and mining industrial sector (Kolk et al., 2004). Moreover, carbon-intensive companies (Okereke & Russel, 2010) are taken as a reference. Accordingly, the sectors are analyzed grouping the business industries as follows: Electrical energy, Mining & Extraction, Natural gas (see Map 7).

Map 7. Sample distribution by sensitive industry location



Source: Own elaboration using Philcarto (2021)

Table 14 presents the descriptive statistics of the model variables. The CMS index presents a mean value of 2.23. Considering that the maximum possible value is 4, it shows that companies are half-way to have a complete CMS. Variable (Size) for companies in the sample ranged from 9 to 17 and average value 13.31. Variable (Indebtedness) presents an average of 2.43, showing a minimum of 0.77 and a maximum of 15 and a standard deviation of 1.95. The variable (ROA) presents a mean of 3.19, a minimum of -28.42 and a maximum of 30.03. Variable (Shareholders) presents a composition range of the number of shareholders between 1 and 82, with a mean of 5.80.

Table 14. Descriptive statistics of the variables

Variable	N.	Mean	Std. Dev.	Min	Max
CMS-index	180	2,23	1,58	0	4
Size	180	13,31	1,85	9,15	17,52
Indebtedness	180	2,43	1,95	0,77	15
ROA	180	3,19	6,13	-28,42	30,03
Shareholders	180	5,80	9,28	1	82

3.4. Results and discussion

This section analyzes the results obtained from the empirical analysis and provides a thorough discussion.

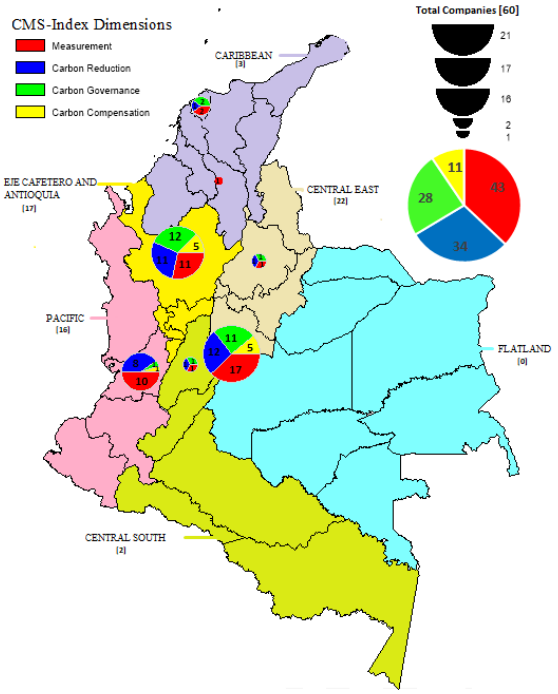
3.4.1. CMS Index

The first finding of this research is related to the outcome of the content analysis performed to construct the CMS Index, the dependent variable of our model. The results show that Colombian companies do not explicitly disclose the development of a CMS as such in their sustainability reports. Therefore, the analysis of the dependent variable is relevant for those

regions that have not adopted this strategic concept. In the regions under analysis, it is possible to identify the progressive incorporation of the CMS-Index Dimensions in the years 2016, 2017 and 2018 (See Map 3,4,5 and Figure 3). The dimension of measuring the carbon footprint is the dimension that presents the highest percentage of participation in relation to the other dimensions. This indicates that a significant percentage of companies are increasingly involved in carbon footprint measurement in the period under study ([2016 -72%] [2017 - 77%] [2018- 83%]). The carbon reduction dimension requires a greater commitment by companies, although in 2017 and 2018 a significant increase was observed in companies that establish actions to mitigate climate change ([2016 -57%] [2017 - 72%] [2018- 73%]). In the dimension that relates to carbon governance, a gradual increase in actions taken by corporate governance is observed to develop risk management mechanisms, innovation, and integration of carbon while making investment decisions in their strategy ([2016 -47%] [2017 - 57%] [2018- 68%]). In the carbon compensation dimension, it is possible to point out that very few companies implement compensation mechanisms, but still the number of companies addressing this dimension is increasing ([2016 -18%] [2017 - 32%] [2018- 38%]).

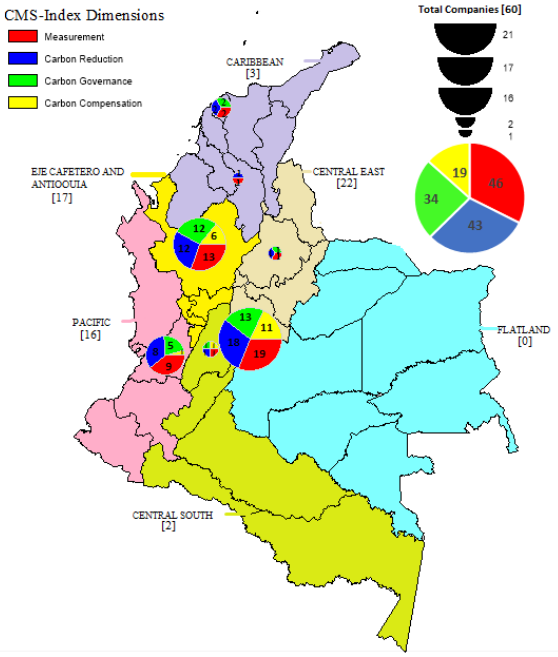
The CMS Index results provide inputs to different stakeholders that may consider taking concrete actions, for example, government and regulators should consider exerting legislative pressure to encourage companies to define a CMS. This will promote a shared responsibility to meet the goals proposed in the global climate change agenda. The business sector has an important challenge in building and developing permanent training actions to contextualize its actions in relation to the adoption and disclosure of a high-quality CMS. Having said this, it must be noted that companies are increasingly addressing the three CMS Index dimensions in the period under study.

Map 8. Regional CMS-Index Dimensions 2016



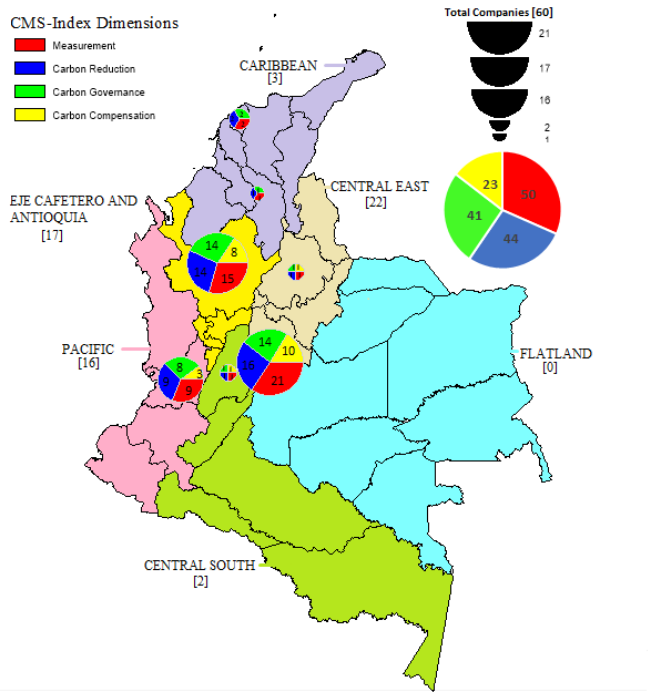
Source: Own elaboration using Philcarto (2021)

Map 9. Regional CMS-Index Dimensions 2017



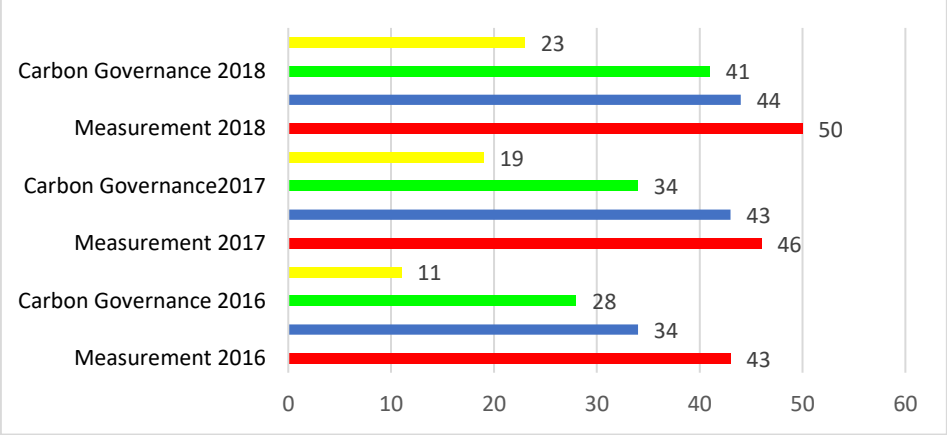
Source: Own elaboration using Philcarto (2021)

Map 10 Regional CMS-Index Dimensions 2018



Source: Own elaboration using Philcarto (2021)

Figure 6. CMS- Index Dimensions disclosure during the 2016-2018 period.



3.4.2. Empirical model

Tables 15 and 16 show the Pearson correlations and the variance inflation factor (VIF) of the variables used in our model. Although some correlations are significant, the model does not show multicollinearity issues. The variance inflation factor (VIF) was calculated after the regression. Accordingly, if the VIF value is greater than 10, it is an indicator of a multicollinearity problem. The results obtained show that the explanatory and control variables are less than 6 with an average of 2.61 showing the absence of multicollinearity.

Table 15. Model variables - Pearson correlations

	CMS-Index	Tax	Indsens	Size	Shareholders	Indebtedness	ROA
CMS-Index	1.00	-	-	-	-	-	-
Tax	0.20*	1.00	-	-	-	-	-
	0.00	-	-	-	-	-	-
Indsens	0.43*	-0.00	1.00	-	-	-	-
	0.00	1.00		-	-	-	-
Size	0.57*	0.01	0.24*	1.00	-	-	-
	0.00	0.85	0.00		-	-	-
Shareholders	-0.06	0.08	-0.13	0.19*	1.00	-	-
	0.41	0.26	0.07	0.00		-	-
Indebtedness	-0.30*	-0.02	-0.19*	-0.39*	-0.03	1.00	-
	0.00	0.69	0.00	0.00	0.65		-
ROA	0.27*	-0.06	0.27*	0.04	-0.16*	0.04	1.00

*Significant at 5%.

Table 16 Model variables - VIF

Variable	VIF	1/VIF
_IRegion_2	5.79	0.172857
_IRegion_5	5.65	0.176949
_IRegion_4	5.55	0.180308
_IRegion_3	1.67	0.598274
Size	1.48	0.676317
Indsens	1.42	0.705286
Indebtedness	1.29	0.775477
ROA	1.13	0.885233
Shareholders	1.11	0.900050
Tax	1.01	0.989260
Mean VIF	2.61	

Table 17 shows the regression results. The R2 of the model is 53.2%. The results for the categorical variable Region, which takes region 1 as reference, show a significant positive relationship of region 4 (Eje Cafetero and Antioquia- coefficient: 0.65- p <0.05) with the CMS Index. The other regions present a positive coefficient in relation to the CMS index, but they are not statistically significant. This confirms that there is a relationship between the geographical location of the company and the adoption of a high-quality CMS, providing support to hypothesis 1.

The significant behavior of the Antioquia region is explained by different factors: (i) this region has established indicators for the mitigation of climate change in sub-regional programs led by the Secretariat of Environment (Gobernación de Antioquia, 2016), (ii) it also has been a pioneer in implementing concrete actions such as measures that improve the environment in a post-conflict scenario, for example, the BanCO_2 which is an initiative that has been replicated in other regions of the country and that has also been adopted by other countries such as Peru (CORNARE, 2020), (iii) the region has developed a comprehensive climate change plan with focus on coordinating territorial and intersectoral mitigation and adaptation actions recognizing the particularities of the nine subregions of the region through five strategic lines: (1) resilient energy and transport, (2) regional competitiveness and promotion of new economies, (3) resilient urban development, (4) resilient agricultural development and, (5) ecosystems and related services; and (iv) this region has the largest number of environmental authorities in Colombia[16], therefore, this institutional intervention in the territories is a determining factor in the articulation and integrated management of the territory (Gobernación de Antioquia, 2018). Our findings suggest that, when policies and actions regarding climate change are implemented in

[16] Autonomous Regional Corporation of Central Antioquia (CORANTIOQUIA), Autonomous Regional Corporation of Negro and Nare rivers basins (CORNARE), Corporation for Sustainable Development of Urabá (CORPOURABÁ).

regional governments, effects are shown on the behavior of regional companies that is reflected in the adoption of a CMS and the disclosure in the sustainability report.

Table 17. Regression results

CMS- Index	Robust Coef.	Std. Err.	T	P>t	Significance
Size	.38	.04	7.94	0.000	***
Tax	.72	.17	4.24	0.000	***
Indsens	.85	.18	4.70	0.000	***
Indebtedness	-.04	.03	-1.23	0.220	
ROA	.04	.01	3.12	0.002	**
Shareholders	-.02	.01	-1.76	0.080	
_IRegion_2	.45	.25	1.76	0.080	
_IRegion_3	.23	.28	0.81	0.420	
_IRegion_4	.65	.28	2.27	0.025	*
_IRegion_5	.14	.32	0.44	0.661	
_cons	-39	.71	-5.60	0.000	***

Notes: No. of observations = 180; R2 = 0.532; p > F = 0.0000; * p<0.05, ** p<0.01, *** p<0.001

The variable Size is positive and significant (coefficient: 0.38- p <0.001). This indicates that larger companies disclose higher quality information in relation to a CMS. The result is associated with the expected sign and provides support to hypothesis 2. This result is similar to prior studies' findings focused on environmental strategies and disclosure of a CMS (Dhanda & Malik, 2020; Hoffmann et al., 2010).

The variable Tax is positive and significant (coefficient: 0.72- p <0.001). This variable is related to hypothesis 3 (H3) and shows that the carbon tax is positively related to the CMS index confirming the expected sign and consequently the hypothesis is supported. This result is associated with the regulatory pressure exerted by the Colombian government with the creation of the carbon tax law in 2016 that encourages companies to certify that they

are carbon -neutral[17]. This explains why companies adopt different actions, for example: (i) Clean Development Mechanism (CDM) (ii) Methodologies developed by the certification or carbon standards which must be verifiable by an independent third-party accredited body - ONAC (National Accreditation Body of Colombia) - IAF (International Accreditation Forum) or by the United Nations Framework Convention on Climate Change (UNFCCC), or comply with the requirements for registration of initiatives established by the registry of the Program of the United Nations for the Reduction of Emissions from Deforestation and Forest Degradation (REDD +) (Aristizábal et al., 2019). These methodologies could play the role of a CMS without explicitly adopting this name. This result also reaffirms the analysis carried out in the Australian context in which the financial pressure exerted by the carbon tax was the most influential factor that forced companies with high carbon emissions, to take measures on their emissions management (Jayanthi, 2017). However, these fiscal regulations must be strengthened with other regulatory mechanisms that promote better results facing climate change in the country. This result is interesting as shows that companies in developed and emerging countries have a similar reaction to the government pressure through carbon tax implementation. This is good news as this leads companies to define corporate governance structures and business models that incorporate GHG emissions management.

The variable Indsens is positive and significant (coefficient: 0.85- $p < 0.001$). This indicates that companies categorized in a sensitive industry adopt and disclose quality environmental strategies related to GHG, particularly a CMS, aiming at legitimizing their performance with respect to environmental impacts (Lindblom, 1994; Patten, 2002). This result provides support to hypothesis 4 (H4). This is relevant in the Colombian context since companies operating in sensitive industries have been associated with different environmental conflicts related to increasing levels of extraction and exploitation of natural resources (e.g.

[17] In Colombia, carbon neutrality is the total or partial compensation of emissions derived from the use of fossil fuels without considering other sources of emissions. (Rona, 2019)

Ecopetrol SA - company associated with contamination by oil spill in different regions of Colombia). Also, Bewley & Li, (2000) underscore that companies with a greater propensity to contamination and political exposure are more likely to disclose information.

The control variable ROA is positive and significant (coefficient: 0.49- p <0.01), which means that the most profitable companies adopt and disclose a CMS to a greater extent. The control variables Indebtedness and Shareholders are negative and non-significant. This indicates that the indebtedness level is not related to the CMS disclosure quality. Likewise, the number of shareholders does not affect the CMS disclosure quality.

3.5. Conclusions, policy implications and managerial implications

The study was developed based on the stakeholders theory and the legitimacy theory; it empirically identifies the determinants that explain the disclosure quality of a CMS by Colombian companies. In this study, the companies were analyzed based on the actions implemented by the government through the carbon tax and the regulatory pressure exerted on industries classified as climate change sensitive. Internal company factors such as profitability and leverage were also analyzed to understand if they affected CMS adoption and whether stakeholder pressure influences CMS governance and disclosure quality practices. The methodology of the study involves content analysis to develop the dependent variable (CMS Index) and a robust OLS empirical regression model.

Our results show that the characteristics of the context where the company operates influence the behavior and attitude of companies towards adopting and disclosing higher quality information about CMS. The government´s initiatives such as the implementation of a carbon tax and the regulatory pressure and monitoring coming from regional governments played a disciplinary role for companies to develop a CMS. Additionally, inherent

companies' characteristics such as size and the industry sector are also related to the propensity of companies to design and implement a CMS. Larger companies doing business in climate change sensitive industries provide CMS higher quality information to their stakeholders to legitimize their actions.

Furthermore, this is an innovative study developed in one of the world's megadiverse countries whose geographical and biodiverse conditions are a key factor in addressing environmental issues that interconnect aspects related to climate change and the activism of social actors. This study is also groundbreaking in looking at CMS adoption and disclosure in an emerging economy and in a territory where GHG-related disclosure is not mandatory. Additionally, this is the first study to show that within a country there are differences between the attitude of companies towards a CMS quality based on its context and its inherent characteristics, and this is influenced by the national and local governments commitment to climate change adaptation and mitigation. Another key factor in this study is the development of the CMS index from sustainability reports' content analysis. This makes this study different from prior studies which construct indexes based on data obtained from surveys to companies, and this may incorporate management bias. Although Colombian companies do not explicitly mention the existence of a CMS in the sustainability report, we find that companies are transitioning to a new environmental management model, and these actions are, related to the CMS' four dimensions with a significant improvement in the period under study. This implies that the quality of the implicit CMS increases over time, and this is a contribution of Colombian companies to SDG 13 - climate action.

The limitation of this study is that it is focused only on the Colombian context and hence the results can not be generalized. This study opens paths for future research. It would be interesting to do comparative studies in this line between developed economies and

emerging economies. Additionally, further research is needed to understand if companies with higher quality CMS produce higher or lower GHG emissions levels than companies with no CMS or lower quality CMS.

3.5.1. Policy implications and managerial implications

This study offers a theoretical and empirical approach for those countries that do not have a GHG emission regulations. It also incorporates the regional analysis to stratifying and categorizing the internal behavior of the country's companies regarding the adoption, implementation, and quality of disclosure of a CMS. Moreover, it takes up the strategies and mechanisms used by the Colombian government to include the business sector in the public and private action network to meet the objectives agreed in the 2030 Agenda. From the business perspective, this study contributes to the literature related to GHG emissions and orients Colombian organizations to determine the design and implementation of a Carbon Management Strategy- CMS. Also, this study helps companies to generate coordinated actions that contribute to improving the indicators related to climate action (SDG 13).

This leads to the following implications:

- Colombia is a country economically dependent on fossil fuels. This should be a factor that encourages the government to seek regulatory mechanisms to control CO_2 emissions. The foregoing implies greater monitoring of companies in sensitive industries, particularly, in the dimensions of the Index related to carbon reduction and carbon compensation.

- The pressure exerted by the Colombian government with the implementation of the carbon tax generates results in companies´ adoption and disclosure quality of a CMS. According to statistical reports presented by the DIAN, the Colombian

government collected 130M USD in 2017 and, 78.5M USD in 2018 due to carbon tax (DIAN, 2020). However, it is detected that the resources collected through this tax have not fulfilled the destination for which they were created. This affects the projected results in the peace agreements in Colombia and also affects the fulfillment of the objectives set in the climate change policy which requires structural change to ensure decarbonization projected by 2050 (Delgado, et al., 2020).

- The findings reaffirmed the importance of developing segmented analyzes within the regions of a country. The main implication of these results is to encourage the government to implement public policies in accordance with territorial needs and to replicate the good practices developed on environmental issues by regional governments. It also implies the need of coordination among national government, regional governments, and the business sector to strengthen actions that mitigate climate change.

- This study guides the business sector about the concept of a CMS. Our analysis of the sustainability reports in the different regions´ companies present a progressive behavior in the adoption of strategies derived from a CMS. That includes actions related to the measurement of the carbon footprint, integration of investment decisions and innovation for carbon reduction, implementation of reduction goals and compensation strategies. This implies that, although Colombian companies have begun important implementation phases, it is essential to replicate good practices and encourage business leaders and corporate governance to know and acknowledge the importance of incorporating the carbon management strategy into the global strategy of the company, ensuring that the company operates under a business scheme within the framework of climate change mitigation. The results also show the need of management training in the field of CMS field of study.

National and regional governments, together with industrial chambers and chambers of commerce should develop training courses together with the academia.

The results of our study provide evidence in the context of SDG 16 as it shows that corporate governance plays a relevant role in the strategies developed by the companies, in this case, specifically in actions related to CMS development and implementation. The study also shows the relevance of SDG 17, as it shows the need of coordination among national and regional governments, the private sector and the academia to provide training to corporate governance in CMS and to design effective regulatory frameworks to address climate change – related issues.

CAPÍTULO 4: CARBON MANAGEMENT STRATEGY EFFECTS ON THE DISCLOSURE AND EFFICIENCY OF CARBON EMISSIONS: A STUDY OF COLOMBIAN COMPANIES' CONTEXT AND INHERENT CHARACTERISTICS[18]

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4. Carbon Management Strategy effects on the disclosure and efficiency of carbon emissions: a study of Colombian companies' context and inherent characteristics

4.1. Introduction

The impacts of human activities on terrestrial ecosystems have intensified and led to a turning point in climate change and the loss of biodiversity. The aftermath of these actions reflects the instability of systems on a planetary scale in the so-called Anthropocene era (Bebbington, et al., 2019; Hoffman & Jennings, 2018). Consequently, the beginning of this new dystopian decade reveals new models and ways of understanding the social, economic, and environmental problems of human beings. These challenges require immediate action by governments to face survival difficulties in the short term. However, the changes generated at the planetary level imply a greater effort to face the challenges established by the 2030 agenda, and the decarbonization planned for the year 2050. The above implies the development of joint actions by governments, organizations, and civil society (Bebbington & Unerman, 2018). Facing these global challenges, the sustainable development goals have established the need to adapt and integrate policies and strategies to mitigate climate change, prompting organizations to include related actions in the disclosure of their non-financial information reports[19].

Since the SDGs were incorporated and the urgent need to mitigate climate change rose, various studies have highlighted the importance of studying companies' emissions disclosure and the impact of regional climate policies (Hoffmann & Weinhofer, 2010). Also,

[19] The report by (PWC, 2019) reveals that in a sample of 1141 analyzed companies, great differences are found in the incorporation of the SDGs and three SDGs are mainly disclosed: "Decent Work and Economic Growth (SDG8), Climate Action (SDG13) and Responsible Consumption and Production (SDG12)" (PWC, 2019, p. 12). In the case of companies located in Colombia, this report reveals that 97% of the companies analyzed in this territory mention the SDGs in their disclosure.

some studies focus on the interaction between public and private policy to generate proactive measures of disclosure and risk management of carbon emissions. This is studied in a scenario in which environmental disclosures continue to increase and generate an effect by influencing public policies to develop mitigation and reduction of emissions strategies (Dhanda, et al., 2022; Reid & Toffel, 2009). Accordingly, respective views rise and associate organizational behavior with the urgent need to face global environmental problems from the planetary boundaries stance (Schaltegger, 2018). In accordance with the above, recent literature has incorporated the concept of efficient emissions management and the importance of carrying out policies in developing countries aimed at the constant reduction of CO_2 emissions from a fiscal perspective and strict regulations for the use of cleaner technologies (Akram, et al., 2020). In more-developed countries, there is evidence that suggests they do not have the best CO_2 emission control efficiency score. In reference to this, Lu, et al., (2013) discuss a relevant approach to identify the gaps between countries that control their emissions versus countries that do not and are not regulated.

By monitoring scientific activity in the field of emissions disclosure, the Carbon Disclosure Project (CDP) report is generally used as a primary source of reference for the disclosure analysis, mainly in regulated countries[20]. Reid & Toffel, 2009 shows empirical evidence of public and private policies aside from those applied to the industry and the company to disclose carbon management strategies. Also, Liao, et al., (2015) and Ben-Amar & McIlkenny, (2015) underscore the importance of gender diversity and board independence in balancing the company's financial and non-financial objectives in relation to GHG disclosure in corporate response to sustainability initiatives. Furthermore, Matsumura, et al., (2014) analyze the effects of carbon disclosure on the value of the company and the penalization of the markets, mainly for companies that do not disclose information. Luo L,

20 TITLE (carbon AND emissions AND disclosure) AND (LIMIT-TO (SUBJAREA , "BUSI")) - Mostly cited documents in the Scopus database.

et al., (2012) discuss corporate incentives to disclose information on carbon report and identify the general public and the government as influential participants in this type of disclosure. This diversity of analyzes is relevant to understand the progress in terms of emissions disclosure and efficiency. But what can be done when the information required for emissions analysis does not have an official source available? How to analyze the sustainability reports and CO_2 emissions in non-regulated countries?

From our perspective, it is possible to solve this information gap in non-regulated countries by identifying the characteristics of the context and the inherent characteristics of the companies. This study has the purpose of analyzing the disclosure of carbon emissions and the efficiency of emissions from the implementation of a carbon management strategy developed by the companies. Accordingly, this study is located in Colombia, a country where CO_2 emissions and sustainability reports are not regulated. It is a country cataloged as one of the "megadiverse" countries in the world, hosting about 10% of the planet's biodiversity (United Nations, 2019). The country has areas of high biological diversity in the Andean ecosystems characterized by an important variety of endemic species. It has part of the Amazon rainforest and the humid ecosystems of the Chocó biogeographic area (United Nations, 2020). This biodiversity is affected by social inequality[21], the current armed conflict, the post-conflict with the FARC guerrillas, and the lack of government guarantees regarding socio-environmental and economic policies. Colombia has developed a dependence on fossil fuels for export and domestic use and its climate policy requires structural changes since the current ones do not lead to net net-zero emissions by the year 2050 (Delgado, et al., 2020). Another major impact on this territory corresponds to changes in land use and deforestation. The loss of primary forests in Colombia in 2019 was even greater than any year recorded before the peace agreement. This loss of vegetation is

[21]According to the worldwide Governance Indicators, the Political Stability and Absence of Violence Colombia is ranked 178 out of a sample of 211. With a score of 15.71 Percentile Rank (0-100) 0 corresponds to lowest rank and 100 corresponds to highest rank. (Worldbank Governance, 2020)

detected in several protected areas (Global Forest Watch, 2020). The carbon atlas report in protected areas of the system of national and natural parks of Colombia establishes that the Colombian Amazon is one of the territories with the highest level of emissions due to deforestation[22] (Minambiente, 2020). This implies that there is a significant deterioration in one of the world's lungs and hinders progress in the decarbonization process in this territory.

In accordance with this regional problem, this study focuses on actions related to climate change (SDG13) based on two fundamental elements: (i) the adoption and implementation of a Carbon Management Strategy (CMS) and their relationship with GHG emissions disclosure and, (ii) the efficiency of emissions when scopes 1, 2 and 3 are disclosed by Colombian companies. This study is based on two models: i) Carbon emissions disclosure, which includes a final sample of 240 observations for the period 2016-2019, and ii) Efficiency of carbon emissions, which gathers 152 observations of direct emissions (scope 1), 128 observations of indirect emissions (scope 2) and 56 observations of other emissions (scope 3). The data to build the dependent variable is obtained from the sustainability reports of the GRI database and from the companies' webpage. Financial and shareholder data is obtained from the ORBIS database. To test the hypotheses, an OLS regression model is used for the disclosure model of carbon emissions and a robust OLS model for the carbon emissions' efficiency using a balanced panel data. The study is based on the legitimacy theory and signaling theory. Our research study makes several contributions from a theoretical and practical perspective by analyzing the environmental disclosure implications of carbon emissions in an emerging non-regulated country. The analysis is useful to detect organizational advances derived from carbon management and provides relevant information to analyze the disclosure and efficiency of GHG emissions. We also

[22] The highest total deforestation from 1990 to 2019 has occurred mainly in protected areas from 1990 to 2019, a deforestation of 388,430.1 hectares which have emitted 175 $MtCO_2e$ into the atmosphere. (Amazon – 58.579.820,4 Emissions from deforestation (tCO_2e)

show the usefulness of analyzing specific geographic areas in a territory to explore the social, economic, and cultural gaps that hinder or facilitate specific actions related to SDG 13 – Climate Action.

The structure of this study is presented as follows: Section two presents the theoretical framework and the hypotheses. The third section describes the research design. Section four presents and discusses the results. Finally, section five draws the conclusions and describes the implications of this study.

4.2. Theoretical framework and hypotheses development

4.2.1. Legitimacy, stakeholders, and signaling theories.

In the last decades, the GHG dissemination practices have gained relevance, mainly due to the problems derived from global warming and the future scenarios that humanity faces in relation to the "planetary boundaries[23]" (Hoffman & Jennings, 2018). These concerns have generated a greater scrutiny of companies, mainly those that are assigned to a sensitive sector (Comyns, 2016; Lindblom, 1994). That is why several studies of an organizational nature have used the legitimacy theory to identify those behaviors derived from the notion of "social contract" (Dowling & Pfeffer, 1975).

The concept of social contract seeks to associate the coherence between the value system established for the operation and continuity of an organization to the system to which it belongs through the perception of its actions in such system. Likewise, it allows us to

[23] "Key environmental vectors and thresholds below which humanity can safely operate and beyond which the stability of planetary-scale systems cannot be relied upon" (Hoffman & Jennings, 2018)

analyze the gaps that the organization can generate when not complying with the agreements derived from its social, political, economic, and environmental immediacies (Deegan, 2002; Lemaire,1997; Lindblom, 1994). Therefore, organizations seek social communication mechanisms to justify their "responsible" corporate actions and thus, articulate their motivations to inform (Bebbington, et al., 2008). Some disclosure motivations are related to negative events caused by the organization (Patten D., 1991) and adhere to greenwashing practices to divert the attention of interested parties through positive information on environmentally friendly actions to strengthen its social reputation (Lyon & Maxwell, 2011). Other disclosures are developed to address stakeholder pressure (Chithambo, et al., 2020). These pressures can differ widely according to the characteristics of the political, labor, and cultural system in which the company operates (Baldini, et al., 2018).

In accordance with the above, GHG disclosures present information gaps mainly due to contextual and inherent characteristics of the company. A relevant contextual characteristic, for this type of disclosure, corresponds to the geographic location in which the company operates. Accordingly, (Hoffmann & Weinhofer, 2010) point out that this factor is decisive for the prioritization process of a company's carbon strategy and, consequently, environmental management will depend firstly on regulatory pressures which are stricter in some territories that in others (Jayanthi, 2017) and secondly, by the pressure exerted by stakeholders according to their interests and regional environmental problems. Additionally, (Broadstock, et al., 2018) underscore that:

> "The firms have different stakeholders who are interested in different objectives, and also that multinational firms may well have similar stakeholders from different geographic regions that may well place more or less importance on the same objectives." (pág. 51)

The inherent characteristics of companies such as the size (Dhanda & Malik, 2020) and the industrial sector to which it belongs, for example electrical energy, mining & extraction, Natural gas ,and oil (Kolk & Pinkse, 2004; Okereke & Russel, 2010) are relevant to control the industrial effects derived from fossil fuel extraction and processing operations as activities that are considered the main causes of CO_2 emissions (Zhou, 2020). To control this type of emissions, for more than a decade some governments have established laws to establish a relationship between climate change agreements and the disclosure and performance of corporate emissions in their territories. For example, Australia passed the National Greenhouse and Energy Reporting Act 2007 (NGER Act)[24] and the United Kingdom passed the Climate Change Act 2008[25]. In emerging countries such as Colombia, the climate change management law[26] was issued in 2018 and is still in the regulatory process. Considering this generational gap in regulatory pressure, we can observe environmental and regional inequality to face climate change. This has a preponderant influence on the motivations to disclose information about GHGs. In this scenario, some Latin American countries have used fiscal policy tools such as the carbon tax to "encourage" companies to develop strategies to reduce their emissions and disseminate the results of their sustainable practices to access to compensation mechanisms (Goulder, 2013).

GHG disclosures research also related to the signaling theory (also known as the "voluntary disclosure theory") (Luo & Tang, 2014, p. 193). This theory allows us to understand those organizational practices derived specifically from the carbon strategies implemented and adopted within a CMS and their impact on emissions disclosure practices as a positive

[24] "(NGER Act) establishes the legislative framework for the NGER Scheme which is a national framework for reporting greenhouse gas emissions, greenhouse gas projects and energy consumption and production by corporations in Australia. Several legislative instruments sit under the NGER Act, providing greater detail about corporations' obligations (Australian Government - Clean Energy Regulator, 2021).

[25] "The Climate Change Act 2008 is the basis for the UK's approach to tackling and responding to climate change. It requires that emissions of carbon dioxide and other greenhouse gases are reduced and that climate change risks are adapted to. The Act also establishes the framework to deliver on these requirements. The Act supports the UK's commitment to urgent international action to tackle climate change" (Climate Change Committee, 2021).

26 Law 1931 of 2018. by which guidelines are established for the management of climate change.

management signal to stakeholders. This association implies that companies with better performance or efficiency in terms of carbon tend to disclose more voluntary information as a strategy to differentiate themselves from competitors and as a positive signal directed towards investors (Datt, et al., 2019). The voluntary disclosure theory highlights that companies that control their emissions can achieve a competitive advantage and can bear higher costs (Mateo-Márquez, et al., 2019). This is based on the fact that the disclosure of carbon emissions requires the development of a CMS that incorporates a qualitative and quantitative information analysis to accomplish short-term and long-term goals (Rodríguez et al., 2022). Hence, we propose the following hypothesis:

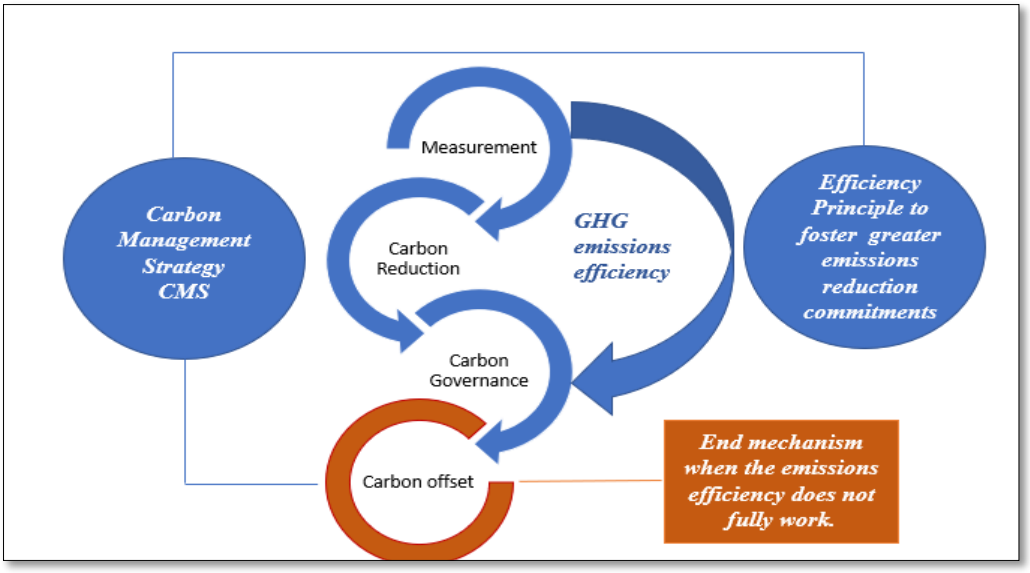
> Hypothesis 1. (H1): There is a relationship between the adoption of a high-quality Carbon Management Strategy and the disclosure of Direct Emissions, Indirect Emissions and Other Emissions in Colombian Companies.

4.2.1.1. The relationship between a Carbon Management Strategy (CMS) and the efficiency of GHG emissions.

The concept of CMS focuses on strategies aimed at mitigating climate change in which the concept of efficiency is involved through the reduction of GHG emissions. A CMS incorporates four fundamental dimensions (i) measurement; it refers to measuring the impact of carbon emissions in all business activities to establish the carbon footprint (ii) Carbon Reduction; it refers to the reduction of combustion emissions, production management, replacing inputs with high potential for emissions (iii) Carbon Governance; it refers to governance mechanisms, integration of carbon in investment decisions (iv) Carbon offset; it includes carbon trading with emission rights and other compensation mechanisms (Damert et al., 2017; Cadez et al., 2015; Rodríguez et al., 2022; Radu et al, 2020) These dimensions establish corporate environmental management mechanisms to improve organizational processes focused on establishing businesses that adopt concrete

and efficient actions to mitigate climate change. The incorporation of carbon strategies is directly related to the efficient management of GHG emissions (see figure 7).

Figure 7. The relationship between a Carbon Management Strategy and the efficiency of GHG emissions



Source: Own elaboration based on, Bai, et al., 2014; Damert et al., 2017; Cadez et al., 2015; Carbon Solutions Global, 2020; Li, et al., 2020; Rodríguez, et al., 2022; Radu et al., 2020.

From the perspective of emissions efficiency, some studies focus on regional behavior observing the economic characteristics and level of emissions. Bai, et al., (2014); Li, et al., (2020) use the principle of efficiency to refer to the responsibility of the territories with the highest emission levels and the reduction commitment they must assume. Other studies mention the concept of emissions efficiency from the perspective of industrial sectors and the pressure that regulatory institutions must exert to control sensitive sectors (Gao, et al., 2021). The transition to a low-carbon economy requires long-term efforts, so inadequate regulation for industrial sectors can lead to inappropriate operating practices that result in low levels of business investment that affect emissions efficiency (Alves, et al., 2019). Consequently, in the industrial sectors, efficiency is analyzed from the gaps generated in

energy consumption, the levels of technology implemented and the application of differential emission reduction strategies for each sector are also involved.

From the point of view of the companies, it is possible to replicate the principle of efficiency to assign a greater reduction commitment to those companies that are in environmentally sensitive sectors. In the business case, efficiency is analyzed based on the results of emissions reduction in commercial operations and in the supply chain (Scope 1,2,3). Rietbergen, et al., (2015) highlights the role of carbon accounting and corporate management as fundamental elements to achieve permanent improvement in the performance of GHG emissions. Likewise, they underscore that establishing GHG or energy emission reduction targets are key elements for evaluating voluntary or negotiated performance, even if ambitious goals are not achieved to optimize corporate environmental performance. In accordance with the above, we devised the following hypothesis:

> Hypothesis 2. (H2): There is a relationship between the adoption of a high-quality Carbon Management Strategy and the emissions efficiency of Direct Emissions, Indirect Emissions and Other Emissions in Colombian Companies.

4.3. Data source and methodology

The method described in this study is based on the disclosure of GHG emissions in a non-regulated country. Therefore, the content analysis of the sustainability reports is essential to obtain relevant information about the companies' emissions management and disclosure. In the reports of the analyzed country, we find heterogeneity in the information reports due to industrial differences, standards, initiatives, and information models of environmental information required by standardized certifying companies. In accordance with these contextual disclosure features, a manual data collection was carried out to elaborate the first research phase related to the consolidation of disclosure categories. The

information gathered from the sustainability reports led to an analysis of emissions disclosure in each of the scopes established in the GHG Protocol Corporate Accounting and Reporting Standard (WRI and WBCSD, 2010). Finally, we develop two empirical models to identify the characteristics of the context and the company-inherent characteristics in order to analyze the disclosure of carbon emissions and the efficiency of emissions from the Colombian companies' implementation of a carbon management strategy as detailed in this section.

4.3.1. Study Methodology

The study uses content analysis through the three phases implemented as addressed by Bardin, 2002: Phase (i) identification of GHG emission information disclosure by Colombian Companies: we classified the scope of emission through the GHG Protocol Corporate Accounting and Reporting Standard (WRI and WBCSD, 2010). We use three Scopes: (i) Scope 1- Direct Emissions Disclose: from activities controlled by the organization. (ii) Scope 2 - Indirect Emission Disclose: generated by electricity production plants as a result of the company's own consumption. (iii) Scope 3 - Other Emission Disclose: these are activities that occur in sources that are not owned by the company and that are not directly controlled. Phase (ii) categorization of sustainability reports: The coding of the information was carried out manually as follows: firstly, we identified the GHG disclosure of the companies related to scopes 1, 2 and 3 (disclosed in CO_2 equivalent). In some cases, we carried out the conversion of the GHG emissions to unify the information in the same unit. Phase (iii) Analysis: the research team discusses the results; two researchers audited the results produced by one member of the team.

Dependent variable Model – Carbon emissions disclosure: It is established by consolidating the presence or absence of each one of the scopes in sustainability reports. Model - Efficiency of carbon emissions: It is established by means of an indicator that is elaborated

under the business metric of emissions of scopes 1,2 and 3 divided into the company "income". This carbon efficiency ratio measures how efficient is a company in the sense of generating the maximum possible income producing the lowest possible GHG emissions (Busch et al., 2017; Galama & Scholtens, 2021). The variables are summarized in Table 18.

Table 18. Dependent Variables for the Carbon emissions disclosure and Efficiency of carbon emissions Models

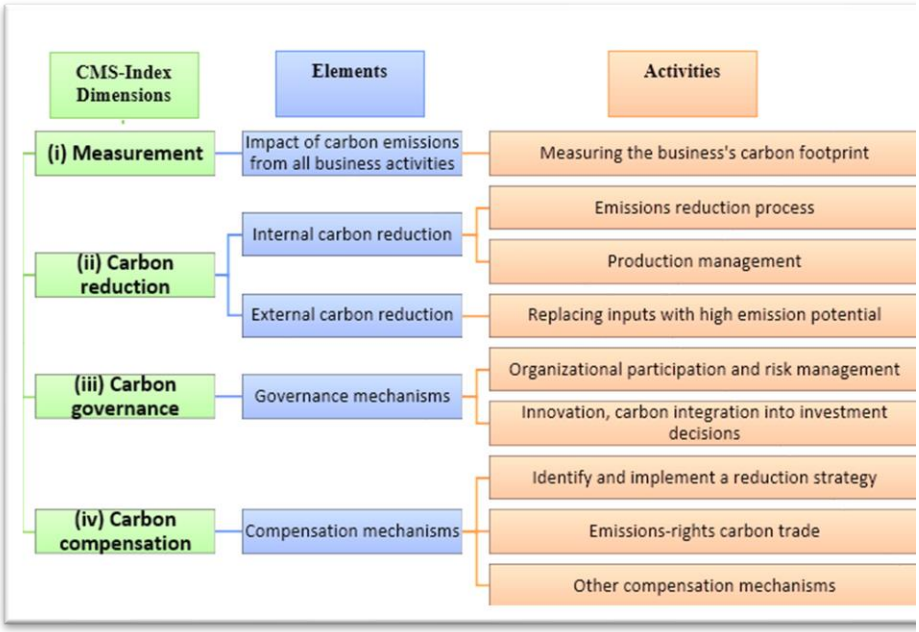
Variable	
Model – Carbon emissions disclosure	
Direct Emission Disclosure (DED)	Dummy variable: 1 is assigned to companies that disclose direct CO_2 emissions and zero (0) for those that do not.
Indirect Emission Disclosure (IED)	Dummy variable: 1 is assigned to companies that disclose indirect CO_2 emissions and zero (0) for those that do not.
Other Emission Disclosure (OED)	Dummy variable: 1 is assigned to companies that disclose other CO_2 emissions and zero (0) for those that do not.
Model - Efficiency of carbon emissions	
Direct Emission Measure (DEM)	Log (Total Direct Emissions /Income)
Indirect Emission Measure (IEM)	Log (Total Indirect Emissions / Income)
Other Emission Measure (OEM)	Log (Total Other Emissions / Income)

4.3.1.1. Explanatory variables

Following Rodriguez, et al., 2020 we used the theoretical constructs developed by (Cadez et al., 2015; Carbon Solutions Global, 2020; Damert et al., 2017; Radu et al., 2020) to identify four fundamental dimensions to define the adoption and quality of a CMS: (i) Measurement: Impact of carbon emissions from all business activities. (ii) Carbon reduction: internal and external emission reduction. (iii) Carbon governance and (iv) Carbon compensation mechanisms. The CMS-Index variable is established by consolidating the presence or absence of each one of the dimensions (each dimension scores 1 point, so the

CMS Index ranges from 0 to 4) after determining that each one of them meets at least one activity (see figure 8).

Figure 8. CMS- Index



Source: Own elaboration based on (Cadez et al., 2015; Carbon Solutions Global, 2020; Damert et al., 2017; Radu et al., 2020)

This study includes variables in relation to the company-inherent characteristics: (Size), this variable is measured as the natural logarithm of total assets (Choi, et al., 2020; Luo & Tang, 2020). It is expected that larger companies will have higher emissions disclosure than those categorized as small (Dhanda & Malik, 2020). The sensitive industry sector (Indsens) variable reflects the behavior of companies that are considered environmentally sensitive (Comyns, 2016; Lindblom, 1994; Patten D.M., 2002). Companies in environmentally sensitive industries have incentives for disclosure beyond their environmental performance (Cho & Patten, 2007; Kolk & Pinkse, 2004; Okereke & Russel, 2010). This is a dummy variable that equals 1 if the company belongs to an environmentally sensitive

industry (Electrical energy, Mining & Extraction, Natural gas) and 0 otherwise. Also, this study includes variables in relation to the companies´ context: Carbon tax (Tax), this variable represents the carbon tax in Colombia which was created in 2016. It is regulated and applied in the 2017- 2019 period (Rona, 2019). In the model, it is represented as a dummy variable equal to 1 for the year of implementation and 0 otherwise. Region this categorical variable represents the classification of the regions in the Colombian national development plan in the 2014-2018 period. This variable explains the Colombian territorial behavior (Dhanda et al., 2020; Hoffmann et al., 2010; Vogel, et al., 2020). This comprises five regions (1) Caribbean, (2) Central-East, (3) Central-South-Amazon of Colombia, (4) Eje Cafetero and Antioquia (5) Pacific. The variables are summarized in Table 19.

Table 19 Explanatory variables

Context	Explanatory Variable	Description
Carbon Management Strategy	**CMS- Index**	The index score is established by consolidating the presence or absence of each one of the dimensions (Measurement, Carbon reduction, Carbon governance, Carbon compensation) each dimension scores 1 point, so the CMS Index ranges from 0 to 4
Company-inherent characteristics	**Size:**	It is the natural logarithm of total assets.
	Indsens:	A dummy variable that equals 1 if the company belongs to an environmentally sensitive industry *, and 0 otherwise. (*Electrical energy, Mining & Extraction, Natural gas, and oil).
Companies´ context	**Tax:**	A dummy variable equivalent to 1 for the carbon tax implementation year in Colombia, 0 otherwise.
	Region	Categorical variable. This analyzes five regions (Caribbean, Central-East, Central-South, Eje Cafetero and Antioquia, Pacific) Ranges from 1 to 5.

4.3.1.2. Control variables

The following control variables are included in the study: (i) Return on assets (ROA). This variable is used in empirical studies to determine the financial implications of companies on carbon performance and disclosure (Browers, et al., 2018; Velte, et al., 2020). This also allows us to identify the effects of carbon efficiency and its relation to profit (Trinks, et al., 2020). It is measured as net income divided into total assets. (ii) Indebtedness: this variable detects the financial flexibility and the potential financial problems of the companies analyzed in this study in the Colombian context (Hatakeda, et al., 2012). Additionally, this variable can affect the companies' efficiency of direct and indirect CO_2 emissions since indebtedness forces companies to optimize production costs derived from their operations. It is defined as total debt divided into total assets. (iii) Shareholders: this variable represents the number of shareholders of the firm and their influence in CO_2 emissions disclosure and efficiency (Bueno-Garcia, et al., 2020; Kim, et al., 2020; Matsumura, et al., 2014).

4.3.2. Empirical model

To test the hypotheses, a regression model is used based on a balanced panel data to control individual and temporal effects. After implementing the Hausman test, the fixed effects model and the random-effects model were compared, and the results indicated that the most suitable model is that of fixed effects. After implementing the Breusch and Pagan Lagrangian test, the results suggest that the OLS ordinary least squares regression model is suitable for this study. We implement the Carbon emissions disclosure OLS model and the Efficiency of carbon emissions robust OLS model. Goodness-of-fit tests show normality for the models (Francia & Shapiro, 1972; Shapiro & Wilk, 1965). The equations to estimate the regression are the following:

Hypothesis 1 is tested using the following models:

$$Direct\ Emission\ Disclosure\ (DED)\ it = \beta 0 + \beta 1\ CMSIndex\ it\ + \beta 2\ Size\ it\ + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \beta 8 Region\ i\varepsilon \quad (1a)$$

$$indirect\ Emissions\ Disclosure\ (IED)\ it = \beta 0 + \beta 1\ CMSIndex\ it\ + \beta 2\ Size\ it\ + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \beta 8 Region\ i\varepsilon \quad (1b)$$

$$Other\ Emission\ Disclosure\ (OED)\ it = \beta 0 + \beta 1\ CMSIndex\ it\ + \beta 2\ Size\ it\ + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \beta 8 Region\ i\varepsilon \quad (1c)$$

Hypothesis 2 is tested using the following models:

$$Direct\ Emission\ Measure\ (DEM) = \beta 0 + \beta 1\ CMSIndex\ it\ + \beta 2\ Size\ it + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \beta 8 Region\ i\varepsilon \quad (2a)$$

$$Indirect\ Emission\ Measure\ (IEM) = \beta 0 + \beta 1\ CMSIndex\ it\ + \beta 2\ Size\ it + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \beta 8 Region\ i\varepsilon \quad (2b)$$

$$Other\ Emission\ Measure\ (OEM) = \beta 0 + \beta 1\ CMSIndex\ it\ + \beta 2\ Size\ it + \beta 3\ Tax + \beta 4\ Indsens + \beta 5\ indebtedness\ it + \beta 6\ ROAit + \beta 7 Shareholdersi + \beta 8 Region\ i\varepsilon \quad (2c)$$

4.3.3. Data sources and sample selection

The sample comprises Colombian listed companies for the period 2016 - 2019 with a total of 280 company-year excluding the financial sector. Ten company-year that did not issue sustainability report are excluded from the sample. The final sample includes 240 company-year. The data was first obtained from the sustainability reports of the GRI database and from the companies' websites to construct the information related to disclosure and efficiency of GHG emissions in Colombian companies to devise the dependent variable. The companies' financial data was obtained from the ORBIS database.

The regions subject to analysis are distributed according to the Colombian national development plan 2014-2018 based on the following groups: (i) characteristics of the territory in terms of social welfare, (ii) city system and the differentiation of degrees of rurality, (iii) regional characterization of the dynamics and incidence of the armed conflict (iv) strategic environmental zones of the country (Departamento Nacional de Planeación, 2015). Table 20 shows the statistics of the companies by region. Likewise, the business sectors according to the Bureau van Dijk (BvD) classification.

Table 20 Sample distribution by region - business sector (BvD) and sensitive sector

Distribution by business sector (BvD)	Caribbean	Central- East	Central- South	Eje Cafetero and Antioquia	Pacific	Freq.	Percent
Electrical energy*	4	12	4	12	8	40	17%
Mining & Extraction*	0	8	0	4	0	12	5%
Natural gas*	8	12	0	0	4	24	10%
Agriculture, Hortic..	0	0	4	0	24	28	12%
Business Services	0	0	0	4	0	4	2%
Cement, Leather, St..	0	8	0	4	0	12	5%
Communications	0	8	0	0	0	8	3%
Construction	0	0	0	8	4	12	5%
Food	0	8	0	0	12	20	8%
Leather, Stone, Cla..	0	0	0	4	0	4	2%
Media & Broadcasting	0	8	0	0	0	8	3%
Metals & Metal Prod..	0	8	0	0	0	8	3%
Printing & Publishing	0	0	0	0	4	4	2%
Retail	0	4	0	4	0	8	3%
Rubber & Plastic	0	4	0	12	0	16	7%
Textiles & Clothing.v	0	4	0	8	0	12	5%
Transport, Freight ..	0	4	0	0	0	4	2%
Waste Management & ..	0	0	0	4	0	4	2%
Wood, Furniture & P..	0	0	0	4	8	12	5%
Total	12	88	8	68	64	240	100%
Percent	5%	37%	3%	28%	27%	100%	

*Sensitive industry

The classification of sensitive sector is carried out based on the guidelines issued in the Colombian carbon tax law. This law covers activities related to fossil fuels and oil derivatives for energy purposes. This regulation focuses on the control of emissions and has a direct impact on companies in the oil, gas, and mining industrial sector (Kolk, et al., 2004). Moreover, carbon-intensive companies (Okereke & Russel, 2010) are taken as a reference. Accordingly, the sectors are analyzed grouping the business sectors as follows: Electrical energy, Mining & Extraction, and Natural gas.

Table 21 presents the descriptive statistics of the model variables. The mean value (Direct Emission Measure (DEM)) is -1.40 and min value is -5.68 and max value 1.73, with a standard deviation of 1.50 and a total of 152 observations. (Indirect Emission Measure

(IEM)) is -2.21 and the minimum value is -5.72 and the maximum value is 0.56 and a total of 128 observations. The mean value (Other Emission Measure (OEM)) is -1.96 and the minimum value is -4.56 and the maximum 0 with a total of 56 observations. These categories have a measurement scale of the logarithm of the amount of carbon CO_2 emissions equivalent divided into income. These statistical results show a decrease in the maximum disclosure range, mainly for the other emissions variable due to the significant decrease in companies that disclose this type of information. The CMS index presents a mean value of 2.32 considering that the maximum possible value is 4. It shows that companies are half-way to have a complete CMS. (Size) Firm size is measured by the natural logarithm of assets represented in thousands of dollars. Until 2019, Colombian companies classified their size following Law 905 of 2004. Accordingly, those that exceed 6.480 thousand dollars are considered large companies. The companies in the sample are considered large companies in the Colombian market, as the size ranges from 9,15 to 17,52 and the average value is 13.31. The variable (Indebtedness) presents an average of 2.44 showing a minimum of 0.73 and a maximum of 15 and a standard deviation of 2.09. The variable (ROA) presents a mean value of 3.15, a minimum of -28.42, and a maximum of 18.41. The variable (Shareholders) presents a composition range of the number of shareholders between 1 and 82, with a mean value of 9.4.

Table 21 Descriptive statistics of the variables

Variable	N.	Mean	Std. Dev.	Min	Max
Direct Emission Disclosure (DED)	240	.57	.49	0	1
Indirect Emission Disclosure (IED)	240	.49	.50	0	1
Other Emission Disclosure (OED)	240	.18	.39	0	1
Direct Emission Measure (DEM)	152	-1.40	1.50	-5.68	1.73
Indirect Emission Measure (IEM)	128	-2.21	1.43	-5.72	0.56
Other Emission Measure (OEM)	56	-1,96	1,32	-4.56	0
CMS-index	240	2.32	1.58	0	4
Size	240	13.31	1.85	9.15	17.52
Indebtedness	240	2.44	2.09	0.73	15
ROA	240	3.15	5.85	-28.42	18.41
Shareholders	240	9.4	11.77	1	82

4.4. Results and Discussion

4.4.1. Results

The SDGs have prompted organizations to disclosure sustainability-related information in non-financial reports. A study by PWC (2019) reveals that there are still differences in this type of disclosure of the SDGs in corporate reports worldwide. It also indicates that 97% of the Colombian companies analyzed in the study disclose matters related to the SDGs in their reports. In our study, we analyzed disclosure, specifically within the framework of SDG 13 through the concept of a CMS and the disclosure of scope 1, 2 and 3 of GHG emissions. We also analyzed carbon performance using an efficiency indicator of emissions when companies manage and disclose their emissions. In accordance with the above, we present the results of Carbon emissions disclosure and Efficiency of Carbon emissions models below.

4.4.1.1. Carbon emissions disclosure model

Tables 22 and 23 show the Pearson correlations and the variance inflation factor (VIF). Although some correlations are significant, the model does not show multicollinearity issues. The variance inflation factor (VIF) was calculated after the regression. Accordingly, if the VIF value is greater than 10, it is an indicator of a multicollinearity problem. The results obtained show that the explanatory and control variables were less than 6 with an average of 2.66, showing the absence of multicollinearity.

Table 22. Pearson correlations

	DED	IED	OED	CMS – Index	Size	Tax	Indsens	Indebtedness	ROA
DED	1.00	-	-	-	-	-	-	-	-
IED	-	1.00	-	-	-	-	-	-	-
OED	-	-	1.00	-	-	-	-	-	-
CMS – Index	0.70*	0.61*	0.24*	1.00	-	-	-	-	-
Size	0.59*	0.50*	0.19*	0.58*	1.00	-	-	-	-
Tax	0.03	0.07	0.08	0.20*	0.01	1.00	-	-	-
Indsens	0.47*	0.39*	0.45*	0.44*	0.24*	0.00	1.00	-	-
Indebtedness	-0.30*	-0.28*	-0.18*	-0.32*	-0.40*	-0.01	-0.19*	1.00	-
ROA	0.31*	0.18*	0.02	0.33*	0.08	-0.05	0.36*	0.04	1.00
Shareholders	-0.0	0.07	-0.02	0.01	0.13*	0.23*	-0.10	0.02	-0.07

*Significant at 5%.

Table 23. VIF

Variable	VIF	1/VIF
_IRegion_2	5.82	0.171769
_IRegion_5	5.64	0.177428
_IRegion_4	5.62	0.177957
CMS- Index	2.18	0.459747
Size	1.86	0.537856
_IRegion_3	1.67	0.599355
Indsens	1.60	0.626549
Indebtedness	1.33	0.753623
ROA	1.31	0.765441
Tax	1.17	0.851986
Shareholders	1.13	0.887816
Mean VIF	2.66	

Table 24 presents the results of the regression of Carbon emissions disclosure model. The results of the CMS Index variable show a positive and significant relationship (coefficient: 0.14 - p <0.001) with Direct Emission Disclosure - DED. The CMS index is also positive and significant for Indirect Emissions Disclosure IED (coefficient: 0.14 - p <0.001). Regarding the variables related to the companies´ inherent characteristics, the variable

(Size) is positive and significant (coefficient: 0.08- p <0.001) for Direct Emissions Disclosure - DED. Also, it is positive and significant for Indirect Emissions Disclosure - IED (coefficient: 0.05- p <0.001). In the case of Other Emissions Disclosure - OED there is no significant results. This indicates that larger companies tend to disclose scopes 1 and 2 emissions.

These results indicate that there is a positive relationship between the adoption of a high-quality CMS and the disclosure of emissions for scopes 1 and 2. The disclosure of emissions in scope 3 is not significant for the CMS index. The CMS Index incorporates characteristics of the context and characteristics of the companies presenting significant results of quality and adoption of a CMS. This occurs in large companies and in industries belonging to sensitive sectors due to the implementation of the carbon tax in Colombia (Rodriguez et al., 2022). This result is consistent with the results reported by Dhanda and Malik, (2020) in which the development of a CMS index applied to US companies suggests that "firms with an effective CMS are more likely to disclose their carbon emission information than the firms with less effective or no CMS" (p. 235). Regarding the size of the company, this result is also in line with Yunus, Elijido, & Abhayawansa, (2016) "in which the size of the company is positively correlated with the adoption of CMS" (p.172).

The disclosure of direct and indirect emissions (scope 1 and 2) of large Colombian companies is also related to the characteristics of the industrial sector in which they operate. In this study, 31% of the companies are grouped into the following sectors: electric power, mining and extraction, and natural gas. The emissions disclosure of these large companies is influenced by the context of voluntary disclosure in which case the companies adopt international disclosure methodologies for the specific sectors in which they operate. Therefore, large Colombian companies adopt a mimetic isomorphism that confirms a similar behavior of large companies worldwide. These large companies do not fully disclose their GHG emissions and focus their disclosure on controlled emissions (scope 1 and 2)

and reveal less information on other emissions (scope 3) (Blanco, et al., 2016; Depoers, et al., 2016; Sustainability Reports, 2019).

The variable (Indsens) is positive and significant for the DED (coefficient: 0.11- p <0.05) and IED (coefficient: 0.14 - p <0.05). For OED it is also positive and significant (coefficient: 0.36 - p <0.001). This suggests that those companies that belong to the sensitive sector disclose information of scopes 1,2 and 3. Particularly, there is a greater disclosure by these sensitive industries' companies in scope 3, in other words, they manage emissions in their supply chain and disclose emissions that are not included in their operations. According to Prado - Lorenzo, et al., 2009 companies generally disclose information on GHG as a mechanism that allows them to legitimize themselves and access certain benefits. Likewise, Bewley et al., (2000) emphasize that companies with a greater propensity to contamination and political exposure are more likely to disclose information. This finding is relevant in the Colombian context since companies that operate in sensitive industries have been associated with different environmental conflicts. For example, Ecopetrol SA has been categorized as one of the 100 companies responsible for 70% of global emissions according to the Carbon Disclosure Project report (2017).

The variable (Region) shows the behavior of the five analyzed regions compared to region 1 (the benchmark region). For model (1a) DED shows a negative and significant behavior in region 4 - Eje Cafetero and Antioquia (coefficient: -0.38- p <0.001). For model (2b) IED, this region also shows a negative and significant behavior (coefficient: -0.33- p <0.01) and for model (1c) OED shows the same result (coefficient: -0.38- p <0.001). Although this region had presented a positive and significant behavior due to the adoption of high-quality CMS (Rodríguez, et al., 2022), the results for DED, IED and OED do not reflect the same behavior to emissions disclosure. This implies that companies located in this region have developed important categories of qualitative information in their reports to highlight their

environmental carbon strategy actions. However, its environmental actions in quantitative terms Scope 1, Scope 2 and Scope 3, have not yet been disclosed in the sustainability reports. These results suggest that companies located in this region seek to legitimize and give a positive signal to their stakeholders through information related to the CMS without incorporating specific quantitative data that could be subject to public scrutiny in terms of GHG emissions.

Model (1b) - IED, region 3 Central South- shows a significant and negative behavior (coefficient: -0.54- p <0.01). Also, this region shows a significant and negative behavior in model (1c) OED (coefficient: -0.54- p <0.001). This last model shows a negative and significant behavior in region 2 - Central-East (coefficient: -0.40- p <0.001). These regions basically do not disclose information on indirect emissions. The foregoing indicates that the disclosure of emissions in each region can generate a dissimilar effect. Furthermore, the three models attest to a negative behavior in the coefficients of the analyzed regions. This means, in general terms, that the Colombian government must implement policies aligned with the territories to create climate plans and actions focused on the control of carbon emissions. This result may be a significant finding for the Colombian context and for other countries that have not yet established adequate and detailed disclosure criteria. In our study, the sustainability reports present global emissions results. In other words, companies do not provide detailed information by geographic sector, business operation, or location of their subsidiaries or branches. Generally, companies that belong to the sensitive sector are multinational companies that do not tie their disclosures to the context of the report. Global GHG reports do not facilitate control or research on the real impact of operations in a specific territory.

Control variable (ROA) is negative and significant in model (1c) OED (coefficient: -0.01- p <0.01). This indicates that companies have an adverse disclosing effect, particularly for

operations carried out in their supply chain as well as the differentiation and projection of non-controlled indirect emissions. The control variables (Indebtedness) and (Shareholders) are non-significant. This indicates that the indebtedness level is not related to the disclosure of scopes 1,2 and 3. Likewise, the number of shareholders does not affect emissions disclosure.

Table 24 Results of Regression Carbon emissions disclosure model

	Model (1a) -DED				Model (1b) -IED				Model (1c) -OED			
	Coef.	Std. Err.	P>t	S	Coef.	Std. Err.	P>t	S	Coef.	Std. Err.	P>t	S
CMS-index	0.14	.018	0.000	***	0.14	.021	0.000	***	0.01	.019	0.350	
Size	0.08	.014	0.000	***	0.05	.017	0.001	***	0.02	.015	0.172	
Tax	-0.07	.049	0.138		-0.05	.057	0.322		0.04	.052	0.359	
Indsens	0.11	.054	0.032	*	0.14	.062	0.020	*	0.36	.057	0.000	***
Indebtedness	-0.00	.010	0.831		-0.01	.012	0.325		-0.02	.011	0.081	
ROA	0.00	.003	0.141		-0.00	.004	0.423		-0.01	.004	0.005	**
Shareholders	0.00	.001	0.895		0.00	.002	0.081		-0.00	.001	0.925	
_IRegion_2	-0.18	.099	0.069		-0.09	.115	0.402		-0.40	.105	0.000	***
_IRegion_3	-0.17	.143	0.236		-0.54	.165	0.001	**	-0.54	.151	0.000	***
_IRegion_4	-0.38	.104	0.000	***	-0.33	.121	0.006	**	-0.38	.110	0.001	***
_IRegion_5	-0.17	.106	0.112		-0.05	.123	0.656		-0.16	.112	0.136	
_cons	-0.16	.216	0.002	**	-0.45	.250	0.070		0.11	.228	0.610	
R-sq	0.62				0.51				0.33			
adj. R-sq	0.61				0.49				0.30			
Rmse	0.30				0.35				0.32			

Notes: No. of observations = 240; p > F = 0.0000; * p<0.05, ** p<0.01, *** p<0.001

4.4.1.2. Efficiency of carbon emissions model

Table 25 shows variance inflation factor (VIF) Efficiency of a Carbon emissions model. The variance inflation factor (VIF) was calculated after the regression. Accordingly, if the VIF value is greater than 10, it is an indicator of a multicollinearity problem. The results obtained

show that the explanatory and control variables were less than 6 with an average (scope1 - 2.06, scope 2 -1.95, scope 3- 2,32) showing the absence of multicollinearity.

Table 25. VIF model Efficiency of a Carbon emissions

Model (2a) – DEM			Model (2b) – IEM			Model (2c) – OEM		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
_IRegion_4	4.13	0.242	_IRegion_2	3.48	0.287	_IRegion_5	4.03	0.248
_IRegion_2	4.12	0.242	_IRegion_4	3.43	0.291	CMS-Index	2.69	0.372
_IRegion_5	3.12	0.320	_IRegion_5	2.79	0.358	_IRegion_4	2.47	0.405
CMS-Index	1.67	0.599	Size	1.69	0.591	Size	2.43	0.411
Size	1.59	0.629	ROA	1.54	0.648	Indebtedness	2.32	0.431
ROA	1.51	0.660	CMS-Index	1.54	0.648	Indsens	2.26	0.442
Indsens	1.43	0.700	Tax	1.34	0.743	_IRegion_2	2.15	0.465
_IRegion_3	1.39	0.718	Indsens	1.30	0.767	Tax	1.98	0.505
Tax	1.30	0.771	Shareholders	1.20	0.834	Shareholders	1.46	0.686
Shareholders	1.20	0.835	Indebtedness	1.15	0.867	ROA	1.41	0.710
Indebtedness	1.19	0.839						
Mean VIF	2.06		Mean VIF	1.95		Mean VIF	2.32	

Table 26 presents the regression results. Model (2a) – DEM, shows the variable (Indebtedness) as negative and significant (coefficient: -0,54 - $p < 0.05$). Also, model (2b)-IEM presents a negative and significant relation in this variable (coefficient: -0.94 - $p < 0.01$). The emissions indicator used to measure the efficiency of the Colombian companies reflects a connection with indebtedness. This variable shows a significant and negative behavior for the emissions controlled by the company (scope 1 and 2) meaning that highly leveraged companies tend to be more efficient to manage emissions scope 1 and 2. Peng, et al., 2014 underscore that it is possible that negative signs of leverage are directly related to a lower level of disclosure of carbon information by companies with high leverage. Companies that use the source of financing present a risk associated with the lack of investment possibilities in new technologies that make significant emissions' reductions (Busch & Lewandowski, 2017). In the Colombian context, "listed companies maintain debt

levels close to 60% in the case of total debt" (Meneses-Cerón, et al., 2021). Therefore, this result indicates that Colombian companies opt for indebtedness to acquire technology that contributes with higher efficiency of emissions. In this case, indebtedness can generate positive trends in management and strengthen commitment of governance on environmental responsibility matters. The finding above is aligned with Trinks, et al., (2020) which reports that when carbon emission become more expensive, companies with lower-carbon production technologies are benefited in comparison to those with higher-carbon technologies. Therefore, the debt ratio would have an impact considered a financial posturing to align the company's environmental objectives.

Table 26 Results of Regression Efficiency of a carbon emissions model.

	Model (2a) – DEM				Model (2b) – IEM				Model (2c)- OEM			
	Coef.	Std. Err.	P>t	S	Coef.	Std. Err.	P>t	S	Coef.	Std. Err.	P>t	S
CMS-Index	-0.02	0,15	0,89		0,38	0,15	0,02	*	-0,45	0,24	0,85	
Size	0,6	0,09	0,53		-0,06	0,1	0,56		-0,34	0,13	0,02	*
Tax	0,14	0,33	0,66		-0,42	0,32	0,20		-0,76	0,52	0,15	
Indsens	-0,52	0,29	0,08		-0,54	0,29	0,06		-0,94	0,66	0,16	
Indebtedness	-0,54	0,22	0,017	*	-0,94	0,29	0,00	**	-0,17	0,57	0,76	
ROA	0,01	0,02	0,701		0,00	0,28	0,92		-0,01	0,53	0,91	
Shareholders	-0,02	0,008	0,007	**	-0,02	0,009	0,03	*	-0,02	0,017	0,24	
_IRegion_2	-0,35	0,3	0,246		-0,34	0,33	0,32		0,05	0,43	0,9	
_IRegion_3	-1,13	0,27	0,00	***								
_IRegion_4	-0,13	0,44	0,758		-0,26	0,48	0,60		-0,15	0,48	0,75	
_IRegion_5	-0,63	0,43	0,152		-0,44	0,41	0,29		-0,47	0,63	0,45	
_cons	-0,5	1,38	0,716		1,14	1,6	0,48		4,76	2,31	0,05	*
R-sq	0,11				0,20				0,35			
adj. R-sq	0,042				0,13				0,21			
Rmse	1.47				1,44				1,17			
N	152				128				56			

p > F = 0.0000; * p<0.05, ** p<0.01, *** p<0.001

Model (2a) – DEM, shows a negative and significant coefficient for the variable (Shareholders) (coefficient: -0.02 - p <0.01). Also, model (2b) IEM, presents a negative and significant relation in this variable (coefficient: -0.02 - p <0.05). This result could be associated with the information reported to shareholders about future costs and possible

risks derived from the operation of the business related to emissions. By reducing this asymmetry of information between the company and the shareholders, the management and allocation of scarce resources is facilitated (Matsumura, et al., 2014). A negative result in this variable indicates that the shareholders of the analyzed companies may put some pressure on managers to disclose, manage and control carbon emissions, thus guaranteeing the incorporation of costs of environmental initiatives. Investors are also increasingly incorporating environmental criteria in their investment decisions in a significant way (Benz, et al., 2020).

Model (2a) - DEM, presents a negative and significant coefficient for variable (Region 3-Central South) (coefficient: -1.13 - $p < 0.001$). This indicates that companies located in this region show an emissions efficiency ratio compared to region 1 (the benchmark region). This region presents a small sample of observations. Those companies geographically located in this region only present emissions related to scope 1. Likewise, it is necessary to highlight that the other regions also present a negative result. This generality indicates that the analyzed regions show efficiency for scope 1 although they are in a very germinal stage of implementing actions that respond to the efficiency of emissions.

Our findings suggest that the (CMS-index) presents a positive and significant result for controlled indirect emissions (Model 2b IEM, coefficient: 0.38 - $p < 0.05$). This indicates that Colombian companies with a higher quality CMS present lower efficiency of scope 2 emissions. This result suggests that companies which produce a considerable level of emissions but establish a high-quality CMS have the capacity to carry out strategic changes (changes in electricity providers that use renewable sources or efficient plants). This has the purpose of improving its cost indicators associated with the consumption required in its commercial operations (Busch and Lewandowski, 2017). These companies also use compensation mechanisms using financial instruments. In the Colombian context,

companies which belong to the energy sector have entered the green energy certificate market since 2017 (for example, Enel-Emgesa, EPM). These companies operate as agents under the international standard REC (Renewable Energy Certificates). This accreditation allows non-regulated companies to certify the use of renewable energy in any technological source. This means that the companies registered in this program have a clean energy certificate that allows them to differentiate their consumption and their reduction mechanisms in scope 2. In the analysis of the sustainability reports, we found that different companies operate under this REC model (Pacto Global Colombia - Red Colombia, 2020). This result can also be associated with regulations issued by the Ministry of Mines and Energy (Resolution 40807 of 2018), a standard that promotes "reducing vulnerability to climate change and promoting low-carbon development at the Sectorial level, strengthening and protecting the sustainability and competitiveness of the mining-energy industry". These actions are developed through the PROURE program - Program for the rational and efficient use of energy. These types of actions are directed to the industrial sector with a monitoring stage through the use of the RENARE platform (National Registry for the reduction of GHG emissions). This platform registers the projects associated with the reduction of emissions for Colombian companies. Likewise, companies that incorporate efficient energy management mechanisms have tax incentives such as the investment deduction up to 50% of their income statement, exclusion of sales tax and tariff-type advantages for this type of investments (República de Colombia, 2021)

Model 2c – OEM, presents a negative and significant coefficient for the variable (Size) (coefficient: -0.34 - $p < 0.05$). This result is associated with the efficiency of emissions in scope 3. Size is the only relevant variable for other indirect emissions. This result involves two fundamental elements: i) The number of companies that disclose this type of emissions is small. In this group of companies, we found mainly those that are part of the sensitive sector, electric power, mining & extraction, natural gas and oil. ii) large companies usually have the capacity to control indirect emissions associated with production activities within

the value chain. This type of emissions adjusts flexibly to large companies and do not represent substantial changes in long-term production activities (Busch & Lewandowski, 2017; Trinks, et al., 2020). The other variables do not represent a significant behavior.

4.5. Discussion

The results of the Carbon emissions disclosure model suggest that the CMS index is decisive in the disclosure of emissions of scope 1 and 2. The size of the company is significant for voluntary disclosure. In the sustainability reports, we identified international disclosure methodologies in accordance with the company-industrial sector. In accordance with the above, Colombian companies develop a mimetic isomorphism in relation to the disclosure of companies from other regions in which direct emissions are disclosed more frequently (scope 1 and 2) and the disclosure of indirect emissions is limited (scope3). Although it was evidenced that sensitive industries tend to disclose the three categories of emissions, it is important to highlight the interest of these companies to legitimize their actions and issue a signal of environmentally responsible behavior to their stakeholders (Datt, et al., 2019). Our results show that companies that operate in a sensitive industry in an emergency economy as Colombia tend to have a similar behavior of companies in a developed country. Considering that Colombia in a non-regulated GHG emissions market, sensitive industry companies tend to disclose GHG emissions voluntarily, while in regulated GHG emissions markets (generally developed countries) disclose GHG emissions in compliance with in-forced regulations. It is also interesting to note that companies design and incorporate the elements of a CMS without knowing they are doing so. This is problematic, as the CMS elements are created but not as part of an emissions management process or with a strategic vision.

The regional performance is deficient. Although in some regions a significant performance is observed in the qualitative content of the sustainability reports, the quantitative content

that involves the measurement of the carbon footprint and the registration of reduction commitments that allow the validation of indicators in the short, medium and long term are still of limited disclosure. This generalized result in all the analyzed regions suggests that companies are not willing to disclose information that sends a negative signal of their environmentally inefficient actions. This study also shows that the sustainability reports do not disclose detailed information by geographic location where they carry out their operations. This situation restricts the analysis of the real impact that companies generate in the different locations. This shows that companies in non-regulated GHG emissions markets tend to cherry-pick the information they disclose in relation to GHG emissions, especially those that do not operate in a sensitive sector (because usually sensitive sectors are exposed to some king of regulation or tend to be in the limelight). Disclosure regulation and assurance of the information must be implemented to avoid cherry-picking.

In the Efficiency of Carbon emissions model, the CMS index is significant for controlled indirect emissions. In other words, companies that incorporate CMS criteria are able to seek more efficient alternatives with their electricity providers or establish cooperation agreements for the use of renewable sources that allow them to improve their financial indicators in operational management and promote the reduction of CO_2 emissions. In accordance with this result, since 2017 Colombian energy companies began the process of operating as agents of international standards REC (Renewable Energy Certificates) to facilitate the incorporation of non-regulated companies into clean energy processes. The scope 3 emissions model has a reduced number of disclosures, and the size variable is the only variable which is related to the efficiency of emissions. These results show that even though companies create and implement the elements of a CMS without knowing they are creating a CMS, the effect produced by these implemented elements produce a similar effect of those created by a CMS. But this is in relation to scope 1 and 2 emissions, the desired effects are not produced at scope 3 level. This is reasonable, as scope 3 emissions require a more strategic vision.

We identified that Colombian companies use leverage mechanisms to acquire technology, thus managing innovation projects that allow them to manage their GHG emissions more efficiently. Additionally, the shareholders have an impact on the efficiency of emissions. This is associated with the fact that these shareholders increasingly incorporate environmental criteria in their investment decisions. Also, the voluntary disclosure of direct and indirect emissions allows shareholders to obtain information to exert pressure on managers to disclose, manage and control CO_2 emissions. This also aids them to obtain relevant information on future costs that affect profit margins in the midterm and long-term. Efficiency behavior in the regions is focused on scope 1. Nonetheless, it is important to underscore that Colombian companies are in a very germinal stage and require actions of greater coverage aligned with regional policies and plans. Likewise, it is pertinent to highlight that the national and regional regulatory context is still limited. A coordination between national and regional governments and the public sector is needed.

4.6. Conclusions

All territories worldwide have experienced adverse effects generated by climate change derived from the increase in GHG emissions. Therefore, the SDGs, in particular SDG 13 "Climate Action" seeks to foster actions to develop strategies that promote decarbonization (United Nations, 2021). Accordingly, companies have also developed actions to manage their environmental incidents and therefore have revealed results related to this problem in the sustainability report. Therefore, this research focuses on two fundamental elements: (i) the disclosure of GHG emissions and its relationship with a Carbon Management Strategy (CMS) and (ii) the efficiency of emissions when companies disclose and manage scopes 1,2 and 3.

In accordance with the above, in the Carbon emissions disclosure model we studied the relationship between a CMS with the disclosure of emissions. In this regard, in this study we established that companies that incorporate CMS elements in their sustainability reports (although they do not directly mention this strategic concept in their reports) tend to disclose scopes 1 and 2. The results of the variables of this model are comparable with the results obtained in studies carried out in other regions of the world(mainly, considering the implementation of a CMS, the company size, and sensitive industries). The regional analysis is typical in the Colombian context showing a high component of qualitative information when disclosing GHG emissions. However, qualitative information is still limited. In this regard, this information gap has recently been questioned in developed countries (eg, the United States), generating parameters for climate reporting with assurance and certification requirements to identify the risks associated with qualitative and quantitative information (KPMG, 2022). The regional results of this model are also essential to understanding territorial differences and encourage sub-national governments to seek new actions to meet the objectives proposed for the decarbonization process in the regions.

The Carbon emissions efficiency model has incorporated in this study a business metric based on the emissions of companies in a given period (2016-2019) in relation to the income generated (generate the maximum amount of income with the least GHG emissions possible). In this regard, Galama & Scholtens, (2021) points out that "the sample studies are not always clear what exactly is being used as the denominator about the emissions, implying that the literature is subject to the homogeneity problem" (p.4). Mainly, this information heterogeneity and the different methodologies of analysis are associated with the information gap generated by companies when disclosing their absolute and relative emissions. Therefore, it is necessary that companies improve the quality of disclosure of GHG and, in turn, governments advance actions that promote and ensure a mechanism that allows the systematic and urgent integration of information related to GHG in Colombia

and in other non-regulated Latin American countries. Mainly prioritizing companies belonging to sensitive sectors with high emission levels.

This study provides evidence of corporate strategies to advance in the use of cleaner technologies through instruments offered by the Ministry of Mines and Energy regulations and the implementation of the carbon tax in Colombia, as well as business decisions to use the indebtedness to invest in efficient technologies that allow them to align financial objectives with environmental objectives. This corporate posture is associated with the pressure exerted by the interested parties, mainly the shareholders. From the perspective of the legitimacy and signaling theories, this study shows that environmentally sensitive companies tend to disclose more information about the management of their emissions. To our knowledge, this is the first study carried out in Colombia and in Latin America that incorporates elements of a CMS to analyze the disclosure and efficiency of GHG emissions. Due to the above, the contextual and inherent study of companies is significant and is considered of great interest to the government, shareholders, and suppliers, but mainly to civil society and environmental leaders interested in the development of public policies that strengthen the actions to mitigate climate change effects.

4.6.1. Implications of this study

The analysis of GHG emissions disclosure in the sustainability reports and the GHG emissions efficiency of non-regulated countries unveil an information gap that limits the interpretation of public and private actions related to climate change. In the introduction, we posed two fundamental questions: What can be done when the information required for emissions analysis is not available from an official source? and, how to analyze the sustainability reports and GHG emissions of non-regulated countries? In this study, we analyze the main characteristics of the Colombian context and the inherent characteristics of the Colombian companies to understand the organizational behavior in the disclosure

and efficiency of GHG emissions. Nonetheless, to a certain extent, this cannot be compared with the results from countries where GHG emissions are regulated. Therefore, the main implication of the study is to promote new research methodologies that can be used in Latin American countries (another emerging economies) for a better understanding or regional features and thus, advancing towards accomplishing the goals established in the 2030 agenda and the decarbonization processes for the year 2050.

In accordance with the above, the following implications stand out:

• This study provides results that help companies to incorporate and disseminate carbon management strategies -CMS- to manage direct and indirect emissions and improve indicators related to climate action (SDG 13) in the 2030 Agenda.

• This study also offers a regional analysis and prompts companies to improve their actions related to emissions from a community-based perspective incorporating territorial information for governments to establish the impact of industrial activities in each region.

• Colombian companies´ financial management is sensitive due to their indebtedness level. However, within the climate change mitigation context, companies' indebtedness rises to invest in cleaner technologies, and this is considered an advance to match environmental objectives with their financial objectives. In this regard, it is expected that Colombian regulations encourages companies to invest efficiently in cleaner technologies by means of state financing.

• The SDG indicators in Latin America suggest that after the crisis caused by COVID 19, trends of stagnation or regression have taken place (United Nations, 2022). Therefore, the degree of confrontation between governments is greater and requires alliances with the private sector to strengthen the challenges posed by the planetary boundaries. This implies a greater regulatory effort in terms of GHG emissions.

CONCLUSIONES

5. Conclusiones

El cambio climático está considerado como uno de los limites planetarios[27] (Dao, Peduzzi, & Friot, 2018). Esta realidad global ha sido confirmada claramente por la comunidad científica destacando la necesidad de emprender esfuerzos urgentes y reales para la reducción sustancial de las emisiones globales de gases efecto invernadero (Chomsky, 2017). Esta problemática ambiental global se ha instalado en un discurso planetario a partir de los Objetivos de Desarrollo Sostenible. Los ODS se consideran el mapa de navegación y la ruta que establece acciones decisivas por parte de todos los actores sociales para enfrentar y mitigar los riesgos a los que se enfrentan las actuales y futuras generaciones.

La búsqueda de estabilidad de los sistemas a escala planetaria representa un desafío para los líderes a nivel global. Principalmente, por la acelerada pérdida de biodiversidad y el alto componente de emisiones de GEI expulsados a la atmósfera derivados de las actividades industriales desarrolladas en una economía basada en los combustibles fósiles. En este contexto, países como China, Estados Unidos, Rusia y países de la Unión Europea se consideran algunas de las potencias más contaminantes y se les atribuye mayor responsabilidad. En contraste, países ubicados en regiones en desarrollo como América Latina se le atribuye una responsabilidad menor a pesar de considerarse una de las regiones altamente frágiles a sus efectos (Comisión Económica para América Latina y el Caribe/Alto Comisionado de las Naciones Unidas para los Derechos Humanos (CEPAL/ACNUDH), 2019; WRI, 2022).

Diversos estudios académicos han analizado los efectos del cambio climático principalmente en países regulados en emisiones de GEI y en los países más

[27] Emisiones de GEI acumuladas restantes (incluidos los cambios en la cobertura del suelo) para un 50 % de probabilidad de mantenerse por debajo de un aumento de 2 °C para 2100 en comparación con el nivel preindustrial.

contaminantes a nivel mundial (Charnock & Hoskin, 2020; Doni y Johannsdottir, 2021; Hwang, et al., 2021; Yunus, Elijido-Ten, & Abhayawansa, 2019; Yunus, Elijido, & Abhayawansa, 2016). Ante esta creciente dinámica de investigación por parte de la comunidad científica en el análisis de la acción climática en los territorios, hemos visto la importancia de desarrollar estudios en países emergentes no regulados en emisiones de GEI y en informes de sostenibilidad.

De acuerdo con lo anterior, esta tesis planteó analizar el nivel y calidad de divulgación del ODS 13 (Acción por el Clima) así como la divulgación y eficiencia de emisiones de GEI a través de una Carbon Management Strategy, incorporando características contextuales e inherentes a las empresas colombianas. La orientación teórica y metodológica de la tesis se fundamentó en el concepto denominado "Carbon Management Strategy" a partir de las definiciones aportadas en la literatura internacional (Cadez et al., 2015; Carbon Solutions Global, 2020; Damert et al., 2017; Radu et al., 2020).

El planteamiento de esta tesis se ha fundamentado en distintas teorías. La importancia de la teoría de la legitimidad se basa en la consideración de las características de comunicación (acciones corporativas "responsables") y estrategias de gestión relacionadas con CMS, que utilizan las organizaciones para adaptarse a las exigencias sociales, económicas, políticas y ambientales que les permiten enfrentar, adquirir y salvaguardar su legitimidad (Bebbington, et al., 2008; Comyns, 2016; Dowling & Pfeffer, 1975; Lemaire, 1997; Lindblom, 1994;).

A lo largo de esta tesis doctoral destacan los stakeholders como un aspecto muy relevante ya que son participantes decisivos en los procesos de reducción de GEI. Ello se debe principalmente, a la influencia que ejercen para que las corporaciones cumplan las demandas sociales y ambientales (Cotter & Najah 2011; Freeman, 1984). Por ello, en esta tesis la teoría de los stakeholders constituye un referente importante para establecer el

relacionamiento de las empresas con las partes interesadas (gobiernos, inversionistas, clientes, ONG, proveedores y competidores) y de esta manera asociar el enfoque de responsabilidad social de las empresas y su conexión con la estrategia ambiental y de carbono. También, para comprender si la empresa gestiona sus emisiones por presiones regulatorias, por la gestión de sus costos, por su reputación o por el efectivo cumplimiento de sus responsabilidades con la sociedad. (Baboukardos, Beddewela, & Soobaroyen, 2021; Jayanthi, 2017).

Adicionalmente, para comprender las prácticas de divulgación de emisiones de GEI y la intencionalidad de la comunicación de los emisores de información a sus stakeholders, incorporamos la teoría de la señalización o teoría de la divulgación voluntaria (Luo & Tang, 2014), para identificar el propósito y "calidad" de la información que se genera del remitente al receptor (Connelly, et al., 2011; Yasar, Martin, & Kiessling, 2020). De esta manera se puede indagar acerca de los niveles de divulgación y los mecanismos que usan las empresas para diferenciarse de la competencia como una señal dirigida a los accionistas (Datt, et al., 2019). Asimismo, incorporamos el concepto de greenwashing para analizar si las empresas realizan acciones para reducir sus emisiones o, por el contrario, presentan una brecha de información acerca de lo que divulgan y su compromiso real con el medio ambiente. Al mismo tiempo, abordamos el concepto de SDG-washing para analizar si existe un compromiso simbólico más que sustantivo acerca del ODS 13 (Heras-Saizarbitoria, Urbieta, & Boiral, 2022; Kornieieva, 2020).

De acuerdo con lo expuesto anteriormente, a continuación, se presentan las principales conclusiones de nuestra investigación:

Conclusiones

Primera conclusión:

La estrategia empresarial para la gestión de emisiones de GEI presentó un comportamiento paulatino y progresivo en la implementación y calidad de divulgación de una CMS en las empresas colombianas debido principalmente a factores asociados al contexto y a las características inherentes de la empresa.

La implementación de una Carbon Management Strategy en las empresas colombianas se ha desarrollado paulatina y progresivamente por diferentes fatores. En primer lugar, el auge de los procesos de comunicación acerca de los ODS y específicamente de la acción climática toma fuerza en los informes de sostenibilidad de las empresas a partir del año 2016, año posterior a la puesta en marcha de los Objetivos de Desarrollo Sostenible. En segundo lugar, en el contexto colombiano en el año 2016 el gobierno toma medidas relacionadas con los compromisos establecidos en la agenda 2030 y sus compromisos de reducción de emisiones e incorpora como mecanismo fiscal el impuesto al carbono. Este mecanismo logra ejercer presión regulatoria para que las empresas inicien un proceso de medición de la huella de carbono y ejecuten mecanismos de compensación para responder a este nuevo enfoque fiscal. En tercer lugar, los gobiernos regionales jugaron un papel característico mediante sus planes de desarrollo enfocados al cambio climático entre los cuales se incentiva la participación de las corporaciones autónomas regionales (CAR) para ejecutar proyectos público-privados. Asimismo, sobresalen iniciativas regionales como las desarrolladas por el Banco$_2$, vinculando a las empresas en acuerdos de cooperación con las comunidades para realizar acciones de mitigación y compensación. En cuarto lugar, encontramos mayor nivel y calidad de divulgación de una CMS en las empresas más grandes y en las que se ubican en industrias consideradas ambientalmente sensibles al cambio climático. Estos hallazgos agrupan las presiones externas mencionadas anteriormente, a la vez que muestran como las características inherentes a las empresas como el tamaño y pertenecer a un sector sensible definen, motivan e impulsan a las compañías a generar información con destino a sus stakeholders y de esta manera mantener y salvaguardar su legitimidad (Dowling & Pfeffer, 1975; Lindblom, 1994).

Segunda conclusión:

Aunque el gobierno nacional ha implementado mecanismos de política fiscal como el impuesto al carbono, se requiere un esfuerzo mayor de regulación y articulación con las entidades territoriales y con el sector empresarial para enfrentar el cambio climático. Nuestros hallazgos evidencian brechas importantes entre la política pública y el comportamiento del sector privado para enfrentar la estrategia colombiana de desarrollo bajo en carbono.

Colombia ha establecido la Estrategia Colombiana de Desarrollo Bajo en Carbono (ECDBC), cuyo objetivo se centra en facilitar y promover las condiciones para orientar al país hacia un desarrollo económico bajo en emisiones de GEI. Este es un proyecto de corto y mediano plazo y tiene como objetivo cumplir con los desafíos regionales y sectoriales para reducir las emisiones de GEI (Ministerio de Medio Ambiente, 2022). Después de una década del inicio de esta estrategia, las emisiones de GEI no están reguladas en Colombia y esto crea una brecha importante para establecer cambios en el comportamiento organizacional para cumplir con la meta de descarbonización para el año 2050. Aunque, la segunda fase de implementación de la ECDBC se inició en el 2018 con un direccionamiento estratégico frente a los resultados concretos con el sector empresarial, nuestros hallazgos evidencian brechas que pueden considerarse un obstáculo para el cumplimiento de esta estrategia:

1) Brecha entre el gobierno central y los territorios:

   El gobierno colombiano requiere mecanismos de gobernanza que le permitan fortalecer su interacción con los territorios y fijar mecanismos de regulación de las empresas con actividades más contaminantes. También, es necesario que el gobierno nacional priorice las condiciones sociales, económicas y ambientales de las regiones y enfatice sus esfuerzos en las regiones vulnerables (ej. región pacifico). Nuestros hallazgos evidencian que el sector empresarial ubicado en la

región pacífica tiene un aporte limitado frente a las acciones relacionadas con el cambio climático.

2) Brecha entre el sector público y privado:

Las alianzas y los planes territoriales deben alinearse con fuerza con el sector productivo para incentivar y asegurar acciones concretas de lucha contra el cambio climático. Al respecto, uno de los vacíos estratégicos del sector público se encuentra en el hecho de no controlar los resultados de emisiones y de reducción de carbono por parte del sector empresarial. El informe del año 2020 por parte del gobierno de Colombia acerca de la presentación de contribuciones determinadas a nivel nacional (NDC), no incluye información de mitigación relacionada con las empresas y los territorios (Gobierno de Colombia, 2020). Esta inexistencia de información pública acerca de las emisiones del sector empresarial restringe la toma de decisiones del gobierno en relación con la incidencia real del sector empresarial frente al cambio climático.

Tercera conclusión:

A pesar del avance en la implementación y divulgación de una CMS en las compañías colombianas, el progreso del sector empresarial colombiano en materia de cambio climático es aún muy incipiente para los desafíos planteados en la agenda 2030. Al respecto, el nivel y calidad de divulgación del ODS 13 presenta brechas de información cualitativa (información simbólica) y cuantitativa (información sustantiva). Estos hallazgos se asocian con prácticas de greenwashing y SDG-washing.

El primer estudio empírico desarrollado en el marco de la tesis se enfocó en la meta 13.2 que formula la necesidad de incorporar medidas relacionadas con políticas, estrategias y

planes del cambio climático. Desde la perspectiva del sector empresarial y con un análisis de su comportamiento en las regiones y en los sectores, hemos podido establecer un avance limitado de las acciones climáticas. Nuestra elaboración y comparación de los índices ODS 13 cualitativo y cuantitativo respectivamente, muestran de forma certera la brecha que existe en los niveles de divulgación cualitativa y cuantitativa. Principalmente, las empresas se centran en las categorías de divulgación cualitativa (simbólica) en las que se esmeran por informar acerca de acciones ambientalmente proactivas. Sin embargo, cuando se analizan las categorías relacionadas con las acciones tangibles de medición, reducción y compensación de emisiones de GEI, los resultados indican una disminución significativa en el nivel y calidad de divulgación. Todo lo anterior, muestra una baja conexión de las acciones descritas por la empresa y las cifras que respaldan el compromiso real con el cambio climático. Estos resultados se asocian con comportamientos de greenwashing y SDG-washing.

Los hallazgos señalados anteriormente, permiten indicar que la divulgación que se produce para informar acerca de las acciones del cambio climático debe contener un referente informativo solido de datos cuantitativos que respalden los hechos y logros reales de la organización. No basta con mencionar cuestiones superficiales que se interpreten por parte de los stakeholders como acciones que contribuyen al cambio climático. Se requiere transformar esas acciones en datos reales para clarificar las tendencias y los desafíos del sector empresarial frente a la Agenda 2030 y el proceso de descarbonización para el año 2050 (Heras-Saizarbitoria, Urbieta, & Boiral, 2022; Kornieieva, 2020; Luo, Zhang, & Zhang, 2021).

Es importante indicar que las entidades gubernamentales deben apoyar de forma más consistente al sector empresarial para incentivar la medición de la huella de carbono. Asimismo, los académicos contables tienen un papel clave para ayudar a integrar políticas y acciones a nivel organizacional que permitan el cumplimiento de las metas establecidas en los ODS (Bebbington & Unerman, 2018).

Cuarta conclusión:

Los resultados regionales permitieron desagregar y contrastar las dinámicas del sector empresarial de acuerdo con su ubicación geográfica. Nuestros hallazgos evidencian un comportamiento asincrónico regional derivado de las características sociales, económicas e industriales que subyacen en cada territorio. Estas características de contexto influyen de forma directa en la implementación de una CMS y en el nivel y calidad de divulgación de acciones climáticas por parte de las empresas colombianas.

A nivel mundial se estudian las desigualdades generadas por problemáticas socioambientales que se derivan de los elevados niveles de emisiones de GEI en los territorios con mayor industrialización (Kartha, et al., 2020). Para contrarrestar estas desigualdades, es oportuno determinar los impactos del sector empresarial principalmente cuando las actividades industriales se encuentran concentradas en espacios geográficos de asentamiento poblacional y con una historia empresarial adscrita al desarrollo político y económico del territorio. Ante este planteamiento problemático, las políticas globales del territorio deben superar las barreras socioeconómicas, institucionales, tecnológicas y financieras para favorecer a las regiones más vulnerables (IPCC, 2019).

En el desarrollo de esta tesis hemos enfatizado en cada capítulo elementos relevantes del contexto colombiano para entender de forma holística las características de los territorios situados en un país megadiverso (United Nations, 2019). Asimismo, este contexto permitió argumentar las brechas regionales que existen en estos territorios por diferentes factores: (i) escalada del conflicto armado más longevo del hemisferio occidental con mayor incidencia en algunos territorios colombianos, (ii) el asesinato de lideres ambientales con mayor número de víctimas a nivel mundial, (iii) los conflictos socioambientales en las regiones más vulnerables del país (EJAtlas, 2022; Global Witness, 2020; Rettberg, Leiteritz, Nasi, & Prieto, 2018).

Estas consideraciones contextuales se relacionan directamente con el comportamiento empresarial y sus actuaciones ambientales, principalmente en los asuntos referentes al cambio climático. A raíz de estas consideraciones, encontramos que una de las regiones más desiguales en el análisis corresponde a la región Pacífico. Los resultados mostraron que en este territorio las empresas presentan un rezago significativo frente al nivel y calidad de divulgación del ODS 13 y a la adopción y calidad de una CMS. Estos resultados también son compatibles con la falta de interés y de apoyo del gobierno nacional (baja presencia del Estado e insuficiente garantía de acceso a derechos) en esta región debido a que se considera un territorio con el mayor índice de pobreza multidimensional, la población carece de acceso a la educación, seguridad social y vivienda. Pese a que esta ecorregión tiene la mayor biodiversidad del planeta y es una de las zonas más lluviosas en el mundo (Comisión de la Verdad, 2022; González, et al., 2018). Esta inestabilidad territorial repercute en el comportamiento empresarial y su compromiso social y ambiental por diversas razones: (i) bajo nivel de exigencia gubernamental al sector empresarial para el logro de los ODS en la región, (ii) bajo nivel de exigencia por parte de los actores territoriales a las empresas por desconocimiento o por factores de violencia que limitan sus derechos. (iii) falta de regulación de las principales actividades industriales de la región. En este último aspecto, es importante mencionar que gran parte de las empresas de esta región son de sector agrícola y un alto porcentaje de ellas no establece acciones y estrategias frente al cambio climático pese a que se encuentran priorizadas en el Plan de Gestión Integral del Cambio Climático (PIGCC).

Otro aspecto es el comportamiento de las regiones más industrializadas. La región centro oriente, que incluye la capital del país, refleja un mayor nivel de calidad de divulgación cualitativa y cuantitativa de acciones relacionadas con el ODS 13 por parte de las empresas analizadas. A su vez el comportamiento de adopción y calidad de divulgación de una CMS es favorable. Esta región se caracteriza por el desarrollo del Plan Regional Integral de Cambio Climático de Bogotá - Cundinamarca (PRICC), que es "uno de los

modelos piloto globales impulsados por Naciones Unidas para fortalecer la capacidad de los gobiernos regionales para construir territorios resilientes que enfrenten los desafíos del cambio climático" (IDEAM, 2020). También, la ciudad de Bogotá forma parte del C40, red de alcaldes de diferentes ciudades a nivel mundial para enfrentar la crisis climática. Este tipo de dinámicas regionales favorecen el comportamiento empresarial y destacan la intervención de políticas públicas con mayor eficiencia en algunos territorios. La región Eje Cafetero y Antioquía, presenta un comportamiento favorable en el nivel y calidad de divulgación de una CMS, en esta región se ubican mayor cantidad de Corporaciones Autónomas regionales y se establecen mecanismos activos de participación pública y privada para el trabajo con las comunidades en temas de mitigación del cambio climático. Esta región también forma parte del C40 y desarrolla diferentes planes de acción climática (PAC - Plan de Acción Climática 2020-2050/ Plan Integral de Cambio Climático de Antioquia (PICCA)/ Programa de Cambio Climático y Variabilidad (PAC&VC) / Plan Regional de Cambio Climático (PRCC, entre otros). También, esta región ha sido pionera en implementar acciones para mejorar el medio ambiente en un escenario de posconflicto, entre ellas se encuentra el BancO2, iniciativa que ha tenido eco en otras regiones del país y que también se ha adoptado por otros países como Perú (CORNARE, 2020). Sin embargo, es la región que presenta brechas significativas en el nivel y calidad de divulgación cualitativa versus la información cuantitativa. Es decir que, los informes de sostenibilidad de las empresas de esta región informan con mayor preponderancia acerca de acciones simbólicas más que sustantivas acerca del cambio climático.

Estos resultados regionales deben ser considerados como un referente para incentivar la medición de la huella de carbono en las empresas colombianas y fortalecer las metas de reducción y compromiso de gobernanza de emisiones por parte de los gerentes, lideres regionales y gobiernos territoriales. Los hallazgos regionales reafirman la importancia de realizar análisis segmentados en el interior de los países de manera que estos resultados contribuyan con la implementación de políticas públicas que permitan de forma coordinada utilizar la experiencia y buenas prácticas regionales para replicar y fortalecer las acciones

positivas que contribuyan a la reducción de los GEI. Asimismo, permite responsabilizar a los territorios con mayores niveles de emisión y potenciar el compromiso de reducción que deben asumir (Li, et al., 2020; Bai, et al., 2014).

Quinta conclusión

El análisis sectorial realizado permite establecer el contexto de divulgación en las diferentes actividades desarrolladas por las empresas colombianas. Al respecto, se evidencia que las empresas ubicadas en sectores considerados ambientalmente sensibles divulgan con un mejor nivel y calidad. Este comportamiento de divulgación voluntaria relacionada con el ODS 13 y emisiones de GEI se asocia a estrategias de comunicación que permiten a las empresas mantener y salvaguardar su legitimidad y enviar una señal positiva a sus stakeholders.

Las prácticas de comunicación sobre el cambio climático se consideran una tipología de información sensible independientemente de la gestión que realice la empresa para cumplir con un desempeño ambiental óptimo. Las empresas se ven obligadas a desarrollar estrategias de legitimación permanente para responder a las exigencias sociales, económicas políticas y ambientales y de esta manera desarrollar sus actividades bajo los límites de lo que la sociedad identifica como un comportamiento socialmente aceptable (O'Donovan, 2002; Deegan, 2002; Lemaire, 1997; Lindblom, 1994; Dowling & Pfeffer, 1975). Principalmente, las empresas adscritas a sectores ambientalmente sensibles requieren de la gestión de herramientas comunicativas asertivas que les permitan relacionarse públicamente para mejorar el nivel de reputación. La teoría de la señalización o conocida como "teoría de la divulgación voluntaria" permite comprender aquellas prácticas organizacionales derivadas específicamente de las estrategias de carbono y su impacto en las prácticas de divulgación de emisiones como una señal de gestión positiva para los grupos de interés. También es utilizada como una estrategia para diferenciarse

de los competidores mediante una señal positiva dirigida a los inversores (Datt, Luo, & Tang, 2019; Luo & Tang, 2014).

De acuerdo con los hallazgos del segundo capítulo de esta tesis doctoral, las empresas ubicadas en sectores sensibles o intensivas en carbono tales como; energía eléctrica, minería y extracción, gas natural (Kolk y Pinkse, 2004; Okereke y Russell, 2010), presentaron un comportamiento diferencial en relación con otros sectores industriales. Estas empresas obtuvieron el mayor porcentaje de divulgación y calidad en los índices del ODS 13. En el tercer capítulo de esta tesis doctoral, los resultados empíricos demuestran que las industrias sensibles tienen un impacto significativo en la adopción y calidad de una CMS. Asimismo, el capítulo cuatro permitió evidenciar que estas empresas tienden a divulgar las tres categorías de emisiones (scope1, scope 2, scope 3). Sin embargo, los resultados empíricos de este último capítulo muestran que las empresas ubicadas en este sector no desarrollan un comportamiento eficiente en el manejo de sus emisiones. Por consiguiente, planteamos que la exposición política de estas empresas propicia mayores y mejores niveles de divulgación (Bewley & Li, 2000) para influir en los stakeholders. No obstante, aún falta un compromiso transparente para gestionar de forma eficiente los niveles de emisiones y mostrar un desempeño climático real.

Sexta conclusión

Los hallazgos permitieron determinar que la eficiencia de emisiones desde la perspectiva empresarial requiere un grado mayor de implementación de una CMS. Los resultados evidenciaron esfuerzos por parte de las empresas colombianas a partir de mecanismos de apalancamiento para adquirir tecnología y de esta manera gestionar de manera eficiente sus emisiones de GEI. Sin embargo, se requieren acciones de mayor cobertura y compromiso para contrarrestar los efectos derivados de las actividades industriales.

Conclusiones

El concepto de eficiencia de emisiones desde la perspectiva de los sectores industriales involucra el comportamiento de consumo de energía y los niveles de tecnología implementados a partir de estrategias de gestión de carbono que permitan la reducción de emisiones de manera diferencial en cada sector (Gao, et al., 2021). Desde la perspectiva del consumo de energía, identificamos empíricamente que las empresas con mayor índice de divulgación y calidad de una CMS presentan menor eficiencia de emisiones alcance 2. Este hallazgo sugiere que las empresas que producen un nivel considerable de emisiones y establecen una CMS de calidad tienen la capacidad de realizar cambios estratégicos o buscar alternativas más eficientes con sus proveedores de energía eléctrica. También tienen la capacidad de establecer acuerdos de cooperación para el uso de fuentes renovables que les permitan mejorar sus indicadores financieros en la gestión operativa y promover la reducción de emisiones de CO_2. Al respecto, en Colombia en el año 2017 las empresas energéticas colombianas iniciaron el proceso de operar como agentes de los estándares internacionales REC (Certificados de Energías Renovables) para facilitar la incorporación de empresas no reguladas a procesos de energía limpia. Esto como una alternativa que favorece el desempeño eficiente en términos del alcance 2.

Por otra parte, nuestros hallazgos evidenciaron que las empresas altamente apalancadas tienden a ser más eficientes para gestionar las emisiones de alcance 1 y 2. Principalmente, puesto que recurren a este mecanismo para adquirir tecnología y gestionar proyectos de innovación que les permitan mayor eficiencia en el manejo de sus emisiones de CO_2. Esto sugiere una conexión directa y significativa con el desempeño financiero de las empresas. No obstante, los resultados del modelo empírico de eficiencia establecen que el sector empresarial colombiano se encuentra en una etapa muy germinal y requieren acciones de mayor cobertura alineadas con las políticas y planes regionales para contrarrestar los efectos del cambio climático.

Séptima conclusión

La divulgación de emisiones de GEI en Colombia presenta un comportamiento de isomorfismo mimético en relación con la tendencia de divulgación del sector empresarial a nivel mundial. Las características inherentes a la empresa como el tamaño y los sectores sensibles presentan un comportamiento positivo para para la implementación y calidad de una CMS y en consecuencia para la divulgación y calidad del ODS 13.

El comportamiento de las grandes compañías a nivel mundial ejerce una tendencia de replica que marca pautas de conducta a otras empresas en desarrollo. Esta connotación tiene efecto en el comportamiento de divulgación y estrategias ambientales y de carbono - CMS que desarrollan las empresas en diferentes hemisferios (Hoffmann & Weinhofer, 2010). Autores como (Choi, Luo, & Shrestha, 2020; Dhanda & Malik, 2020; Hoffmann & Weinhofer, 2010; Luo & Tang, 2020) señalan que el tamaño de la empresa es relevante en el análisis de la estrategia de carbono y la divulgación de emisiones, puesto que, las grandes empresas están sujetas a una mayor presión regulatoria y esto converge a una tendencia de divulgación mayor en comparación con empresas pequeñas. De acuerdo con el capítulo tres de esta tesis doctoral, las grandes empresas colombianas tienen incidencia y una relación positiva en la adopción y calidad de divulgación de una CMS, esto incluye acciones relacionadas con la medición de la huella de carbono, integración de decisiones de inversión e innovación para la reducción de carbono, implementación de metas de reducción y estrategias de compensación.

Por otra parte, las empresas ubicadas en sectores sensibles han generado una tendencia de mayor de escrutinio por parte de diferentes stakeholders. Principalmente por su incidencia directa en el calentamiento global y por su gestión en los alcances de las emisiones directas, indirectas y otro tipo de emisiones (Comyns, 2016; Lindblom, 1994). Esta situación que no es ajena al caso colombiano. En nuestros hallazgos evidenciamos

que las empresas analizadas desarrollan un isomorfismo mimético en relación con la divulgación de empresas de otras regiones en las que se divulgan con mayor frecuencia las emisiones directas (alcance 1 y 2) y se limita la divulgación de las emisiones indirectas (alcance 3) (Blanco, et al., 2016; Depoers, et al., 2016; Sustainability Reports, 2019).

Octava conclusión

Mediante el análisis de contenido de los informes de sostenibilidad, pudimos evidenciar heterogeneidad en la divulgación. Principalmente, por el uso de diferentes estándares, indicadores y certificadores. No obstante, encontramos que el estándar predominante en las empresas colombianas corresponde al Global Reporting Iniciative (GRI).

En búsqueda de las categorías analíticas para los capítulos dos, tres y cuatro de la tesis, encontramos que la información se encontraba dispersa a lo largo del informe de sostenibilidad de las empresas analizadas. En el capítulo 2, la información relacionada directamente con el ODS 13 presentaba un comportamiento disperso por las múltiples interacciones del ODS 13 con otros ODS. En el capítulo 3, el concepto de CMS no se indicaba de forma explícita; razón por la cual, las categorías analíticas se desarrollaron con fundamento a la recopilación teórica y conceptual mediante cuatro dimensiones relacionadas con una CMS (Medición de la huella de carbono, reducción de emisiones, gobernanza y mecanismos de compensación). En el capítulo 4, los alcances de las emisiones (scope 1,2,3) se encontraban en los indicadores del GRI vinculados en el reporte, en otros casos las cifras se encontraban asociadas con los consumos de energía o simplemente como datos globales del informe.

También, encontramos que algunas empresas ubicadas en el mismo sector industrial presentan sus indicadores de GEI de manera similar. Esto se puede derivar de las características de materialidad de la industria. Por lo que, este hallazgo reafirma que las

empresas que adoptan pautas voluntarias o códigos de conducta presentan prácticas de informes similares que imitan las de empresas pares que adoptan los mismos estándares (Comyns, 2016).

De acuerdo con los resultados señalados anteriormente, hemos realizado un inventario de estándares, iniciativas y certificadores y esto nos ha llevado a determinar que el estándar dominante en las empresas analizadas es el GRI (Global Reporting Initiative). Este resultado puede estar asociado al hecho de que Colombia es uno de los países elegidos por GRI en América Latina para formar parte del Programa de Negocios Competitivos y su sede en el país le permite enfocar iniciativas globales para aprovechar a los países de la región (Pacto Global Red Colombia, 2019). También, Colombia ha sido considerada uno de los países de América Latina con un importante grado de desarrollo en materia ambiental y gestión de la responsabilidad social por parte de las empresas (Pacto Global Red Colombia, 2019); aunque, de acuerdo con los resultados de esta tesis los hallazgos relacionados al cambio climático reflejan un desempeño limitado.

Novena conclusión

El desarrollo de los índices de divulgación ODS, CMS y los modelos de divulgación y eficiencia de emisiones, son un aporte fundamental para operacionalizar y mejorar los indicadores relacionados con la acción climática en un país emergente sin regulación de reportes de sostenibilidad y emisiones de GHG.

Este estudio es pionero en analizar el nivel y calidad de divulgación del ODS 13 así como la divulgación y eficiencia de emisiones de GEI a través de una Carbon Management Strategy en las empresas colombianas. Los índices y los modelos diseñados deben entenderse como una contribución para que el gobierno y las entidades de vigilancia ambiental articulen con mayor precisión acciones con las empresas. También los

resultados son relevantes para que las compañías incorporen elementos clave en su estrategia climática. Al mismo tiempo, los hallazgos resaltan la importancia de la contabilidad de carbono para fortalecer y contribuir con la transparencia y calidad de los informes no financieros.

Desde la perspectiva de los inversores, el índice ODS 13 ha permitido observar que se siguen comportamientos de Greenwashing y SDG-Washing en las compañías analizadas. Estos resultados son útiles para tomar decisiones de inversión y permiten generar mayor presión a las empresas para revelar de forma más específica sus impactos ambientales. Finalmente, los resultados en conjunto deben entenderse como un aporte a la estrategia colombiana para conducir al país hacia un desarrollo económico bajo en emisiones de gases de efecto invernadero y obtener la neutralidad de carbono para el año 2050.

Futuras líneas de investigación.

Este estudio abre caminos para futuras investigaciones. El análisis de la literatura en cada uno de los capítulos permitió comprender las diferentes acepciones para abordar la problemática global del cambio climático. En consecuencia, es posible mencionar los temas centrales y potenciales que podrían abordarse a partir de los resultados y hallazgos de este estudio.

- Si bien este estudio se centra en Colombia considerado como un país megadiverso, estudios futuros podrían incorporar análisis comparativos entre economías desarrolladas y economías emergentes.
- A partir de la incorporación de los índices ODS y CMS, podría ser interesante analizar países de América Latina (por ejemplo, Alianza pacífico) y su comportamiento empresarial relacionado con la gestión de emisiones y el nivel y calidad de divulgación del ODS 13
- Este estudio incorporó el impuesto al carbono considerando la presión que este mecanismo ejerce a las empresas ambientalmente sensibles. Sin embargo, sería

importante identificar si este impuesto ofrece otro tipo de beneficios en los países de la región. Asimismo, es interesante escudriñar acerca de las implicaciones y beneficios de utilizar la política fiscal para resolver problemas medioambientales.

- Una de las principales limitaciones para el desarrollo de estudios en países emergentes se encuentra asociado con la falta de información oficial de las emisiones de GEI emitidas por el sector empresarial. Al respecto, futuras investigaciones en este campo podrían enfocar esfuerzos en utilizar mecanismos de sistemas de información para resolver esta problemática en América Latina.
- Entendiendo que las consecuencias del cambio climático no tienen territorios excluidos, sería interesante agrupar las áreas biológicamente sensibles en América Latina y las áreas que por sus condiciones de contexto son más vulnerables al cambio climático y a partir de esta segmentación analizar la incidencia del gobierno, sector empresarial y stakeholders en relación con la gestión y eficiencia de emisiones de GEI.

Reflexión Final

Es prioritaria la intervención de diferentes actores sociales para responder a las necesidades del cambio climático en el contexto colombiano. Si bien es un tema de grandes potencialidades para el desarrollo investigativo, este es un asunto que requiere de acciones rápidas y concretas por parte del gobierno, las empresas, los stakeholders y la sociedad civil para mitigar el avance de sus efectos y, de esta manera, preservar la vida de las actuales y futuras generaciones.

En esta tesis hemos resaltado los esfuerzos e iniciativas que se han adelantado para mejorar las condiciones de las actuales y futuras generaciones. No obstante, si nos detenemos a pensar por un momento en los resultados obtenidos, podríamos argumentar que existe una brecha significativa ente lo que se espera y lo que realmente se logra para mitigar el cambio climático. Esta brecha puede ser un indicio de vivir en un sistema de

creencias dominado por la idealización del sistema económico y la subestimación racional de los recursos más allá de los limites planetarios. En este contexto, son muchos los desafíos a los que nos enfrentamos como especie humana y de los cuales se espera una reacción inmediata, por ejemplo: (i) entender que el cambio climático es un problema que demanda una gestión de riesgos colectiva, (ii) gestionar el cambio climático en un entorno complejo y mediático de relaciones políticas, sociales, económicas y ambientales dominantes y (iii) transitar a modelos sostenibles en los que las economías no dependan del carbón y del petróleo.

Los desafíos expuestos anteriormente deberían ser una alternativa para detener el cambio climático. Sin embargo, estas iniciativas no tendrán eco si no se logra un trabajo conjunto por parte de todos los actores sociales. En el caso particular de Colombia, una de las reflexiones iniciales por parte de la sociedad civil debería estar encaminada a cuestionar el grado de influencia que ejercen las grandes empresas en las decisiones del poder político para favorecer sus intereses privados. La cooptación del poder político en Colombia es una figura que ha trascendido en un escenario en el que “los grupos con amplio poder económico manipulan la formulación de leyes” (Salamanca, et al., 2008 p. 16). Este comportamiento limita la intervención y regulación de temas relevantes como el proceso de regulación de las emisiones de GEI para las grandes empresas y en especial para aquellas pertenecientes a sectores ambientalmente sensibles, situación que requiere una presión social para transformar los esquemas de gobernabilidad del país.

Desde la perspectiva del gobierno existen muchos desafíos para afrontar el cambio climático. En este estadio reflexivo indicaremos que para avanzar en estos desafíos se debe propender por garantizar la mejora inmediata de los indicadores de gobernanza del país, principalmente aquellos con mayor rezago en comparación con otros países de la región y a nivel mundial. Entre estos indicadores podemos destacar: (i) la estabilidad política, (ii) la calidad regulatoria y (iii) el control de la corrupción (Worldbank Governance,

2020). Si esto logra mejorar rápidamente, se podrán ejecutar diferentes mecanismos que posibiliten un cambio en los retos sociales y ambientales que tanto requiere el país.

Ahora bien, ninguna empresa por si sola resuelve la problemática del cambio climático (Folke, et al., 2019; Schaltegger, 2018). Sin embargo, la gestión que realiza cada empresa es determinante en los efectos del calentamiento global. Por consiguiente, es necesario que las empresas como fuentes de progreso economico de una región se encuentren alineadas con las iniciativas del sector publico para garantizar un proceso de adaptación y mitigación transparente frente a los desafios de descarbonización del país.

Finalmente, consideramos de suma relevancia la intervención de otros actores sociales como; ONGs, académicos multidisciplinarios, fundaciones, lideres sociales y ambientales entre otros. Estos actores podrían ocuparse de una estrategia de apoyo a las regiones con mayor rezago en temas sociales y ambientales. Este tipo de intervención propiciaría un escenario de mejora inmediata en estos territorios, principalmente en comunidades que tienen limitaciones comunicativas para defender sus derechos y responsabilizar a las empresas por conflictos ambientales que puedan derivarse de sus actividades industriales y extractivas.

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