Biodiversity reporting within the chemical industry

Tiivistelmä - Referat - Abstract

Ihmisten hyvinvointia ja toimintaa tukeva luonnon monimuotoisuus eli biodiversiteetti heikkenee uhkaavasti ja se on toiseksi suurin globaali riski ilmastonmuutoksen jälkeen. Luonnon monimuotoisuus tukee ekosysteemipalveluita, joista ihmistoiminta on riippuvainen. Luontopohjaiset ratkaisut mahdollistavat myös uusien, luonnonmukaisten vaihtoehtojen kehittämisen, joilla pyritään korvaamaan nykyisiä luontoa kuormittavia raaka-aineita, jotta luonnon pilaantumista ja kuormittumista voitaisiin ehkäistä ja vähentää. Kemianteollisuudella on merkittävä rooli tällaisten kestävien tuotteiden kehittämisessä. Bio-pohjaisten raaka-aineiden hyödyntäminen tuotteiden valmistuksessa kuitenkin lisää luontokatoon kohdistuvaa painetta. Monet yritykset ovat kuitenkin tiedostaneet tämän ja koettavat kiinnittää asiaan huomiota. Raportoinnin avulla yritykset voivat osoittaa toimivansa vastuullisesti ja huomioivansa biodiversiteetin toiminnoissaan, mikä tukee yritysten legimiteettiä.

Tämä tutkielma osallistuu tieteelliseen keskusteluun biodiversiteetin raportoinnista, joka on suhteellisen vähän tutkittu aihe. Tutkielman materiaali on kerätty yritysraporteista ja haastattelemalla globaalisti toimivia kemian alan yrityksiä. Kuvailevaa sisällönanalyysiä hyödyntäen, tämä tutkielma tutkii ja kuvailee, kuinka kemian teollisuuden yritykset ymmärtävät biodiversiteetin ja raportoivat siitä ylläpitääkseen uskottavuuttaan.

Biodiversiteetti on käsitteenä monimutkainen ja vaikeasti ymmärrettävissä oleva aihe, jota ei vielä pystytä riittävästi mittaamaan. Tämä voi selittää, miksi kemianteollisuuden yritysten raportointi biodiversiteetistä on vaihtelevaa. Yritysten ymmärrystä biodiversiteetistä tulee tukea, jotta siitä voidaan laadukkaasti raportoita. Laadukas raportointi yritysten vaikutuksista voi tukea monimutkaisten luonnonprosessien ymmärtämistä, luonnonsuojelun edistämistä ja ehkäistä viherpesua.

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Tiivistelmä - Referat - Abstract

Biodiversity is essential for human wellbeing and activities as it supports a diverse set of ecosystem services. Currently, biodiversity is rapidly declining. Biodiversity loss is the second significant global risk after climate change. To reduce environmental stress, there is a need to find sustainable alternatives to unsustainable raw materials and consumables. The chemical industry has an important role in developing environmentally friendly solutions such as bio-based products and solutions, which require utilization of biomass. However, extraction of bio-based raw materials creates more pressure on biodiversity and contributes to biodiversity loss. It is essential that companies who extract natural resources are transparent about their actions concerning biodiversity. By adequately sharing information in corporate reports, companies can enhance their legitimacy.

This thesis contributes to scientific discussion on biodiversity reporting which is researched to a limited extent. Material of the thesis was collected from corporate reports and interviews with globally operating chemical companies. By using qualitative content analysis, this thesis describes how chemical companies report on biodiversity as part of their corporate reporting to maintain their legitimacy and how biodiversity is perceived within the chemical industry.

Biodiversity is a complex concept and intangible system, which cannot be sufficiently measured yet. This may help to explain why biodiversity reporting within the chemical industry is varying and inconsistent. There is a need to improve companies' understanding on biodiversity to enhance biodiversity reporting. Adequate reporting can help to understand complex natural processes, enhance environmental protection, and reduce the problem of greenwashing.

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Abbreviations

CR   Corporate Responsibility

CSR   Corporate Social Responsibility

GHG   Greenhouse Gas

GRI   the Global Reporting Initiative

IUCN   International Union for Conservation of Nature

QCA   Qualitative Content Analysis

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1   Introduction

Biodiversity is essential for human life as diverse natural processes provide societies with ecosystem services that enable human activities and production of goods. Biodiversity is the mainstay of ecosystem functions. Ecosystems and biodiversity are threatened by climate change and human activity. (Millennium Ecosystem Assessment, 2005.) Therefore, it is imperative to achieve sustainable transition in the practices of societies and to preserve nature.

As environmental awareness of negative impacts of fossil fuel-based products increases, new solutions are sought to replace them. Consequently, there is growing interest towards bio-based raw materials within the chemical industry as chemical companies are searching for alternative solutions to replace fossil fuels to combat climate change (Bos & Sanders, 2012a). However, utilization of bio-based raw materials put more pressure on biodiversity as natural resources are extracted to produce sustainable consumer commodities. Therefore, it is the responsibility of companies to acknowledge biodiversity and their impacts along value chains. Companies' responsibility over their actions is significant for legitimacy of their operations and management. Companies demonstrate their responsibility on corporate reports. Reporting aims for transparency and assurance of credibility through information disclosures, which is important for companies' stakeholders. Adequately reported information creates legitimacy, which is gained from public's acceptance of companies' actions. By strategically reporting out information, companies influence society's perception of discussed topics and the public image of a company. However, environmental disclosures are voluntary based as application of certain management tools is not required, which creates flexibility in information disclosures. (Beck et al., 2010.)

Environmental disclosures can include biodiversity related information. Biodiversity reporting is about disclosing information on companies' actions, operations, and management that have an impact on biodiversity. Inclusion of biodiversity in corporate reports is important as biodiversity loss is accelerating (Millennium Ecosystem Assessment, 2005) and companies' impacts on it increase. Large number of studies have carried out research

into sustainability reporting and research on biodiversity is increasing, yet it remains conflicting (see e.g. Samkin et al., 2014; Maroun et al., 2018; Van Liempd & Busch, 2013). Biodiversity reporting has somewhat been studied globally and nationally (see e.g., Rimmel & Jonäl, 2013; Van Liempd & Buch, 2013; Adler et al., 2018; Samkin et al., 2014). This thesis aims to provide insight into biodiversity reporting within the chemical industry. It is especially relevant in the chemical industry because chemical companies are currently extending the utilization of bio-based raw materials, which impacts biodiversity. Therefore, there is a need to comprehend how biodiversity is discussed and represented in chemical companies' corporate reports.

This thesis aims to provide insight into biodiversity reporting within the chemical industry by responding to the following research questions: how chemical companies report on biodiversity as part of their corporate reporting to maintain their legitimacy? How is biodiversity perceived within the chemical industry? By conducting Qualitative Content Analysis (QCA), 27 corporate reports were analyzed for their references to biodiversity. Additionally, four interviews with globally operating chemical companies were conducted to gain deeper comprehension about biodiversity reporting. Application of legitimacy theory incorporates theorical background to biodiversity accounting.

This thesis is written in the Helsinki Institute of Sustainability Science Co-Creation Lab with an industry partner who gave motivation for this thesis. The challenge provided by the partner was "the impact of bio-based raw material use on biodiversity by the chemical industry and its value chain". While this thesis is not a contract research, it gained inspiration from the discussions with partners, supervisors, and other students during the lab. This thesis is structured the following way. It starts with a description of the concept of biodiversity and its relation to the chemical industry. The focus narrows down to the emergence of corporate sustainability and biodiversity reporting and continues with a specification of the applied theoretical and methodological frameworks and proceed to show how this thesis was conducted before results, discussion, and conclusions.

1.1. Biodiversity

Biodiversity is "fundamental to human life on Earth" (WWF, 2020, p. 6). It "provides composition, structure, and function to ecosystems" enabling the function of ecosystem

services. Ecosystem services consist of provisioning services such as raw materials, regulating services such as climate control, cultural services, and supporting services such as soil formation that support and enable human activities and production of commodities. (Millennium Ecosystem Assessment, 2005, p. 16.) Ecosystem services are comprised of species and organisms that share close networks and connections, which support and maintain life providing people with food, water, medicine, and shelter (WWF, n.d.). Humans depend on this diversity of species and ecosystems (Reaka-Kudla, Wilson & Wilson, 1997, p. 15). Higher biodiversity contributes to larger supply of ecosystem services (Millennium Ecosystem Assessment, 2005). United Nations Environmental Programme define biodiversity:

> *"Biodiversity: the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part: this includes diversity within species, between species and of ecosystems" (UNEP, 1997, p. 12).*

Human activities have altered the living conditions of species since the industrial revolution. Destruction of ecosystems is mainly driven by human activities, such as land- and sea-use change as well as over-exploitation of natural resources, which have caused habitat fragmentation further reducing living conditions of natural species. This fragmentation is a key factor in species extinction. (WWF, 2020; WEF, 2020; Jones & Solomon, 2013.)

Biodiversity loss has been acknowledged to be the second most significant global risk accompanied by climate change, extreme weather, and natural disasters. It is defined as "*human caused biodiversity decrease relative to a particular baseline. Actually, biodiversity loss is usually a net figure resulting from a decrease of abundance and distribution of many species and the increase of a smaller number of other species*" (UNEP, 1997, p. 12). Acceleration of biodiversity loss has caused rapid decline in species abundance; we are now on the brink of sixth mass extinction (Jones & Solomon, 2013). Changes in species number influence ecosystem services (Millennium Ecosystem Assessment, 2005). The loss of biodiversity weakens ecosystem services (Hoekman & Broch, 2017), which contributes to reduction in human well-being through several interconnections, such as food security (Millennium Ecosystem Assessment, 2005; WEF, 2020).

Biodiversity has a significant role in business as ecosystem services are essential for economic development; provisioning services provide companies with resources to produce goods and products (Jones & Solomon, 2013). Although biodiversity is valuable in many different ways, it does not have proper value in the market system. Exploitation of biodiversity by businesses has intensely contributed to reductions in species abundance. The role companies play in biodiversity loss is considerable, however, companies can reverse and reduce their effects by assessing and mitigating their impacts on biodiversity, which can significantly support biodiversity conservation. (Bhattacharya & Managi, 2013.)

Biodiversity loss is an important aspect for any company. For complex natural interlinkages, biodiversity loss is a systemic problem; meaning that risks cumulate throughout the changes that occur within the web of complex biological relationships (WEF, 2010b). Loss of diversity risks companies' operations and activities when ecosystem services and natural resources diminish or run out (Bhattacharya & Managi, 2013). Risks for companies will likely increase and become a concern of all sectors; especially for extractive companies, biodiversity has become "a significant business issue" (F&C, 2004). Biodiversity loss related risks to companies comprise reputational, operational, regulatory, market and product, and financial risks (Dempsey, 2013).

1.2 The chemical industry and related environmental risks

The chemical industry creates important everyday life products. Chemicals are used in multiple ways to support human life, such as to intensify agricultural practices, to reduce energy consumption, and to produce medicine. Almost 80% of the world's chemicals are produced in 16 countries, of which most are OECD countries: the US, Japan, Germany, China, France, the UK, Italy, Korea, Brazil, Belgium/Luxemburg, Spain, the Netherlands, Taiwan, Switzerland and Russia. Currently, OECD countries are the leading chemical producers within the chemical industry. The need for chemicals is growing as production and consumption rates are increasing. (OECD, 2001.)

Chemicals can have negative environmental impacts when they are inadequately managed regardless improvements in the environmental footprint of the chemical industry.

The industry is governed by multiple regulations that require sufficient performance regarding manufacturing and processing of chemical products. Despite strict regulations, chemicals may cause negative environmental impacts at any stage of supply chains. Negative impacts alter from depletion of resources to pollution and human and environmental exposure, for instance, chemical industry among other industries contribute to climate change by releasing greenhouse gasses (GHG) and other substances that deplete tropospheric and stratospheric ozone layer. (OECD, 2001.) Therefore, managing the value chain of chemicals is extremely important. However, supply chains are often comprised of complex networks of actors and operations, which makes the impact management challenging.

1.3 Bio-based raw materials and the impacts of the chemical industry

Demand to reduce the use of fossil resources and climate change require shifting from oil-based economy to bio-based economy. Bio-based materials are produced from biomass that are sourced from terrestrial and marine ecosystems, usually from crops and trees (Weiss et al., 2012). Bio-based raw material can be perceived as an umbrella concept that comprise multiple different natural resources, for example, different species provide raw materials for clothing and medicine (Reaka-Kudla, Wilson & Wilson, 1997, p. 15). Biomass is a focal substitute for fossil fuels while more sustainable ways to produce chemicals and materials are sought (Bos & Sanders, 2012a). The utilization of biomass by the chemical industry has been estimated to increase by 2030, for instance, biofuels have been estimated to cover 20% of the transportation fuels by 2030 (Sanders & Boss, 2012b). The utilization of renewable and non-renewable raw materials contributes to resource depletion (OECD, 2001), which has impacts on the environment.

Companies' impacts on biodiversity can be direct or indirect (F&C, 2004). Over-exploitation of flora and fauna is a direct impact; indirect impacts derive from activities, such as pollution and habitat destruction (Jones & Solomon, 2013). The use and production of bio-based materials have different environmental impacts. Increased sourcing of bio-based raw materials increases land use, which has further negative impacts on the environment. Moreover, they negatively increase eutrophication in waters and may increase the depletion of stratospheric ozone due to chemicals used in agricultural practices and biomass production. (Weiss et al. 2012.) On the other hand, bio-based products enable

production of green energy, which contributes to GHG emission reduction and climate change mitigation (Weiss et al. 2012). However, long and complex value chains for biomass in bio-based material production (European Commission, 2011) can complicate impact management.

Other indirect impacts on terrestrial and marine biodiversity come from land use change and agricultural management processes (Hoekman & Broch, 2017). Biomass production requires land-use reforms when more crops are grown to respond to the growing demand for bio-based materials (Sanders & Boss, 2012b). Maximization of agricultural expansion and farming of biofuel crops in monocultures reduce biodiversity and ecosystem services. Land use changes contribute to habitat fragmentation (WWF, 2020). In addition, biofuel production is connected to invasive species, pollution, and climate change. (Hoekman & Broch, 2017; Meijaard et al., 2020; Gasparatos et al., 2011.) Palm oil serves as an example of bio-based vegetable oils, which demand is growing. Meijaard et al. (2020) discuss that palm oil accounts for approximately 40 precent of the annual demand, and global demand for all vegetable oils is likely to increase by 46 percent by 2050. Increased production of bio-based materials may result in competition between food production and biomass production, which can further cause over-exploitation of natural resources and loss of biodiversity (European Commission, 2011) and influence food security.

2 Literature review on environmental reporting and theoretical framework

The following literature review provides insight into existing research on sustainability and biodiversity reporting. Environmental reporting has been widely studied while less attention has been given to biodiversity and its role in corporate reporting (Solomon et al., 2011). Corporate reporting is based on shared information on corporate management, activities, and operations (KPMG, 2005:1) and it reflects companies' interpretation of issues to respond to external pressures and expectations (Buhr et al., 2014, p. 59). Reporting is associated with Corporate Responsibility (CR), which concerns companies' responsibility to economic, social, and environmental aspects; often sustainability and sustainable development are addressed in the CR reporting (KPMG, 2005).

As corporate reporting is interconnected with corporate legitimacy, this thesis applies legitimacy theory as a theoretical background. Legitimacy theory emphasizes companies' disclosure practices in relation to societal pressure and expectations; companies report to maintain legitimacy by demonstrating how they comply with increasing expectations regarding biodiversity conservation. (Fernando & Lawrence, 2014.) The theory gives tools to interpret accounting practices (Gary et al., 2010, p. 28). Next, the legitimacy theory is shortly presented after which previous research on sustainability, environment, and biodiversity reporting is introduced and how those have developed over the years and what issues challenge corporate reporting. Then, the focus concentrates on how companies report on biodiversity and why biodiversity should be reported.

2.1. Legitimacy theory

Legitimacy theory is a system-oriented theory, which means that an entity, such as a company, and society interact influencing each other; organizations are not separated from society (Deegan, 2002). The theory incorporates conflict and dissension (Gray et al., 2010, p. 28) and focuses on companies' communication with stakeholders and disclosure practices that maintain legitimacy (An et al., 2011). Corporate disclosure through reporting is one means to maintain corporate image and shape external conceptions. Legitimacy theory argues that politics, society, and economics are intertwined, and this unity must be studied as one. (Deegan, 2002.) The theoretical approach has been previously applied in social and environmental accounting literature (Deegan, 2019) to show how companies respond to changes and comply with values and expectations.

Companies need to comply with socially relevant values to continue their operations and create legitimacy (Gray et al., 2010, p. 21). Compliance is referred to be "embodied within the social contract" by Deegan who describe the relationship between organizations and societies as follows, "[o]rganizations exist to the extent that the particular society considers that they are legitimate, and if this is the case, the society "confers" upon the organization the "state" of legitimacy" (Deegan, 2002, p. 292). Deegan (2002) discusses the relation between legitimacy and social contract that originates in the acceptance of society toward organizational actions. Societies allow organizations to source natural resources to provide goods and services to the society and output waste into the environment (Mathews, 1993, p. 26 according to Deegan, 2002). Organizational legitimacy is created

and shaped through impacts that result from companies' actions. Negative impacts can decrease society's acceptance towards the company, which is manifested in sanctions, such as decrease in consumer demand for products. (Deegan, 2002.)

Changes in the values of society affect the legitimacy of organizational management. To maintain legitimacy, companies need to be reflexive to respond to changing conditions and values. (Deegan & Gordon, 1996.) Changing societal values and expectations can lead to "legitimacy gap", which means a gap between the values and expectations of the society and corporate management. In addition, companies may confront legitimization threats resulting from negative accidents and incidents arisen from corporate operations. (Fernando & Lawrence, 2014.) There are four strategies to maintain corporate legitimacy according to Lindblom (1994) cited by Fernando and Lawrence (2014, p. 154):

> *"educate relevant stakeholders about its actual performance; change the perceptions of the relevant stakeholders about the underlying issue without changing the organization's behaviour; distract or manipulate the attention away from the issue of concern and seek to divert the attention to a favourable issue; and/or seek to change external expectations about the organization's performance."*

These strategies can be applied in Corporate Social Responsibility (CSR) and its reporting (Fernando & Lawrence, 2014). Reporting out expected information demonstrate the compliance of organizations with societal expectations (An et al., 2011). Legitimacy theory perceives corporate strategies as a reaction to disparity between society's expectations and an organization. Corporate disclosure reports can be perceived as aims to narrow a legitimacy gap if the gap is acknowledged by management. (Deegan, 2002.) To avoid legitimacy gap, companies are more likely to report on positive environmental information and achievements over negative information (Deegan, 2002; Deegan and Gordon, 1996). Accordingly, Deegan and Gordon (1996) studied Australian companies' reporting practices and found imbalance between the share of positive and negative information in corporate reports. Most companies tended to report only positive environmental information while the share of negative environmental disclosures was minor within sampled companies. Moreover, they found that increase in environmental disclosures and increase in memberships of environmental groups occurred simultaneously. They discuss that this may reflect changes in values or in corporate awareness. (Deegan and Gordon, 1996.)

Legitimacy theory perceives that information disclosures should be voluntary based to demonstrate companies' compliance with societal expectations and values (An et al., 2011). Through voluntary disclosures companies bring to public's attention issues that their operations contribute to. This creates confidence among society in corporate operations. However, corporate disclosures are influenced by the size and profile of an organization. (Gray et al., 2010, p. 22.) Furthermore, there are numerous other motivations than legitimacy to corporate actions in the CSR, for instance, economical consideration for business advantages or "[t]o attract investment funds". (Deegan, 2002, p. 291). However, gaining legitimacy is in itself a great motivation for companies to disclose information, which many researchers support according to Deegan (2002).

There are some limitations to the application of legitimacy theory. Legitimacy theory is not sufficient alone to provide theoretical lenses to understand companies' decision making (Gray et al., 2010, p. 29). Regardless of feebleness in theoretical framework, the theory has been applied in many CSR studies (Fernando & Lawrence, 2014). In addition, legitimacy theory does not explicitly comprehend differences within societal perceptions and expectations, which is important separation, nor how individual corporate managers perceive "social contract". Moreover, accountability may be disregarded when companies' disclosures are produced to respond only to societal expectations and concerns. If there are no specific concerns or incidents, unregulated disclosure may remain limited or non-existent. (Deegan et al., 2002.) However, legitimacy theory offers considerably sufficient context to understand CSR reporting and conceptual tools for analyzing biodiversity reporting.

2.2. Sustainability reporting

Sustainability reporting incorporates economic, environmental, and social aspects regarding companies' risks and opportunities in sustainable development (Ševčík et al., 2014; Bansal, 2005) as well as commitments, targets, and actions. Sustainability reporting emerged as a response to growing public concern over businesses' activities and actions towards sustainable development (Ehnert, 2016). It is now considered to be a prerequisite for companies' economic growth and a tool for sustainability strategies (Ševčík et al., 2014). Sustainability reporting can help companies to gain business benefits and good

reputation (Guidry & Patten, 2010). Accordingly, reporting increases companies' transparency and improves management and public trust (Ševčík et al., 2014; KPMG, 2005:1); it is a demonstration of the CR to stakeholders through disclosures on relevant information (KPMG, 2005:3). Companies produce sustainability reports to show how they contribute to sustainable development and to create discussion with stakeholders (Hedberg & Von Malmborg, 2003). To maintain legitimacy, it is important for companies to address different topics of sustainability and incorporate them into management. Additionally, reporting is enforced through requirements.

EU law requires large and listed companies to report out on their operations and management of social and environmental issues (European Commission, n.d.). However, environmental disclosures are voluntary in a sense that the application of specific management tools is not required (Beck et al., 2010). In other words, companies are free to include and exclude information. Therefore, reporting is "a legitimation device and not an accountability mechanism" according to Gray and Bebbington (2000, p. 20). To maintain a positive image of companies' actions and legitimacy, reporting needs to be transparent (Van Liempd & Busch, 2013), nevertheless, various aspects can hinder the willingness of companies to disclose information (Rimmel & Jonäll, 2013), which are discussed later.

Sustainability reporting has built upon previous reporting practices to include environmental and social policies and impacts concerning business management (Buhr et al. 2014, p. 51). Corporate reporting developed into financial disclosures to reinforce equity and profit (Jones & Solomon, 2013). In addition to financial reporting, in the 1970s, social aspects became largely integrated into reporting, while environmental topics were less reported. Eventually, environmental issues became more extensively discussed in corporate reports in the late 1980s and in the 1990s. Environmental reporting has increased since. (Brown et al., 2009.) Moreover, there was a substantial increase in sustainability reporting between 2002 and 2005 (KPMG, 2005:2). To enhance CSR, the Global Reporting Initiative (GRI) was initiated in the 1990s as a response to growing environmental concern. By the 2000s, the GRI was globally applied to help companies to report their sustainability activities in consistent manner. (Brown et al., 2009.)

The GRI is a guiding tool for reporting that includes standards for information disclosures. The standards aim to create consistency between companies' reports and help companies to meet stakeholders' expectations. (GRI, n.d.) The GRI supports CSR by providing sufficient guidelines for sustainability management, which have been designed to be adaptable to the ISO 14001 standards. The framework enables flexibility and gives structure to reporting. (Buhr et al., 2014, 63; Ševčík et al., 2014; Hedberg & Von Malmborg, 2003.) The GRI categories include economic, environment, labor, human rights, society, and product responsibility classifications (Ehnert, 2016), which, consequently, were then included in corporate reporting (Buhr et al., 2014, p. 54). The GRI includes several indicators for measuring environmental performance, such as materials, energy, water, biodiversity, emissions, and waste. The indicators help companies to produce high quality products and reduce the use of resources. (Ševčík et al., 2014.) It is generally considered to be the most reliable and detailed reporting framework (Boiral, 2016), and it outlines global standards for reporting (Brown et al., 2009). Conversely, Bhattacharya and Managi (2013) criticize the GRI for not including enough biodiversity related reporting points and claim that it will aggravate global biodiversity loss. Moreover, Buhr et al. (2014, p. 55) criticize how sustainability reporting has only a little to do with sustainability or sustainable development goals, because performance is not comparable with sustainability.

Climate change has been a core area in environmental reporting and accounting practices, while less attention has been given to biodiversity (Solomon et al., 2011). However, biodiversity disclosures and its' inclusion in corporate reporting has increased over the years (Rimmel & Jonäll, 2013). Biodiversity reporting is about disclosing relevant non-financial information with respect to biodiversity and is part of environmental management. Reporting on biodiversity has increased because companies are held responsible for biodiversity loss. Consequently, reporting on environmental impacts of companies is now considered to be corporate responsibility. (Boiral & Heras-Saizarbitoria, 2017; Adler et al., 2018; WEF, 2020.)

Research into companies' reporting practices has followed the same trajectory. Over the last thirty years, research on the interactions between humans and nature has increased, and the subject has become more debated. Previous studies have focused on carbon accounting and climate change reporting, while less research interest has been placed on biodiversity accounting. (Jones & Solomon, 2013.) However, research on biodiversity

accounting seems to have increased over the past few years and is now more widely studied from different perspectives while at the same the awareness of biodiversity loss has increased. There is now increasing number of studies that analyze biodiversity reporting, yet it remains limited and contrasting. Mining and forestry have mostly been the focus of biodiversity reporting research. (Boiral, 2016; Ševčík, 2014; Samkin et al., 2014.) Equally important is the chemical industry; biodiversity reporting in relation to the chemical industry has not been adequately researched even though chemical industry has significant impacts on the environment (OECD, 2001). Therefore, biodiversity reporting by chemical companies should be scrutinized more closely.

2.3. Reporting on biodiversity

Biodiversity is one significant sustainability and environmental topic, and its importance has been acknowledged throughout different sectors (F&C, 2004). However, there are differences between sectors whether they accept and adopt biodiversity policies and report on them (Bhattacharya & Managi, 2013). Bhattacharya and Managi (2013) have found that 52 % of chemical companies report on biodiversity policies and conservation actions. Biodiversity reporting is about disclosing data, information, and companies' activities with respect to biodiversity (Gray & Bebbington, 2000). Biodiversity is poorly addressed in corporate reporting (Rimmel & Jonäll, 2013; Van Liempd & Busch, 2013) and is mainly discussed in general manner (Skouloudis et al. 2018).

Discussion on biodiversity in corporate reports varies as the extent of biodiversity disclosures differs between companies and between countries (Adler et al., 2018; Van Liempd & Buch, 2013). For example, Van Liempd and Buch (2013) have found that inclusion of biodiversity in corporate reports is insignificant in Denmark as the quantitative and qualitative performance of the Danish companies' biodiversity disclosures is poor. In fact, they found that the companies may not recognize the ethical need to report on biodiversity (Van Liempd & Buch, 2013). Additionally, Rimmel and Jonäll (2013) have found that Swedish companies disregard biodiversity in their reports if their activities do not have negative impacts on biodiversity. This was seen in the results as very general statements about promoting biodiversity protection and conservation as well as on the importance of biodiversity (Rimmel & Jonäll, 2013). According to Van Liempd and Buch (2013), if

companies perceived having no impacts on biodiversity, they addressed that biodiversity is irrelevant to their operations.

Biodiversity reporting lacks consistency in patterns in which biodiversity data is disclosed; there are differences in the amount of biodiversity reporting, and even those who disclose information adequately are not consistent in their reports, and the focus of information tends to concentrate on different aspects of biodiversity (Adler et al., 2018). Generally, biodiversity related statements are implicit (Van Liempd & Buch, 2013). More detailed and profound information is scarcely disclosed by companies as discussion on environmental impacts is rather comprehensive, and biodiversity disclosures are often based on the GRI indicators (Rimmell & Jonäl, 2013). Some companies briefly address biodiversity impacts through the GRI framework, for instance disclosures on location of operation areas "in or adjacent to protected areas" to inform that their operations locate in industrials sites and not in biodiversity sensitive areas (Adler et al., 2018; Rimmell & Jonäl, 2013). Additionally, numerical disclosures are mostly concerned with afforestation activities and biodiversity assessments (Adler et al., 2018).

Reporting on companies impacts on biodiversity, species, and habitat loss due to company operations is minor (Adler et al., 2018; Van Liempd & Buch, 2013). Similarly, there is only a little reporting on impacts on ecosystems, wetlands, and marine biodiversity (Adler et al., 2018). In addition, reporting on threatened, International Union for Conservation of Nature (IUCN) red list species is insignificant or not included (Adler et al., 2018; Van Liempd & Buch, 2013; Skouloudis et al. 2018). Disclosures on species extends only to general discussion on species and conservation areas excluding specific statements on the current state of species and biodiversity (Samkin et al., 2014). Tregidga (2013) has studied information disclosure by New Zealand companies finding how some species are widely accounted for in companies' reports while other species are not, the reasons remain unclear. Moreover, Skouloudis et al. (2018) have found that most commonly habitat restoration and protection as well as management approach are reported. The latter three aspects are reporting points in the GRI framework, which also includes the IUNC red listed species (Global Reporting Initiative, 2016). The GRI reporting points offer a narrow window to report on biodiversity. Additionally, disclosures on detailed information regarding impact mitigation activities have been found to be insignificant or non-existent by previous studies. (Adler et al., 2018; Van Liempd & Buch,2013.)

Comprehensive biodiversity reporting includes disclosures on the types of species being protected, biological areas under conservation, the nature of their biodiversity partnerships, and the biodiversity programs being pursued (Adler et al., 2018). In addition, detailed information includes biodiversity action plans, examples on biodiversity actions, and the GRI indicators (Rimmel & Jonäll, 2013).

Disclosing detailed information on biodiversity, such as used biodiversity indicators, is a means to overcome generalization problem in reporting practices. Nevertheless, if biodiversity indicator data is disclosed, it often includes information on habitat protection, restoration, and stakeholders or initiatives which companies support through funding rather than reporting financial information about the cost of these activities. (Skouloudis et al. 2018.) On the contrary, Adler at al. (2018) have found that reported information on funding includes the amount of provided financing, yet the revelation does not include information on how funding contributes to biodiversity protection. Companies can report their direct or indirect impacts by disclosing information related to, for instance, pollution, habitat conversion, affected species, extent of areas impacted, or they can list activities that can have impacts on biodiversity. Environmental site impacts assessment is one method that can be applied to collect biodiversity information. (Rimmel & Jonäll, 2013; Skouloudis et al. 2018.)

Information on performance and cost data are topics that are discussed only little in corporate reports as are biodiversity guidelines (Van Liempd & Buch, 2013; Adler et al., 2018). In contrast, Samkin et al. (2014) have found that performance related disclosures are frequently reported. Such disclosures include information on precise plans, projects, actions, and programs that contribute to biodiversity conservation. The descriptions of the activities are specified to certain extent, for instance, aims and protection of native species can be discussed. Used frameworks influence the quality and the extent of disclosed information. (Samkin at al., 2014.)

Large number of disclosed information relates to partners and the importance of cooperation as well as projects and afforestation activities (Adler et al., 2018). Samkin at al. (2014) have found that implementation related disclosures are frequently reported, which include information on contribution to groups, legislations, partnerships, and programs.

In contrast, Van Liempd and Buch (2013) have found that extensive reporting on partnerships and stakeholder engagement is minor. They discuss that reported information concerns engagements, not detailed information on partnerships such as names or outcomes (Van Liempd & Buch, 2013). In addition, a common feature in disclosures is discussion on international conventions and guidelines that focus on biodiversity. (Adler et al., 2018.) Van Liempd and Buch (2013) have found a weak level of disclosures on target performance while Samkin et al. (2014) address that reporting on objects, targets, and outcomes in relation to performance has recurrently been reported since 2000. This shows that while there are few very detailed studies on biodiversity reporting, the results are occasionally contradictory. This calls for more research to be able to demonstrate more solid and coherent evidence on biodiversity reporting.

Adler et al. (2018) address contradictions in information disclosures; some companies actively report out on their action plans and goals for biodiversity while excluding information on biodiversity and species loss as well as irreversible changes in the environment due to their operations. Yet, revelations account for where companies have conducted activities that promote and support biodiversity conservation (Adler et al., 2018). In contrast, Van Liempd and Buch (2013, p. 856) have found that in Denmark "[n]o companies report on Biodiversity Action Plans or report whether they have a Biodiversity Officer" in internal management but there is partial reporting on actions in external reporting, which is based on the GRI indicators. Adler et al. (2018) emphasize the superficial nature of information disclosures on companies' impacts and address such reporting to be a form of green wash. Reporting is most beneficial when companies share statistical data (Ševčík et al., 2014). Additionally, accountability requires measures or estimates on performance. Currently, biodiversity related information is qualitative, context specific, lacks clear objectives, and management is technical, which makes accounting for biodiversity difficult and may result in impression management. (Boiral, 2016.)

2.4. Biodiversity reporting practices and strategies for accountability

Companies' disclosures are motived by several factors, which are discussed in this section. Increasing concern over biodiversity is driving companies to report on the topic as there is a need to respond to future challenges (Rimmel and Jonäl, 2013). Companies with

high-risk status and high risk of exposure to biodiversity risks are liable to report on biodiversity more than those with lower risk status (Rimmel & Jonäll, 2013; Skouloudis et al., 2018). Companies with high risk of being exposed to biodiversity loss have high acceptance towards adopting policy measures to conserve biodiversity, for instance, approximately 90% of companies that have high biodiversity risk ranking, such as mining and crude oil production, report out on their biodiversity protection activities and policies (Bhattacharya & Managi, 2013). However, vulnerability to biodiversity risks does not mean that those companies will disclose specific biodiversity information (Rimmel & Jonäll, 2013). Furthermore, Skouloudis et al. (2018) report that organization size does not considerably influence companies' reporting. In contrast, Gray et al. (2010, p. 22) write how corporate disclosures are influenced by the size and profile of the organization.

Additionally, disclosures are influenced by companies' viewpoints on biodiversity. Anthropocentric approach to biodiversity emphasizes self-centric approach to biodiversity (Jones & Solomon, 2013); companies are more likely to disclose biodiversity related information if they benefit from it. Maintaining reputation is one reason behind information disclosures. Companies are interested in biodiversity if their operations and activities are likely to cause damage to biodiversity because harmful environmental incidents can increase financial losses or obligations and decrease legitimacy. (Rimmel & Jonäll, 2013; Deegan, 2002.) Disclosures on unfavorable impacts on biodiversity can negatively affect companies' reputation, which decreases companies' willingness to report out on the impacts if they do not comply with social expectations (Boiral, 2016). Companies' impacts on biodiversity can undermine their overall operations and success and weaken shareholder value if these issues are not managed appropriately (F&C, 2004). External pressure drives companies to disclose biodiversity related information. (Rimmel & Jonäll, 2013). Deegan & Gordon (1996) suggest that environmentally sensitive organization are under radar of external actors, which leads organizations to report out on positive information to maintain legitimacy. Gray et al. (2010, p. 29) discuss sustainability disclosure as a trend in which corporate actions are disclosed in positive manner. Positive reporting on environmental actions can strengthen legitimacy while negative accidents and incidents may weaken legitimacy of an organization (Fernando & Lawrence, 2014).

To maintain good reputation, some companies use impression management, which means that companies' disclosures do not involve specific information about their biodiversity

assessment activities, their environmental partners, specific biodiversity performance indicators, or biodiversity targets and missions. (Adler et al., 2018; Van Liempd & Busch. 2013.) Moreover, companies may use neutralization techniques to conceal their negative, positive, and compromising activities that can affect biodiversity (Boiral, 2016). By using progressive rhetoric, companies attempt to maintain stakeholders' trust and comply with reporting standards. This demonstrates their awareness of biodiversity problems. Notwithstanding, positive impression management reduces companies' transparency. (Maroun et al., 2018; Boiral, 2016.) Maroun et al. (2018) have also studied biodiversity reporting by using organized hypocrisy theory and found that organizations that disclose practices aim to maintain their image and create good impression of their actions. Companies may obliquely address biodiversity by providing general and theoretical information on biodiversity and disclose their involvement in different biodiversity related activities. (Adler et al., 2018; Van Liempd & Busch, 2013.) Rimmel & Jonäll (2013) discovered such behavior within Swedish companies. Impression management is about promoting positive news rather than negative news, which is comparable to greenwashing. However, there are contradictory results between studies whether companies practice greenwashing methods in their reporting. (Hassan et al., 2020.)

2.5. Problems in reporting

Biodiversity is a broad concept as it comprehends complex natural systems that are linked to social world, which makes it challenging to define; there are more than 80 definitions for biodiversity (Jones & Solomon, 2013). Inconsistency in biodiversity reporting results from the lack of standardized terminology to support uniform reporting (Buhr et al., 2014, p. 55) or the lack of tools to address biodiversity loss (Bhattacharya & Managi, 2013). The complexity of biodiversity as a concept makes it difficult to be measured likewise biodiversity loss due to the complexity of biological systems (WWF 2020; Dempsey, 2013). Therefore, insufficient and indirect reporting is not always caused by apprehension about corporate image but rather a result of the lack of tools to support biodiversity management (Van Liempd & Busch, 2013).

Additionally, there is lack of awareness of sufficient biodiversity reporting methods (Skouloudis et al. 2018). The quantity of disclosed information may be large and specific but remain vague and may not indicate real achievements (Boiral, 2016). Bhattacharya

and Managi (2013) have found that the lack of assessment tools for biodiversity loss contributes to low level of understanding of economic impacts in relation to biodiversity loss, which results in inadequate acknowledgement of biodiversity. Reporting tools and frameworks, such as the GRI, can help companies to disclose biodiversity related information (Boiral, 2016; Brown et al., 2009; Rimmel & Jonäll, 2013).

2.6. Reasons to report on biodiversity

As biodiversity loss is accelerating, it is important for companies to demonstrate their output especially now that biodiversity is becoming integrated into business ethics (Boiral & Heras-Saizarbitoria, 2017). This section discusses why it is important for companies to report out on their biodiversity activities. There are two perspectives that are emphasized in the literature of biodiversity reporting: external pressure and biodiversity protection, which are connected to the CR and reputation. Additionally, legitimacy theory suggests that the legitimacy of corporates is of vital importance for their viability (Fernando & Lawrence, 2014), which is maintained through reporting and information disclosures (An et al., 2011). Moreover, sustainability reporting helps companies to achieve their goals at economic, social, and environmental levels (Ševčík et al., 2014).

External pressure is one of the main drivers of corporate reporting (Boiral, 2016). Businesses are responsible for their accountability to biodiversity related risks, yet "[n]ature-related risks are undervalued in business decision-making" (WEF, 2020, p. 48). Reporting on impacts and sharing information support the reliability of companies as they are called for transparency by consumers, investors, and other stakeholders (IPBES, 2019). Companies' reputation is partly depended on their impacts on biodiversity (Bhattacharya & Managi, 2013).

Stakeholders comprise a diverse group of external actors, such as investors, consumers, suppliers, and environmental awareness associations (Bazin, 2009) who contribute to companies' success (Van Liempd & Busch, 2013). Stakeholders have started to emphasize the importance of biodiversity by acknowledging the responsibility of companies to conserve biodiversity and emphasize the need for disclosures on their efforts towards actions (Boiral & Heras-Saizarbitoria, 2017; Adler et al. 2018). Companies' operations and survival depend on companies' compliance with socially relevant values to continue their

operations as compliance create legitimacy (Gray et al., 2010). Therefore, it is advantageous to disclose biodiversity information if stakeholders are concerned with biodiversity (Van Liempd & Busch, 2013). Accordingly, companies need to comply with regulations and good environmental performance (Bazin, 2009). Clear and specific disclosures demonstrate that companies take responsibility for their actions that may have impacts on biodiversity (Adler et al. 2018). Companies may gain more legitimacy when stakeholders are involved in biodiversity management (Boiral & Heras-Saizarbitoria, 2017). If companies do not report on relevant information, legitimacy gap may arise between companies and society. Accordingly, corporate reports can be perceived as aims to narrow legitimacy gap. (Deegan, 2002.)

Reporting out on impacts on biodiversity may encourage companies to take further actions within their operations to maintain and protect the environment. Biodiversity reporting and accounting can benefit biodiversity protection and the implementation of conservation strategies in policy planning as biodiversity protection activities are made visible in corporate reporting. Additionally, disclosure on used biodiversity indicators can enhance biodiversity protection. (Jones & Solomon, 2013; Skouloudis et al. 2018.) However, it is necessary for companies to acknowledge the importance of biodiversity and the risks involved when adopting biodiversity polices and actions (Bhattacharya & Managi, 2013). Reporting on biodiversity does not only drive behavioral chance within companies, but it can also construct a new way of understanding human actions in relation to biodiversity loss within societies. Accounting for biodiversity is important for understanding the relationship between humans and nature. When this connection is understood, biodiversity conservation can be enhanced. (Jones & Solomon, 2013.)

3 Methodology

This thesis studies biodiversity reporting and the comprehension of biodiversity within the chemical industry. The chemical industry operates globally, therefore the focus of this thesis is on global listed chemical companies and their reporting. The thesis aims to provide answers to two research questions: 1) how chemical companies report on biodiversity as part of their corporate reporting to maintain their legitimacy? 2) How is biodiversity perceived within the chemical industry?

3.1. Research materials

The material consists of interviews and corporate reports of global chemical companies. Corporate reports comprise the primary material which are supported by four in depth interviews in selected global companies. Interviews form secondary material for this thesis.

3.1.1. Corporate reports

First, the aim was to include reports by chemical companies who utilize bio-based raw materials because they operate in close contact with biodiversity. However, with that outlining, the material would have remained limited. Therefore, during the selection of the reports, chemical companies that operate in variable fields were incorporated into the material. The number of companies was increased to gain sufficient material for the analysis. Several types of corporate reports were included in the thesis: annual integrated reports, annual reports, sustainability reports, and GRI reports. Included reports are from 2019 and 2020.

Most of the chemical companies whose reports are included in the material were selected from C&EN's Global Top 50 for 2020 list (Tullo, 2020). Other companies were selected by searching companies that utilize biobased materials in their operations. Companies' reports were included if they mentioned biodiversity and they had a separate or downloadable annual or environmental/sustainability report. When selecting material, companies' reports were excluded if they were online reports on companies' websites, reports were not found, or companies did not have reports for years 2019 and 2020.

Reports of 33 companies in total were surveyed for references to biodiversity, of which 27 companies reported on biodiversity either in both years 2019 and 2020 or only one year. The reports including biodiversity were analyzed. Companies whose reports were surveyed are listed in table 1 below.

Table 1. Selected chemical companies					
Company	**Sales and revenues of 2019**	**Type of the report**	**Is biodiversity mentioned?**		**Other environmental issues discussed in the reports**
1. Air Liquide	$24.2 billion	Universal Registration Document 2019 & 2020	Yes		Climate
2. BASF	$66.4 billion	Report 2019 & 2020 Economic, environmental, and social performance	Yes		Climate, circular economy, water, air, soil, waste, energy
3. Bayer	$11.5 billion	Sustainability Report 2019 & 2020	Yes		Climate, energy, air emissions, water, wastewater, waste, recycling
4. Braskem	$13.3 billion	Integrated Report 2019 & 2020	Yes		Emissions, plastic waste, climate change, energy, water and effluents, waste
5. Covestro	$13.9 billion	Annual Report 2019 & 2020	No 2019	Yes 2020	Waste, air quality, water and wastewater, renewable energy, raw materials
6. Dow	$43.0 billion	Sustainability Report 2019 & Environmental, Social and Governance report 2020	Yes		Energy, emissions, water, waste, supply chain

7.Royal DSM	$10.1 billion	Integrated Annual Report 2019 & 2020	Yes	Climate, energy, resources, circularity, water
8. DuPont	$21.5 billion	Sustainability Roadmap 2019 & GRI Index 2020	No	Energy, emissions, waste, water
9. Eastman	$9.3 billion	Sustainability Report 2019 & 2020	Yes	Climate change, circularity, waste
10. Ecolab	$8.9 billion	Corporate Responsibility GRI Report 2019	Yes	Energy, emissions, water, waste, material use
11. Evonik	$14.7 billion	Sustainability report 2019 & 2020	Yes	Climate change, water and waste management
12. ExxonMobil	$27.4 billion	Sustainability Report 2019	Yes	Energy, plastic waste
13. Formosa Plastics	$32.4 billion	Sustainability Report 2019/2020	No	Energy, water
14. Givaudan	CHF 6.2 million	Annual Integrated Report 2019 and 2020/GRI Sustainability report 2019 & 2020	Yes	Materials, energy, emissions, water, effluents and waste
15. Indorama	$11.4 billion	Sustainability Report 2019 & 2020	Yes	Energy, emissions, climate, water, waste, circular economy

16. Ineos	$32.0 billion	Annual Report 2019 & 2020	No		Circular economy, energy, renewable bio-sourced feedstocks, emissions
17. Kemira	€2,659 million	Corporate Sustainability 2019 & Annual Review 2020	No		Water, circularity, climate change
18. LG Chem	$24.6 billion	Sustainability Report 2019 & 2020	Yes		Circular economy, climate change
19. Linde	$25.4 billion	Sustainable Development Report 2019	Yes		Water, emissions
20.Lotte Chemical	$13.0 billion	Sustainability Report 2019 & 2020	2019 Yes	2020 No	Climate change, emissions, energy, air, waste, wastewater, water, recycling
21. Lyondellbasell	$27.2 billion	Sustainability Report 2019 & 2020	Yes		Plastics, emissions, energy
22. Mitsubishi Chemical Holdings	$27.4 billion	Integrated Report 2019 & 2020	Yes		Climate change, water, plastic pollution, energy and resources
23. Neste	€15,840 million	Annual Report 2019 & 2020	Yes		Material, energy, water
24. Petro China	$22.7 billion	Environmental, Social and Governance Report 2019 & 2020	2019 Yes	2020 No	Climate change, energy, water, land resources, air

25. Sabic	$34.4 billion	Sustainability Report 2019 & 2020	No		Climate change, energy, water, emissions, material loss
26. ShinEtsu	14.2 billion	Sustainability Report 2019 & 2020	No		Energy, climate change, water
27. Sinopec	$61.6 billion	Sustainability Report 2019 & 2020	Yes		Emissions, waste, water, land resources
28. Solvay	$12.6 billion	Integrated Report 2019 & 2020	Yes		Climate, resources
29. Sumitomo Chemical	$15.2 billion	Sustainability Rata Book 2019 & 2020	Yes		Climate change, air, water, waste, resources
30. Syngenta	$10.6 billion	Sustainable Business Report 2019	Yes		Carbon, crop protection
31. Toray	$17.3 billion	Annual Report 2019 and 2020	Yes		Air, water, waste, energy, climate change
32. Umicore	$8.2 billion	Annual Report 2019 & 2020	2019 No	2020 Yes	Emissions to water and air, energy, water, waste, GHG emissions, pollution
33. Yara	$12.9 billion	GRI report 2019 & Sustainability Report 2020	Yes		Waste, emissions, climate change, water, circular economy

Table 1: Companies whose reports were surveyed. Companies' sales and revenues are included as well as other environmental topics that are discussed in the reports.

3.1.2. Interviews

Interviews are secondary material to this thesis. Three globally operating companies took part in this thesis and two interviews were conducted with representatives from one of the companies. Four interviews were carried out in total. The aim was to select companies that utilize bio-based raw materials in their operations and products. Companies and interviewees are anonymized.

The aim was to interview five globally operating chemical companies, but that did not realize. Approximately 14 interview inquiries were sent to global chemical companies who utilize bio-based raw materials. Eight answers were received of which three companies agreed to take part in the thesis. Those of who declined either refused at once or first accepted the inquiry but withdrew later on. In addition, the lining of the companies to be selected for the interviews was strict in a sense that companies that do not utilize bio-based materials were not inquired to take part in the thesis for the aim was to collect insight into biodiversity related reporting activities.

Semi-structured interviews were carried out after corporate reports were selected and reviewed. The design of the interviews was aimed to support the information gained from the analyzed reports and give insight into how biodiversity is perceived and how reporting can be developed as that is not comprehensively addressed in the selected corporate reports. The interviews were conducted via online platform and were recorded for later transcription phase.

3.2. Qualitative content analysis as a data analysis method

Qualitative content analysis (QCA) is used as a methodological framework to this thesis. QCA supports the interpretation and understanding of the meaning of symbolic material. It allows a researcher to describe the content of the material systematically through a coding frame that comprises categories of the units of coding and comprehends what is said. One way to build a coding frame is to create categories from emerging topics from analyzed materials as is done in this thesis. (Schreier, 2012, p. 1, 19-20.)

Schreier characterizes qualitative research as interpretive, naturalistic, situational, reflexive, flexible, inductive, case-oriented, and focused on validity (Schreier, 2012, p. 28). These characteristics apply in this thesis as follows, interviews and corporate reports serve as symbolic material. The thesis is naturalistic in a way that the content of corporate reports is given, and interpretation focuses only on the content.

This thesis uses interpretative approach which is subjective and focuses on underlying meanings found within the content (Smith & Taffler, 2000). This thesis does not quantify information. The aim is to describe how companies report on biodiversity and what information is included in corporate reports to depict how biodiversity is perceived within the chemical industry and what are commonly reported topics.

The method is chosen for its capacity to help the interpretation of biodiversity reporting in the corporate reports (Schreier 2012, p. 2). However, Schreier (2012, p. 23) points out that the QCA does not describe the material thoroughly, the overview of the data is limited. In this thesis this means that the complexity of biodiversity reporting is reduced in categories, some connections between different variables from the material are overlooked (Schreier 2012, p. 28). Content analysis has been applied to studies examining corporate environmental reporting. Vourvachis and Woodward (2015) have used content analysis to study social and environmental reporting trends and challenges. Samkin et al. (2014) have conducted a content analysis study on biodiversity disclosures as well. This thesis is different from Vourvachis and Woodward (2015) as they have conducted a systematic literature review. The thesis resembles the research by Samkin et al. (2014) in the way they have qualitatively categorized and analyzed their data. Their categories resemble to some extent the categories of this thesis, and both are based on corporate reports. Yet, the thesis differs from Samkin et al. (2014) as they have created a specific framework to analyze collected data whereas this thesis builds the framework in data-driven manner.

3.3. Data analysis

The corporate reports selected for this thesis were compiled into one coding frame. First, all the reports were read through for conception of the content. Corporate reports often included a separate environmental section which incorporated different environmental

aspects and issues that companies account for in their operations. Only sections, statements, and sentences that mentioned biodiversity were included. Excluded issues were, for instance, water management and climate change unless biodiversity was simultaneously discussed or referred to in the context. Second, after defining the content, coding frame was built for the reports. Building of the coding frame followed the guidelines of Margit Schreier (2012). Principally, the categories are data driven.

Interviews were separately coded from transcripts in similar fashion to the coding frames of the corporate reports. Coding of the interviews is fully data-driven and reflexive as discussions with the interviewees were navigated by semi-structured questionaries, which allowed discussion outside the questionaries. Before the final analysis, all coding frames were merged into one coding frame, which is presented in table 2 below.

Table 2. Coding frame	
Main Category	**Sub-categories**
Comprehension of biodiversity	The concept of biodiversity
	The role of biodiversity
	What is biodiversity needed for
	Scale of the relevance of biodiversity loss
	The level of importance of biodiversity
	Threats to biodiversity
	Consequences of biodiversity loss
	Interconnections
	Possibilities
	Benefits from biodiversity
	Dependency on biodiversity
	Perception of biodiversity
	Miscellaneous categories
Impacts	Impacts of companies on biodiversity
	Disclosure on the impacts
	Areas of the companies' that affect biodiversity

	The level of impact of biodiversity on companies
	Areas of biodiversity that affect companies
	Areas of companies on which biodiversity affects
	Preventing negative impacts
	Comprehension of effects on biodiversity
	Uncertainties
Biodiversity conservation	Activities contributing to conservation
	Aim of conservation
	Meaning of conservation to the companies
	Challenges
	Outcomes
	Regulations
	Sites in or adjacent to protected areas
	Threatened and endangered species
	Miscellaneous categories
Collaboration to enhance biodiversity	Cooperation
	Supporting of biodiversity related projects
	Investments
	Funding
	Sponsoring
	Products
	Miscellaneous categories
Commitments and compliance	Agreements
	Principles
	Programs
	Policies
	Position to biodiversity
	Guidelines
	Actions
	Laws

	The UN Sustainable Development Goals
	Miscellaneous categories
Biodiversity management and measuring biodiversity	Management of operation sites of biodiversity value
	Planning of production sites
	Development of biodiversity assessment
	Status of biodiversity management
	Managed matters
	How biodiversity is managed
	Requirements
	Aim of assessment
	Monitoring tools
	Challenges and measuring biodiversity
	External actors
	Internal actors
	Approach to biodiversity
	Materiality
	Objectives
	Targets
	Goals
	Expectations
	Raw materials
	Sites in or adjacent to protected areas
	Biodiversity restoration activities
	Identification of risks
	Number of volunteers
	Mapping of raw material categories
	Goal with a numerical target
	Gained benefits
	Percentage of fulfilled obligations
	Pressure reduction
	Number of implemented projects
	Mapping of supply chain in %

	Number of ecological monitoring points
	How much ecological data was collected
	Number of surveyed species
	Awards
	Ratings
	Recognitions
	Certification
	Achievements
	Miscellaneous categories
Corporate reporting	Sustainability reporting
	Biodiversity reporting
	Development of biodiversity reporting
Stakeholders	Relevance of biodiversity to stakeholders
	Stakeholder engagement
	Customer demand
	Miscellaneous categories

Category "comprehension of biodiversity" was formed from the information that comprise companies' perception of biodiversity including descriptions of biodiversity, connections between biodiversity and different dimensions. The category helps to describe how biodiversity is perceived and understood.

Category "impacts" comprises information that relates to different impacts between biodiversity and companies' operations and management. This is to show how companies report on their accountancy for biodiversity impacts.

"Biodiversity conservation" category includes information related to companies' biodiversity preservation activities, perception of biodiversity conservation, and specified disclosures, such as threatened and endangered species. The information was selected based on activities that companies did not connect to external actors. The information on the activities does not contain statements on cooperation activities, which are included in

"collaboration" category. That information is based on statements on companies' collaboration with external actors to establish understanding on how companies address external partner relations.

Companies' commitments and compliance to biodiversity are depicted by listing different internal and external undertakings and engagements. Committed actions are linked to the companies' activities regarding biodiversity conservation. Accordingly, they are actions that the companies report to commit to, but those actions are not always explicitly reported to have been carried out, which is why these committed actions are not listed under the subcategory "biodiversity conservation".

"Biodiversity management and measuring biodiversity" depicts how companies report on current biodiversity management and prospects. The subcategories were constructed from information that regarded different aspects of companies' processes in management that support biodiversity or issues that influence companies' management to examine possible limitations. This category expands from impacts as it comprises all other aspects of management. Raw materials are included as a sub-category as they are an important management topic within the chemical industry even though raw materials occur in the examples of other categories for they are connected to the relationship between biodiversity and companies in varying ways. This created confusion around the categorization of raw materials. Additionally, numerical data is included to demonstrate what type of numerical information is reported. Presented numbers account for a diverse set of actions that provide detailed and concrete information on companies' actions. The category includes reporting on companies' achievements and recognitions to limited extent. These are listed to examine how much companies highlight gained acknowledgements.

Category "corporate reporting" is divided into three sub-categories: sustainability reporting, biodiversity reporting, and development of biodiversity reporting. The category is mostly based on topics that emerged from the interviews when the interviewees were asked about sustainability reporting before leading the discussion on to biodiversity reporting. Accordingly, corporate reporting is addressed as sustainability reporting. This category aims to understand the process of sustainability reporting to examine biodiversity reporting in more depth.

"Stakeholder" category includes information on stakeholder engagements with companies and biodiversity. The category is separated from "collaboration" category because discussion on stakeholders include information on stakeholders' perception of biodiversity.

The categories emerged from the material and are formed to comprehend how companies discuss and report on biodiversity. Categorizing created limitations in a sense that when companies commit to an action it is listed under the category "commitments", however, the company may already be conducting actions towards biodiversity conservation. This connection is reduced in the coding frame. Same type of limitations regards raw materials as well.

4   Results

4.1   Comprehension of biodiversity

The meaning of biodiversity and the comprehension of the topic emerged often in various forms, which are listed under the "comprehension of biodiversity" category. There is a conceptual understanding of biodiversity, and its role is often discussed in relation to sustainable future:

> *"Biodiversity refers to living species of all kinds, including terrestrial, marine and other aquatic ecosystems, and also the ecosystems to which they belong. It includes diversity within and between species, the diversity of ecosystems, and the interactions between living organisms" (Air Liquide, 2020, p. 314).*

> *"Biodiversity is impacted by the effects of climate change, but can also serve as a means of mitigation and adaptation to its consequences" (Givaudan, GRI report, 2020, p. 49).*

It is understood that biodiversity is connected to many aspects of corporate survival and all human life through different dimensions as well as direct interconnections:

"As a chemical company, we depend on ecosystem services like the availability of renewable resources and air, water and soil quality, while also influencing them" (BASF, Report, 2020, p. 5).

Biodiversity loss is relevant in many respects. Hence, companies perceive the importance of biodiversity differently. The ways in which companies comprehend it is company specific and depends on the activities and the field of operation. Biodiversity is an important topic, however, complex and difficult. There are remarks on both positive and negative feedback effects regarding biodiversity and biodiversity loss, which have global consequences. In addition, there is understanding that biodiversity impacts are human driven:

"Biodiversity loss is accelerating, and its key drivers are all connected with human activity" (Royal DSM, Integrated Annual Report, 2020, p. 81).

4.2 Impacts

Information on impacts comprehends both companies' impacts on biodiversity and biodiversity related impacts on companies. This shows that companies understand the feedback effects between companies' operations and biodiversity.

The level of companies' impact on biodiversity is addressed by several companies. Reported information ranges from having "no significant impacts" to medium and "possible negative impacts". Companies, such as Braskem (2019), Ecolab (2019), Linde (2019), Sinopec (2019, 2020), and Neste (2019) reports on having no significant impacts on or threats to biodiversity. Introduced information often addresses what impacts companies did not have, as Eastman (2019) reports having no impact on IUCN red-listed species or as Sinopec (Sustainability Report, 2020, p. 59) reports that *"there was no major harmful incident to biodiversity occurred concerning Sinopec Corp."*

Several companies, such as Evonik (2020), Dow (2019), Air Liquide (2019), and Givaudan (2020) address their impacts on biodiversity and report on having some level of impact on biodiversity, for instance, Evonik reports that their *"business activities can have a negative effect on biodiversity" (*Evonik, Sustainability report, 2020, p. 76*)*. BASF

(2020) acknowledges that they have impacts on ecosystem services. Disclosures by Evonik and Givaudan include information on the areas of business activities that can affect biodiversity, such as the use of raw materials, production, business activities (Evonik, 2020), and ingredient supply (Givaudan, 2020). Typically, disclosures on companies' impacts are represented in positive light and reporting on impacts is neutral as possible negative effects of operations are not revealed in detail. Exclusion of information can be a strategy to maintain legitimacy. Only Neste (2020) revealed that "*[i]n 2020, we had two minor environmental permit-related incidents at our refineries in Rotterdam and Porvoo. In the production of renewable fuels in Rotterdam a small hydrogen sulfide leak for adsorbers to air was observed*" (Annual report, 2020, p. 64).

Companies address the level of impact of biodiversity on companies and acknowledge the risks of declining biodiversity and land degradation as threats to companies. They also report what parts of companies' operations are exposed to such risks, such as operational sites, value and supply chain, and economy:

> *"As we are exposed to biodiversity risks in our supply chain, we strive to responsibly source high-risk raw materials through recognized certification schemes."*
> *(Royal DSM, Integrated Annual Report, 2020, p. 81)*

Above represented result show that companies understand the locality of biodiversity impacts, for instance, when they report on IUCN red-listed species and deforestation and link related impacts to production and raw materials as those can be perceived to be area-specific. The interviewee from company B discusses on reporting on local impacts as companies' activities are carried out in specific places, therefore reporting on impacts is locally driven. To support this, the interviewee from company A addresses the locality of biodiversity impacts: there is a need to comprehend regional circumstances and problems when managing biodiversity. The interviewee continues that comprehension of local issues helps in local biodiversity management and to prevent negative impacts on biodiversity. Moreover, the interviewee from company A discusses time lag between an action and an impact as the outcome of an action can materialize after a long period of time rather than emerging immediately. This challenges biodiversity management. The interviewee emphasizes how this is problematic when biodiversity is considered, identified, and reported.

Companies discuss how they manage their effects to prevent negative impacts. The depth in which impact management is reported varies. Sinopec (2019, 2020) reports to mitigate impacts and survey hidden hazards while Givaudan, BASF, and Royal DSM (2020) report on ensuring certification. Furthermore, three companies, Linde, BASF, and Sumitomo (2019) report on minimizing impacts.

> "*We aim to minimize these raw material-specific risks with measures, projects and targeted involvement in sustainability initiatives in the relevant value chains*" (*BASF, Report, 2019, p. 105).*

> "W*hen planning new sites, processes are in place to ensure that Linde minimizes any potential negative impacts on biodiversity. It follows internationally recognized guidelines when performing its evaluation, such as the Voluntary Guidelines on Biodiversity-Inclusive impacts Assessment issued by the United Nations*" *(Linde, Sustainable Development Report, 2019, p. 59).*

However, information lacks concrete details on how companies conduct impact prevention activities and how impacts are measured. Sharing of adequate impact related information enhances corporate legitimacy. Yet, when information lacks details, legitimacy can be reduced.

4.3   Biodiversity conservation

Companies' activities regarding biodiversity conservation are extensively discussed in corporate reports. Disclosed information is presented either in detail or ambiguously. Some companies provide examples of their activities, and some provide a general comprehension of what they do to conserve biodiversity. Disclosures are more ambiguous when detailed information on concrete actions is not presented. Toray (Annual Report, 2020, p. 84) reports that the company *"pursues biodiversity initiatives in accordance with a three-year action road map and sets its priorities based on the Group's Biodiversity Initiatives."* Accordingly, they report that the initiatives aim to conserve green areas, including natural groves or forestation. They report that the three-year road map includes

palm oil surveys. The quotation is a representation of generalized reporting as concrete steps are not shared.

When detailed information is disclosed, it may include specific information on conducted activities, location, aim, participants, species, and the outcome of activities and restoration.

> *"With the purpose of confirming the impact of business activities on water areas, we conduct aquatic wildlife surveys of the Sabishiro River, into which process water from the Works flows. As a result, we confirmed a vulnerable species of Stenothyra in the Sabishiro River. In addition, we discovered 10 species of precious aquatic benthic organisms, such as the endangered species Cottus reinii"* *(Sumitomo Chemical, Sustainability Data Book, 2020, p. 117).*

By reporting on aquatic wildlife survey, Sumitomo Chemical (2020) emphasizes that they maintain ecosystems and will continue to conduct surveys to ensure further environmental protection. The information includes the outcome of the action and the names a few vulnerable and endangered species that were found. This increases company's legitimacy as detailed information is reported out, which exhibits transparency. However, this type of detailed reporting is minor among surveyed reports. BASF (2020) features the company-initiated project that contributes to creating balance between agriculture and biodiversity. They describe what they do and with who. However, many companies do not report on possible success of the projects explicitly.

While some companies generally describe activities they have carried out, Sumitomo reports out outcomes that they have attained through their efforts for biodiversity. For instance, they report that they have *"[e]nsured compliance with "Sumitomo Chemical's Commitment to the Conservation of Biodiversity" and promoted detailed initiatives"* *(Sutimoto Chemical, Sustainability Data Book, 2020, p. 98).* In their 2020 sustainability data book, they present activities that they have executed and share pictures of the projects.

Companies disclose information relating to the aims of conservation actions and what meanings are attached to biodiversity conservation. In some of the reports, companies

address the meaning of biodiversity conservation as benefit gaining, a critical global environmental issue as well as an important management issues. Biodiversity conservation itself is regarded as important and as a responsibility:

> *"We acknowledge our role to protect biodiversity" (Royal DSM, Integrated Annual Report, 2020, p.81).*

A few companies address the challenges hampering conservation, which are related to management and regulatory issues regarding conservation.

Several companies use the GRI framework to report out on more specific information related to biodiversity, which include the following reporting points. The information often informs how companies' operations do not influence biodiversity. Protected areas, threatened and endangered species are of central importance to biodiversity of which some companies share information and address in reports. Some companies disclose information on locations and names of production sites and activities carried out in or adjacent to protected areas or not having any operations in such areas:

> *"In principle, the industrial premises used by Evonik do not include any protected or restored natural habitats" (Evonik, Sustainability Report, 2019, p.59).*

In addition to Sutimoto Chemical (2020) who report out on endangered species, a few companies address threatened and endangered species. However, the depth of this information varies; Givaudan (2020) reports that they have found IUCN red listed species on their sites, but they do not name those species. Royal DSM (2020) report that the existent of the IUCN red list species on their operational sites is unknown. Braskem (2019) and BASF (2020) name IUCN red listed species that they have found in their sites, rescued, or contributed to the conservation of the species:

> *"The complex in Mexico has two species that are listed on the IUCN red list: Ceratozamia miqueliana (Endangered) and Zamia loddigesii (Near Threatened). It is worth mentioning that these species were rescued by the company during the construction of the complex from 2012 to 2016 and are now in a conservation area" (Braskem, Annual Report, 2019, p. 115).*

4.4 Collaboration to enhance biodiversity

"Collaboration to enhance biodiversity" comprises cooperation activities and projects that are set to promote biodiversity. The activities engage external partners who take part in the activities or are supported by the companies. These activities are sub-categorized as cooperation, supporting, investments, financing, and sponsoring. Often these sub-categories are interlinked due to the diverse nature of collaboration activities.

Information on cooperation with external partners includes activities with partners and what they aim to achieve through collaboration. Companies either name the partners they work with or anonymously refer to them, for instance Bayer reports to work with "nature conservation experts". Detailed information may include the duration of the partnership and activities carried out. Eastman (2019) and Sinopec (2019) provide specified descriptions on their partnership and activities:

> *"the Eastman Foundation's 18-year partnership with The Nature Conservancy has aided in the expansion of wetlands for at least 26 rare, threatened or endangered plant and animal species, investing in the unique biodiversity of the Shady Valley area of Northeast Tennessee's South Fork Holston River basin" (Eastman, Sustainability Report, 2019, p. 23-24).*

> *"In 2019, Sinopec Shanghai Oil Marketing Company signed a strategic cooperation agreement with local universities to use company-owned land in west Chongming Island for field observation activities of the wetland ecosystem in the Yangtze River Estuary. The two parties jointly established an ecological monitoring & research station to provide support for the observation of water quality and wildlife in the Yangtze River Estuary and nearby areas, and the study on the impact of production and operation activities on local water environment and wildlife" (Sinopec, Communication on Progress for Sustainable Development, 2019, p. 51).*

Yet, there is not information on what effects these projects had after implementation. Descriptions are often abstract as detailed information on how collaboration is implemented to contribute to biodiversity conservation is absent. Nonetheless, there are remarks on giving technical support, material donations, or providing access to resources by a few companies, such as Givaudan (2019).

Dow (2020) and Givaudan (2020) report that they engage with communities and help them to protect biodiversity as well as support the communities by creating employment. Additionally, product development is connected to biodiversity protection by some of the companies. Royal DSM (2020) and BASF (2020) report on their co-developed products that contribute to biodiversity conservation:

> *"For example, just one ton of our Veramaris® natural algal oil saves 60 tons of wild fish from having to be caught to produce salmon feed, protecting marine biodiversity in our oceans." (Royal DSM, Integrated Annual Report, 2020, 81);*

> *"For example, the Nutrition & Health division and Isobionics® launched Isobionics® Santalol in 2020, which is a biotechnologically produced fragrance and a convincing alternative to natural sandalwood oil. This oil is extracted from the wood and roots of the sandalwood tree, which is on the Red List of the International Union for Conservation of Nature (IUCN) because it is highly endangered by overexploitation" (BASF, Report, 2020, p. 142).*

While Royal DSM (2020) does not discuss how the product should save marine biodiversity specifically, BASF (2020) provides more detailed description on the product and how it contributes to biodiversity conservation. Furthermore, BASF (2020) reports that the product is produced from renewable raw materials but does not include information on what raw materials have been used to develop the product to replace sandalwood oil. Exclusion of significant information may contribute to creation of legitimacy gap.

Chemical companies who are members of environmental organizations, such as the Alliance to End Plastic Waste (AEPW) provide the information in the reports. Supporting of biodiversity conservation comprise information that includes the subject of supporting, what type of activities are supported, and how companies provide support.

"Evonik supports this plan and is a member of the Fowl River Forever steering committee that is working on a management plan to protect and improve the water quality." (Evonik, Sustainability Report, 2019, p. 60);

"This year, we put our name behind Business for Nature's 'call to action' for governments to set more ambitious policies to reverse nature loss in this decade. We are also a member of One Planet Business for Biodiversity (OP2B) which aims to scale up regenerative agriculture and restore ecosystems to prevent further biodiversity loss through collective member actions" (Royal DSM, Integrated Annual Report, 2020, p. 82).

Roundtable for Sustainable Palm Oil (RSPO) stood out from three corporate reports as part of collaboration partners. Most of the studied companies are either members of the RSPO or engage with the RSPO by supporting them, for instance, BASF (2019, 2020) reports that they have actively supported the RSPO. This indicates that companies are aware of the environmental issues regarding palm oil. Otherwise, companies support or are members of variety of different organizations that contribute to biodiversity conservation.

Funding and sponsoring are forms of supporting and can include investments, which are often discussed separately. Reported information on supporting activities is described in general manner; reports provide information on actions towards biodiversity protection actions, however, information on achievements and outcomes is excluded. Additionally, details on the type and location of projects are occasionally included in reporting, for instance, Air Liquide reported in 2019 that they supported biodiversity conservation. They introduced and described three projects they sponsored as well as a marine biodiversity study that they financed. The reported information included the type and location of the projects. In addition, Dow (2020) reports to fund a project carried out in collaboration with Peabiru Institute and The Nature Conservancy. Reported information includes benefits of the project and what will be done as well as how much land is own by the company and how much money is invested in the project by the company, which are discussed in more detail as part of numerical data in section 4.6. Furthermore, how the

project contributes to biodiversity is briefly discussed as Dow contributes through "*a species delineation and ecosystem services lens on a Dow property in Latin America*" (Dow, 2020, p. 75). Additionally, Bayer (2019, 2020), and Eastman (2019, 2020) address investments relating to biodiversity. However, detailed information on how much companies invest in biodiversity and conservation related projects, or organizations remains minor.

Nevertheless, when investments are addressed, there is information on where companies have made investments and what types of activities they have invested in, what they aim to achieve, and what is the role of biodiversity in investment decision making. Bayer (2019) demonstrates that they acknowledge the need to improve biodiversity conservation and report how they aim to gain more knowledge. This may be a way to interlace possible legitimacy gap.

> "*Bayer invests in research and development to gain more knowledge about how an improved balance between productivity and conserving biodiversity and ecosystem services can be attained, and what measures farmers must take to achieve this, particularly when applying intensive conventional agricultural cultivation systems*" (Bayer, Sustainability Report, 2019, p. 54).

4.5   Commitments and compliance

There is extensive reporting on committing to different engagements, agreements, programs, policies, laws, and actions, such as the U.N. Convention on Biological Diversity, to demonstrate companies' commitments to biodiversity conservation. As an act of maintaining stakeholder trust, companies declare to comply with external and global sets of rules and guidelines or to internally generated agreements and principles. Many of the companies report on committing to different UN Sustainable Development Goals, which they regard important in relation to biodiversity, and implementing them into their biodiversity management. The U.N. Convention on Biological Diversity was addressed by four companies and Nagoya Protocol by three companies, both were most common engagements. As an example, Bayer has committed to both:

> *"We are explicitly committed to the U.N. Convention on Biological Diversity and the associated Nagoya Protocol, as well as the International Treaty on Plant Genetic Resources for Food and Agri- culture of the FAO, which prescribes the balanced and fair division of use of genetic resources" (Bayer, Sustainability Report, 2020, p. 37).*

Discussed committed actions are either specific or imprecise. Often these disclosures do not include all details, for instance, location is mostly absent from disclosed information while generalized actions are reported. However, specific areas of operations are discussed, for instance Neste reports:

> *"Neste takes a clear stand against any actions that would cause deforestation. We are committed to preventing deforestation in our own supply chains, and require the same from all our raw material suppliers." (Neste, Sustainability Report, 2020, p. 64)*

Additionally, Covestro (2020) reports on their commitment to circular economy that will address biodiversity. Yet, there is lack of description on how the commitments are implemented. Imprecise actions are general statements that companies want to commit to: protect and promote biodiversity, restore forest, and reduce impacts. Nevertheless, companies address this issue at some level when they report out on biodiversity management as discussed in the next chapter.

4.6   Biodiversity management and measuring biodiversity

Biodiversity management is discussed in relation to activities, methods, and tools used to assess biodiversity. Information regarding biodiversity management comprehends management approaches and issues that are managed and considered in biodiversity assessments. Many of the companies that report on biodiversity address the materiality of the topic. Companies have methods for assessing biodiversity or report out assessment tools they apply:

> *"Our AgBalance® method and the biodiversity calculator, which has been available since 2020, enable a scientifically sound assessment of the impact of agricultural practices on biodiversity..." (BASF, Report, 2020, p. 143).*

Biodiversity management incorporates management of sites of high biodiversity value and other operational sites where a few companies report to considers biodiversity. Rarely, detailed and specified information on exact actions or data from conducted assessments is disclosed. However, BASF (2020) reports out issuing measures based on their AgBalance assessment and gives examples on actions that may be required to be carried out:

> *"Based on these assessments, we issue recommendations for measures such as planting flower strips or establishing nesting places to benefit pollinators, like wild bees, and farmland birds" (BASF, Report, 2020, p. 143).*

Several companies report out on how they are developing biodiversity assessments discussing what needs to be done or they are currently developing. Some companies address issues in more detail, for example, Evonik (2020) reports their starting point topics of their biodiversity analysis while Air Liquide (2020) addresses more detailed approach:

> *"The biodiversity approach must therefore cover the company's entire value chain, from resource management through to product life cycle analysis" (Air Liquide, Universal Registration Document, 2020, p. 314).*

To improve the development of biodiversity assessments, there is a need for closer consideration and identification of biodiversity as the interviewee form company A emphasizes. Similar notions emerge from the reports when development projects for biodiversity assessments are being planned. BAFS (2020) reports out on their pilot project that is aimed to improve methodological measurement of the impacts of products on biodiversity. Evonik (2019) reports that they have extended their biodiversity analysis with a geoinformation system to examine the impacts on biodiversity of their global sites. Solvay (2019) reports that their biodiversity management is not sufficient.

What is managed, is disclosed to varying extents. Five companies report to manage their impacts. Among them is Evonik (2019, 2020) as they report to manage emissions into water and air to which they connect biodiversity. Givaudan (2019) reports to manage raw materials by mapping some of their raw material supply chains for palm, cheese, butter, and soy. Air Liquide (2020) reports out on the monitoring activities of their subsidiary Seppic:

> *"The subsidiary constantly monitors developments in associated regulatory tools and the status of the plant and marine species it uses with regard to CITES and UICN lists of threatened and endangered species" (Air Liquide, Universal Registration Document, 2020, 315).*

A few companies report out on setting requirements regarding biodiversity. Givaudan (2020) and Neste (2020) report on having requirements for their raw material suppliers. Requirements are company specific, for instance, Neste (2020) has Responsible Sourcing Principle, which they require their suppliers to conform with. However, specific obligations of the content of companies' requirements are not disclosed. BASF (2020) and Givaudan (2020) report on external actors taking part in biodiversity management or conducting third party audit certifications. Additionally, the interviewee from the company C 1 discusses that external assurance supports the relevance of reporting.

There are challenges in biodiversity management, which are reflected in a few reports regarding measuring biodiversity and complex supply chains. In addition, all the interviewees address challenges that hamper biodiversity management, which are derived from complexity of biodiversity and data management. The interviewees from the company A and C 1 remark that biodiversity is a difficult entity as it is difficult to be measured. The interviewee from the company B remarks that data management can be complicated. The difficulty is also acknowledged by BASF:

> *"it is currently extremely difficult to measure impacts on biodiversity and thus BASF's impacts in full" (BASF, Report, 2020, p. 142).*

It is important to realize how to collect reliable data and how to automate data management, as the interviewee from company A addresses. Moreover, the interviewees from

company C emphasize the impacts of sourcing of renewable materials, which comprehends difficulties in measurement and assessment of impacts as well as direct impacts linked to bio-based raw materials. Raw materials have implications along value and supply chains, which is addressed by the interviewee from company A. The interviewee discusses how one action at the beginning of value chain impacts how raw materials take shape and are carried along the value chain from one operator to another. The interviewee emphasizes the difficulty of measuring the impacts and changes in value chains. To emphasize, the interviewees from company C address the complexity of value chains and supply chains of raw materials as well. This complexity is also discussed by BASF (2019, 2020) as they acknowledge the complex relationship between raw materials, biodiversity, and deforestation; effects can be negative and positive, while there are risks deriving from direct and indirect impacts. This is also addressed by the interviewees from companies A and C 2. The interviewee from company C 2 discusses how complexity and lack of control over supply chains challenge actions that preserve biodiversity. However, the interviewee remarks on how sustainability issues can be managed through certification of, for example, palm oil.

In the corporate reports, there is a little information on how the raw materials that are connected to biodiversity are managed except for supplier requirements and certification. Neste (2020) reports on evaluating their raw material suppliers and having a raw material related biodiversity project going annually. Givaudan (2019) and Royal DSM (2020) provide descriptions on raw materials they source. Givaudan (2019) is transparent about one raw material they source by disclosing information on sourced Tonka bean that grows in the area of high biodiversity. However, they do not report out on any specific details about species. They report that they support communities who enhance biodiversity in the area:

> *"Tonka grows wild in the forest of the Caaura Basin, a rich and largely pristine natural environment of high biodiversity in the Amazonas region of Venezuela"* *(Givaudan, Integrated annual report, 2019, p. 55).*

In addition, BASF (2020) reports out on raw materials they source and a related risk:

> *"BASF procures a variety of renewable raw materials. Particularly palm and palm kernel oil, soy oil and its derivatives as well as lignosulphonates, which are*

*extracted from wood, have been determined to have a high deforestation risk"
(BASF, Report, 2020, p. 142).*

Givaudan (2019) and BASF (2020) acknowledge the importance of sustainable use of
raw materials and finding alternatives to nature based raw material:

*"We insist on responsible sourcing from suppliers and investigate more efficient
use of naturals as well as alternative sources of key natural raw materials"
(Givaudan, GRI report, 2019, p. 30).*

*"In cooperation with partners, we are also developing innovative solutions to re-
duce pressure for economic use of forests. For example, the Nutrition & Health
division and Isobionics® launched Isobionics® Santalol in 2020, which is a bio-
technologically produced fragrance and a convincing alternative to natural san-
dalwood oil" (BASF, Report, 2020, p. 142).*

Even though biodiversity is mainly generally reported, some companies share numerical
disclosures. While it is also perceived to be difficult to be measured, there are ways to
depict companies' biodiversity actions in figures. Numerical disclosures are detailed in-
formation and data, which include species, protected areas, areas where biodiversity res-
toration activities have been carried out, identified risks, volunteers, and different man-
agement aspects. This information reveals the results of measurements and what has been
assessed, how much has been done and achieved through actions, what precise targets
companies have set, or numerical information regarding operational sites in or adjacent
to protected areas. Numerical data presents concrete details on companies' activities to
support legitimacy:

*"In 2020, 27% of all our production sites in scope were adjacent to protected
areas and 3% contained portions of registered protected areas" (Royal DSM, In-
tegrated Annual Report, 2020, p.81);*

*"The Formosa-Tejano Wetlands section of the count led the way with 10 bird
species exclusive to that site" (Formosa Plastics, 2019, p. 7);*

"In 2020, Solvay reduced its pressure on biodiversity by 12% compared to 201."
(Solvay, Integrated Report, Sustainability Report, 2019/2020, p. 67).

In the report, Solvay does not provide a clear comprehension on how they have reduced the pressure on biodiversity. They report to focus on the pressure that originates in their operations and supply chain and list some topics, such as greenhouse gas emissions and freshwater eutrophication. The interviewee from the company B supports numerical data disclosures by discussing the importance of numbers and figures:

"when you start putting figures out there of the monetary risks as well of not doing things or what we are exposed to in the future. I think that is when you are getting leadership, that helps a lot" (The interviewee from company B).

Dow is the only company to report out how much their Business Impact Fund has invested in project that contributes to biodiversity:

"[t]he project is receiving an investment of $1 million reais (~US$200,000) from our Business Impact Fund. The Business Impact Fund is a competitive grant program containing more than US$1 million of annual funding to support social impact projects in partnership with nonprofit or non-governmental organizations that spotlight business solutions" (Dow, Environmental, Social and Governance Report, 2020, p. 31).

Biodiversity management includes reporting on prospects. Reporting on future includes information on what companies have set out to do and aim to achieve. Companies report out their objectives for actions, what targets and goals have been set as well as achievements the companies expect to accomplish or have achieved:

"We also aim to reduce the environmental impact of our crop protection products in important crops by 30% and expect this to have a positive impact on biodiversity" (Bayer, Sustainability Report, 2020, p. 7).

A few companies present their achievements that are connected to biodiversity. Solvay (2020) reports that they received a recognition from Act4Nature for reducing pressure on

biodiversity. BASF (2020) reports on an award they received for their measuring system that is linked to biodiversity. They also report on being rated for their environmental management:

> *"BASF was rated for the first time in 2020 in the nonprofit organization CDP's forest assessment (grade: A–). It evaluates companies' management of environmental risks and opportunities. It is based on detailed insights into our palm value chain and the impact of our activities on ecosystems and habitats"* (BASF, Report, 2020, p. 142).

4.7 Corporate reporting

The driving force of sustainability reporting is external influence from stakeholder expectations, sustainability standards, and frameworks as the interviewees from company C discuss. The interviewee from company B addresses that reported information need to be focused on stakeholders. Furthermore, companies' internal goals and visions as well as trends and urgency of the type of the data guide reporting of sustainability topics as the interviewee from company B remarks. At the moment, sustainability topics are reported through voluntary perspective as the interviewee from company B discusses. Additionally, the interviewee discusses that reporting is based on policy level, management practices, and performance. By reporting on these, the aim is to provide visibility and gain legitimacy.

A significant factor in reporting is the authenticity of the data and information, as well the reported information must be relevant as the interviewees from the companies A, B, and C 1 emphasize. Currently, there are no common rules and guidelines for sustainability reporting. Reporting is challenged by the lack of guidance on reporting as the interviewee from company B emphasizes and evolving responsibilities and sustainability expectations as the interviewee from company C 1 remarks. Currently, chemical companies are using different reporting tools and frameworks of which the Global Reporting Initiative (GRI) is most commonly used and perceived as a basic framework by the interviewees from companies B and C for it sets standards for reporting.

Regarding biodiversity reporting, the interviewee from company A remarks that biodiversity related issues, such as halting biodiversity loss and destruction of carbon sinks and storages should be accounted for in reporting. Nevertheless, biodiversity reporting encompasses challenges, which are associated with biodiversity management as seen in section 4.6.

Biodiversity is not a mature topic yet to be reported on. Reporting on mature topics allows demonstration of the output, as the interviewee from company B remarks. While reporting on biodiversity is perceived difficult, it is an important reporting topic as the interviewees from company C discuss. However, biodiversity does not hold a high status in reporting, as the interviewee from company B remarks:

> *"biodiversity is tended to be a weaker player in the sense that it is not the driving force a lot of the time, other things like waste water, greenhouse gas emissions, climate energy tent to get the focus" (interviewee from the company B)*

The interviewee from company C 1 emphasizes that reporting on biodiversity should be balanced to avoid greenwashing. The interviewee describes balanced reporting as equal reporting between requirements for external parties, certification, and activities, such as bio-indicator surveys. Additionally, the interviewees from companies B and C 1 emphasize balanced reporting on actions, performance, and strategies and policies.

Development of biodiversity reporting is connected to development of biodiversity assessments as reporting requires tools to collect and manage information and data, which are discussed in section 4.6, to validate that reporting is relevant. The interviewee from company A stresses that reporting needs to be relevant for authenticity. The interviewee from company B emphasizes the structure, tangible output, and flexibility in future reporting.

To achieve authenticity and reliability, reporting on biodiversity needs to start from understanding the phenomenon, planning, and implementing the plan before reporting on the outcome, as the interviewee from company C 1 emphasizes. There are challenges and questions regarding biodiversity reporting but as the interviewee from company B remarks there are evolving data points coming through on biodiversity, deforestation, and

bio-products. The interviewee also addresses that there are increasing requirements for companies to report out on biodiversity policies, operational sites near areas of high biodiversity, and quantitative targets.

4.8   Stakeholders

Reporting on stakeholders considers engagements and the relevance of biodiversity to stakeholders. Six companies report that biodiversity is a topic of discussion with stakeholders while only Givaudan addresses collaboration with stakeholders regarding biodiversity. The relevance of biodiversity to stakeholders varies from unknown to high importance:

"'Biodiversity is a significant topic for our stakeholders, and we expressly acknowledge the societal importance of this issue" (Covestro, Annual Report, 2020, p. 50).

Stakeholders influence companies' reporting. The interviewee from company B remarks that investors are integrating broader sets of metrics for companies to report on sustainability. Solvay reports on stakeholder interest on biodiversity and how it influences how they take biodiversity into consideration:

> *"Biodiversity has been moved up from "moderate materiality" to "high materiality and priority". The evidence of stakeholder interest in this topic is strong enough for us to consider it a priority even if as of today, financial impact on Solvay is low" (Solvay, Integrated Report, 2020, p. 42).*

Customers and their expectations are important stakeholders for companies, and their perception of companies either reduce or widen possible legitimacy gap and influenced credible legitimacy of companies. BASF contributes to address this issue: *"[o]ur newly developed fragrance addresses customer demand for reliability in the supply of raw materials while conserving natural resources" (BASF, Report, 2020, p. 142).*

5   Discussion

Increasing interest in utilization of bio-based raw materials creates pressure on biodiversity and ecosystems (European Commission, 2011). While attention towards bio-based materials is increasing within the chemical industry, it is even more important for chemical companies to address their impacts on biodiversity in corporate reporting. The research questions that this thesis aims to respond are: how chemical companies report on biodiversity as part of their corporate reporting to maintain their legitimacy? How is biodiversity perceived within the chemical industry? Legitimacy theory helps to respond to these questions by showing the relationship between the depth of disclosed biodiversity information, corporate legitimacy, and what is expected from corporate reporting. Furthermore, this creates understanding of the need to report on biodiversity and improve biodiversity reporting to maintain corporate legitimacy. The theory provides conceptual tools for analyzing biodiversity reporting.

This thesis contributes to increasing, yet, contradictory research on biodiversity reporting by focusing on global chemical companies. The discussion chapter is divided in two parts. First is discussed how chemical companies utilize reporting practices for biodiversity disclosures to maintain legitimacy. Second, the perceptions of biodiversity within the chemical industry are discussed.

5.1. Strategies to maintain legitimacy in biodiversity reporting

Corporate legitimacy is enhanced through corporate reporting (An et al., 2011). Therefore, companies produce reports to stakeholders to demonstrate their compliance with expectations by disclosing relevant information and how they contribute to sustainable development (Beck et al. 2010; KPMG, 2005:3; Hedberg & Von Malmborg, 2003). Legitimacy theory perceives that information disclosures should be voluntary based to demonstrate companies' compliance with the expectations and values of the society (An et al., 2011). Moreover, this thesis finds that stakeholders' expectations contribute to corporate reporting and selection of reported topics. Interestingly, the findings of the thesis show that not all stakeholders perceive biodiversity as an important topic as, for instance, climate change. This implies that there is not always a legitimacy gap that the companies aim to fill via reporting in this regard (Fernando & Lawrence, 2014). This could explain

why biodiversity reporting by chemical companies is so diverse (see also Van Liempd & Busch, 2013). If stakeholders do not exert pressure on companies to report on biodiversity, companies do not perceive that there is a need to address biodiversity. However, as results of the thesis show some companies proactively react to societal values and address consumer concern and thus, report on biodiversity possibly to avoid legitimacy gap (Fernando & Lawrence, 2014; Deegan, 2002). Significantly, the findings of the thesis support the legitimacy theory as they show that stakeholder expectations need to be responded and acknowledged. This indicates the need to maintain corporate legitimacy and avoid legitimacy gap. This is reflected in the extensive reporting on commitments and engagements.

To maintain corporate legitimacy and stakeholder trust, companies must demonstrate that they acknowledge societal values and respond to changes. Consequently, this thesis finds that companies report extensively on their commitments to different engagements regarding biodiversity conservation. Committed engagements relate to internal and external agreements, principles, programs, policies, and actions. In contrast, Bhattacharya & Managi (2013) have found that the companies they studied did not report on biodiversity policies. However, extensive reporting on commitments indicate that companies want to show their commitment to biodiversity as social concern over biodiversity has increased, and this creates pressure for companies to comply with socially relevant values (Gray et al. 2010) to maintain legitimacy. Illustration of commitments can also address a social contract between corporates and societies or narrow down possible legitimacy gaps in advance (Fernando & Lawrence, 2014; Deegan, 2002). Extensive reporting on commitments can be perceived as a legitimacy strategy where the focus is shifted from biodiversity conservation performance and impact disclosures to commitments, which creates a positive impression that companies are acknowledging biodiversity issues. To improve and maintain corporate legitimacy, companies are responsible to act according to the commitments, which is demonstrated through implementation of actions and performance.

Samkin et al. (2014) have found that performance and implementation of actions are most reported topics. While emerged issues were categorized differently in this thesis, the findings consolidate the findings of Samkin et al. (2014) by showing that many of the studied companies' report on activities, implemented projects, and policies regarding biodiversity

conservation. However, the findings of the thesis show that not many companies provide detailed information on the actual outcomes of their activities that would demonstrate their authentic performance on biodiversity. Most common practice is to report on what will be done. This supports the findings of Adler et al. (2018) Van Liempd and Buch (2013) who found that detailed information disclosures on impact mitigation activities is insignificant or non-existent. Correspondingly, Van Liempd and Buch (2013) and Adler et al. (2018) discovered that performance information and cost data are rarely addressed in corporate reports. This questions companies' legitimacy as they do not provide evidence that actions would have been carried out. Reducing disclosed information to prospects can be a strategy to "change external expectations about the organization's performance" or to shift stakeholders' attention from negative to positive information (Lindblom,1994 cited by Fernando and Lawrence, 2014, p. 154). Accountability requires measures or estimates on performance (Boiral, 2016).

Results of the thesis show that numerical data is limited in chemical companies' reports, for instance, the amount of companies' investments in biodiversity. This supports the finding of Bhattacharya and Managi (2013) who found that information on monetary investments in biodiversity protection was rarely reported by the Fortune 500 companies. Adler et al. (2018) have observed that numerical disclosures are mostly concerned with afforestation activities and biodiversity assessments. The findings of this thesis found more categories on numerical disclosures, which include species, protected areas, areas where biodiversity restoration activities have been carried, identified risks, volunteers, and different management aspects. Therefore, the findings indicate that numerical information disclosures have increased and become more specified from what Adler et al. (2018) observed. For instance, detailed information on biodiversity includes discussion on different species. While Adler et al. (2018) and Skjouldis et al. (2018) have found that reporting on IUCN red list species is insignificant or not included, the findings of this thesis show that companies are starting to report on and identify IUCN red list species that are found through environmental assessments. However, findings also show that reporting on species is occasionally specified when companies discuss certain species in relation to their activities. This supports Samkin et al (2014), who have found that the information on the current state of biodiversity is absent in reporting and is rather focused on native species in relation to companies' operations. Numerical and detailed information creates legitimacy on companies' performance and can be perceived as company's

strategy to "educate relevant stakeholders about its actual performance" (Lindblom,1994 cited by Fernando and Lawrence, 2014, p. 154). When companies do not share detailed information, their performance and reputation can be questioned.

Accordingly, previous studies have concluded that biodiversity is inadequately addressed in reporting. Biodiversity disclosures are often general and lack profound information and the inclusion of biodiversity is insignificant (Adler et al., 2018; Van Liempd & Busch, 2013; Rimmel & Jonäll, 2013). Companies have reported on environmental harm as well as emissions they emit but reporting on biodiversity impacts has been less well developed. This is shown by the findings of this thesis, mostly reported information is general, lacks specified descriptions, and detailed information. Reporting is rather focused on how companies promote biodiversity conservation. This creates positive impression that companies embrace biodiversity, yet this can also be perceived as greenwashing if companies do not support their statements with concrete information disclosures.

By using impression management, companies aim to maintain a good image by reporting only positive information (Hassan et al., 2020). This can bias reporting on positive information, whereas negative information is neglected. Positive information bias can partly be explained by legitimacy theory. The theory comprehends that companies aim to maintain societal acceptance to avoid sanctions that may rise if companies report out on negative impacts (Deegan, 2002). The findings of this thesis show that most often negative information is reduced, and the focus is placed on positive information. Companies are more likely to report out on potential negative impacts than negative incidents. The bias to report on positive information might be one reason why biodiversity reporting is gaining ground only now as reporting on biodiversity means admitting that there are negative outcomes. It may be a legitimacy risk for companies to reveal negative incidents. Consequently, companies produce inadequate and positive disclosures on perceived impacts on biodiversity to assure different stakeholders that they comply with increasing social concerns over biodiversity (Rimmel and Jonäl, 2013) to avoid emergence of a legitimacy gap (Fernando & Lawrence, 2014) and to react to values in the society. Therefore, to maintain higher level of legitimacy, it may be more risk-free to reduce the information concerning negative information. On the hand, as the findings of the thesis show, information may be reduced due to the of lack sufficient tools, methodology, and knowledge to account for biodiversity and impacts. This is discussed in more detail in 5.2.

While transparent disclosures on negative incidents can reduce companies' legitimacy (Deegan, 2002; Fernando and Lawrence, 2014), non-transparent and inadequate reporting can be perceived as greenwashing (Adler et al., 2018). The findings of this thesis support Adler et al. (2018) as it was found that balanced reporting on different topics, actions, and detailed information is essential to validate companies' statements and to avoid greenwashing. Balancing between positive and negative information disclosures and maintaining legitimacy can explain some of the shortcomings in impact disclosures. Consequently, the findings show that most of the information reported on impacts concern how companies prevent negative impacts and what areas of business are seen significant in relation to impacts on biodiversity. This can be a strategy to maintain stakeholder trust when demonstrating prevention efforts and acknowledgement of possible risks of operations.

While companies' survival depends on stakeholder trust, which influences selected reporting topics and information, another strategy to maintain legitimacy is distraction and shift in attentions from negative to positive (Lindblom, 1994 cited by Fernando and Lawrence, 2014). Therefore, disclosing information on how to avoid negative impacts on biodiversity is part of the companies' legitimacy strategies that give a signal that companies acknowledge possible biodiversity impacts, yet they do not include negative information in reports. With above discussion in mind, this thesis identifies distraction and shifting practices in reporting, which support the finding of Fernando and Lawrence (2014). Moreover, Deegan et al. (2002) discuss how companies' accountability may be overlooked when reported disclosures respond only to societal expectations, in which case, unregulated disclosures can be excluded. This allows exclusion of disclosures on negative information that could have negative impact on companies' reputation (Beck et al., 2010; Boiral, 2016). More research is needed to identify if reporting on negative impacts reduces corporate legitimacy significantly to solve a paradox between negative and positive disclosures and whether positive reporting is enough to maintain legitimacy.

Companies' impacts on biodiversity materialize when they utilize bio-based raw materials, which makes companies accountable to address the relationship between biodiversity and bio-based materials. The findings of the thesis indicate that only few chemical companies discuss biodiversity in relation to the use of raw materials. Sourcing of raw mate-

rials is connected to biodiversity loss and deforestation (Rimmel & Jonäll, 2013). Consequently, companies need to address them to maintain their legitimacy (Gray et al., 2010). Especially within the chemical industry, transparency on the use of raw materials is essential as different nature-based raw materials will be increasingly deployed during the transition towards green economy. Furthermore, bio-based materials have long and complex value chains, which has implications to value creation that is important for businesses. (European Commission, 2011.) However, the companies who reported on raw materials did not disclose specific information on the effects of their sourcing activities that may have occurred. Consequently, reducing information can also be a neutralization strategy to produce a positive image of the company and avoid legitimacy conflicts (Boiral, 2016). Yet, as the findings of the thesis suggest, it is still difficult to measure impacts in the value chains of raw materials. This is an important addition to the previous literature, which has not accounted for the use of bio-based raw materials explicitly in relation to biodiversity.

Rimmel & Jonäll (2013) and Skouloudis et al. (2018) have examined that companies with high risk level are more liable to report on biodiversity than lower risk level companies, which implies that companies who source raw materials understand the risks for biodiversity. Chemical companies that source bio-based resources can be perceived as high-risk level companies because sourcing of raw materials can reduce the abundance of natural resources (OECD, 2001) and further accelerate biodiversity loss (Bhattacharya & Managi, 2013). To emphasize the importance of accounting for sourcing of bio-based raw materials, the utilization of biomass by the chemical industry has been estimated to increase by 2030 (Sanders & Boss, 2012b).

5.2. Chemical companies' perceptions of biodiversity

This thesis finds that impacts related to biodiversity are discussed to varying extent in corporate reports. Van Liempd and Buch (2013) and Rimmel and Jonäll (2013) have found that reporting on biodiversity is connected to how companies perceive their impacts; if a company does not perceive to have significant impacts on biodiversity, the topic is disregarded. Accordingly, the findings of this thesis also show that biodiversity is perceived as an important sustainability topic, but also a complex and difficult one, which hinders the measuring of biodiversity impacts (see also Boiral, 2016; Adler et al.,

2018). Boiral (2016) and Adler et al. (2018) write that the difficulty to measure biodiversity contributes to the lack of knowledge on companies' impacts. The findings of this thesis show that measuring biodiversity and knowledge are indeed linked and affect reporting on biodiversity, which is, as previous research suggest, influenced by the complexity of biodiversity as a concept.

However, the findings conflict regarding the perceptions of the importance of biodiversity within the chemical industry. The findings indicate that chemical companies do not explicitly regard biodiversity as high importance even though it is regarded as an important sustainability topic. This is also inconsistent with collected material, which show that companies generally address the urgency of biodiversity loss. Interestingly, biodiversity conservation is perceived differently by different companies as some connect biodiversity conservation to sustainable product development and some to preserving natural habitats. This may explain why some companies approach biodiversity from different perspectives. Additionally, companies' perception of biodiversity is shaped by several factor that are linked not only to raw materials but also to other ecological and social systems as well to companies' impacts on biodiversity.

Diverse biological interlinkages challenge how companies understand and manage biodiversity (Dempsey, 2013). The complexity of biodiversity realizes at individual corporate level, local, and regional levels. As the findings indicate, at corporate level, complexity of biodiversity materializes in a way that the effects of actions cannot be predicted until they realize, which can take a long period of time. This challenges companies' efforts to measure and quantify biodiversity and companies' impacts. This is connected to locality of biodiversity which emerged from the findings as a significant factor in managing biodiversity. It can explain the lack of knowledge regarding companies' impacts on biodiversity and complications in biodiversity assessments. However, the findings of this thesis show that complexity of biodiversity is understood at a theoretical level. Companies connect biodiversity to other sustainability issues and different corporate structures. Yet, locality of biodiversity is not often discussed in biodiversity reporting literature (see exception by Samkin et al., 2014 regarding native species reporting). The findings indicate how complexity challenges companies' understanding of biodiversity and their ecological impacts. This can affect corporate reporting negatively by reducing legitimacy even though companies would aim for transparent reporting and disclosures. To overcome the

problem between the complexity of biodiversity, corporate reporting, and maintenance of legitimacy requires better understanding of biodiversity and development of sufficient biodiversity metrics and reporting points. This can help companies to report in a transparent way, which would further support corporate legitimacy.

To summarize, biodiversity is complex and is interconnected to diverse set of variables and systems, which complicates companies' biodiversity management and influences companies' reporting (WWF 2020; Dempsey, 2013). The findings of this thesis indicate that biodiversity reporting needs more structure and guidance for sufficient reporting as collecting and recording of biodiversity data is challenging and needs to be developed. Adler et al. (2018) remarks that biodiversity impact measurement is not yet sufficient and uniformity in measurement systems is required for sufficient impact disclosures. However, the findings indicate that companies are starting to understand and comprehend the importance of biodiversity in relation to other factors such as the use of bio-based raw materials and production of consumables.

6 Conclusions

To conclude, biodiversity is reported to a varying extent by chemical companies. Although some companies give specified statements, biodiversity reporting remains mainly general and vague when outcomes and impacts of activities and operations are not disclosed in detail.

Lack of biodiversity reporting, however, does not always indicate that companies suppress negative information that could reduce their legitimacy, but more likely it originates from the complexity and difficulty of biodiversity management and measuring. However, reduced information in reports can be linked to corporate legitimacy, which companies aim to maintain by applying legitimization strategies as they need to comply with the expectations of their stakeholders and society. Consequently, there remains a paradox in reporting concerning positive and negative, transparent and non-transparent information disclosures in relation to corporate legitimacy. Therefore, there is a need to improve biodiversity management and reporting tools. More research is needed to cover how compa-

nies could develop their accounting for biodiversity so that companies could better address the issue and demonstrate their accountability in their reports for stakeholders while maintaining legitimacy.

Additionally, more research is needed to study how sourcing and utilization of bio-based raw materials are accounted for in relation to biodiversity and impacts, or how this type of reporting could be enhanced. This is especially relevant for chemical companies but also for other industries that are increasingly utilizing bio-based raw materials.

Companies not only maintain legitimacy through reporting but interact with the society. Companies' biodiversity reporting can influence the ways society comprehends biodiversity and human relations to natural environment as well as change society's attitudes and behavior in relation to biodiversity (Jones & Solomon, 2013). Additionally, biodiversity protection can be enhanced through biodiversity reporting and accounting, especially when detailed information is disclosed (Jones & Solomon, 2013; Skouloudis et al. 2018). The findings of this thesis are useful for companies who are finding ways to report on biodiversity. Especially, information on utilized bio-based raw materials in relation to biodiversity should be comprehensively reported. The findings can also benefit other sectors' reporting who are starting to realize the importance of biodiversity and its inclusion in reporting.

Challenges and limitations of this thesis are mainly associated with the collection of material. The complex character of biodiversity complicated data collection from the corporate reports. Information of the reports intertwines, which made categorization of the topics complex. Especially information regarding biodiversity conservation connects to several different reporting topics, such as different type of activities, which complicated coding. Biodiversity is a novel topic within the chemical industry; hence, information and material are limited. This might have affected why it was difficult to get more interviewees.

To conclude, biodiversity is complex in nature and difficult for companies to comprehend and manage. These hamper reporting on progress made in biodiversity protection, which results in insufficient reporting. Furthermore, reporting on biodiversity may be reduced

due to legitimacy issues that derive from possible negative incidents in companies' operations, which could negatively influence their reputation. This creates a paradox between positive and negative information disclosures. More support to understand and measure biodiversity is needed to help companies to overcome problems between biodiversity reporting and corporate legitimacy.

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