

# FRAMEWORK FOR INTEGRATING CSR IN THE SUPPLY CHAIN TO MITIGATE CLIMATE CHANGE

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## ABSTRACT

*This paper aimed to propose an integrative framework, contextualizing CSR within sustainable development and considering it as an approach in reducing GHG emissions within the supply chain. This paper qualitatively synthesized relevant concepts to form an integrative framework. CSR is taken as a management concept that focuses attention on the responsibility of organizations to address GHG emitting anthropogenic activities in the supply chain. The prior research has produced enough evidence to link supply chain activities to GHG emissions which aggravates climate change. Organizations participating in any supply chain must deliberately recognize their ethical, economic, legal, and philanthropic responsibilities to achieve sustainable development. The proposed framework shows CSR as an approach, through mitigation and adaptation, helps to reduce supply chain-GHG emissions. Sustainable development may be achieved when concrete actions are taken by all supply chain participants to reduce GHG emissions in all human activities in the processes within. Organizations can consider several strategies identified in this paper for their CSR initiatives. At the same time, the inherent difficulties and challenges at its operational level are also highlighted drawn from the literature.*

**Keywords:** Corporate Social Responsibility, Climate Change, Greenhouse Gases, Sustainable Development, Supply Chain, Climate Change Mitigation and Adaptation

## INTRODUCTION

One of the pressing problems of the world is the ill effects of climate change induced by anthropogenic activities. Climate change is a significant change in the earth's climate. The Earth is currently getting warmer because people are adding heat-trapping greenhouse gases to the atmosphere. The term 'global warming' refers to warmer temperatures, whereas climate change refers to the broader set of changes that go along with warmer temperatures, including changes in weather patterns, the oceans, ice and snow, and the ecosystems around the world. The term global warming is most often used to refer to recent and ongoing warming caused by human activities (Tucker & Sherwood, 2019).

Climate change has natural and anthropogenic causes. The one experienced by the earth, nowadays, is aggravated by human-induced stresses. The Green House Gases (GHG) generated from fossil combustion in industries and cars are the leading cause of the earth's rapidly changing climate. GHG plays an important role in keeping the planet warm enough to make life possible. But the amount of these gases in our atmosphere has however, increased rapidly in

recent decades. According to the Intergovernmental Panel on Climate Change (IPCC), as cited by Denchak (2017), concentrations of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxides have increased to levels unprecedented at least in the last 800,000 years, necessitating immediate steps for its mitigation (Global Environment Facility, 2020). Indeed, the atmosphere's share of CO<sub>2</sub>—the planet's chief climate change contributor—has risen by 40 percent since pre-industrial times, with global emission reaching its peaks in 2030.

Other anthropogenic sources include the burning of forests and the clearing of land. Anthropogenic emissions currently account for the annual release of about seven billion tons of carbon into the atmosphere. Anthropogenic emissions are equal to approximately three percent of the total emissions of CO<sub>2</sub> by natural sources, and this amplified carbon load from human activities far exceeds the offsetting capacity of natural sinks (Encyclopedia Britannica, 2020)

Like CO<sub>2</sub>, human activity is increasing the CH<sub>4</sub> concentration faster than it can be offset by natural sinks. Anthropogenic sources currently account for approximately 70 percent of total annual emissions, leading to substantial increases in concentration over time. The major anthropogenic sources of atmospheric CH<sub>4</sub> are rice cultivation, livestock farming, the burning of coal and natural gas, the combustion of biomass, and the decomposition of organic matter in landfills. Future trends are particularly difficult to predict. This is in part due to an incomplete understanding of the climate feedback associated with CH<sub>4</sub> emissions. Additionally, as human populations grow, it is difficult to predict how possible changes in livestock raising, rice cultivation and energy utilization will influence CH<sub>4</sub> emissions (Encyclopedia Britannica, 2020).

## OBJECTIVE AND METHODOLOGY

Concerning anthropogenic causes of climate change, concrete and sustainable solutions should be readily in place at the earliest time possible to help protect the environment from destruction. This paper aims to propose a framework for integrating Corporate Social Responsibility (CSR) in mitigating the effect of climate change by addressing its anthropogenic causes, specifically in the supply chain. CSR is a management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders to achieve a balance of economic, environmental, and social imperatives (UNIDO, 2021). Given this context, it is the proposition of this paper that organizations irrespective of sizes, should orient their CSR as an approach to mitigating climate change based on the premise that the long-standing and cumulative effects of organized human activities—the anthropogenic causes—have overwhelmingly escalated global warming, inducing climate change. In this paper, organized human activities are the anthropogenic causes that refer to the economic activities that have taken a toll on the environment. Specifically, this paper

- Describes the anthropogenic activities that contribute to global warming;
- Identifies the effects of these activities relative to the factors that constitute climate change;
- Develop a climate change mitigating framework where corporate social responsibility is used as an approach; and
- Recommend concrete and sustainable corporate social responsibility initiatives to mitigate climate change at various lengths.

This paper qualitatively synthesized available and accessible archived resources on the relevant concepts to form an integrated framework for explaining CSR as an approach to mitigating climate change.

## DISCUSSIONS

### **The Anthropogenic Activities that Contribute to Global Warming**

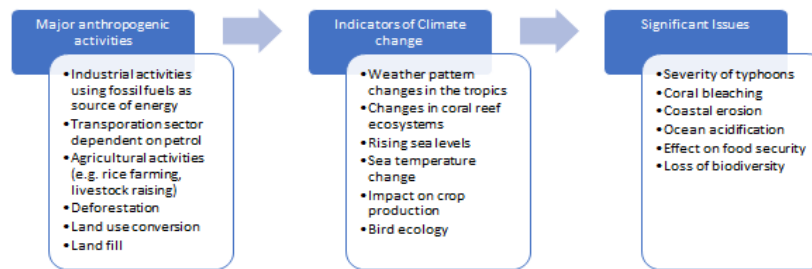
Climate change is defined as the shift in climate patterns mainly caused by GHG emissions which traps heat in the earth's atmosphere, thereby causing global warming. Human activities (predominantly related to energy production, industrial activities, and those related to forestry, land use and land-use change) are the main anthropogenic sources of GHG emissions (Fawzy, Osman, Doran & Rooney, 2020; U.S. Department of Energy, 1999). Over time, various anthropogenic activities have increased the concentration of greenhouse gases in the atmosphere (*i.e.* burning of fossil fuels, removal of vegetation, and land-use conversion). Evidence has shown that these activities have considerably increased the number of greenhouse gases; this has also enhanced the earth's natural greenhouse effect and changed the earth's climate (Mathez & Smerdon, 2018). In other words, anthropogenic activities, especially the burning of carbon-containing fossil fuels, have added CO<sub>2</sub> to the atmosphere faster than it is removed by the carbon cycle (Food & Agriculture Organization, 2001).

Albeit climate change is a global issue, some countries are more vulnerable than others due to their geographical location and dependency on climate-sensitive natural resources. For example, the Philippines is one such country. The Philippines, like other countries, have been experiencing the impacts of climate change (*i.e.* sea level rise, increased frequency of extreme weather events, rising temperatures, and extreme rainfall) due to its high exposure to natural hazards, dependence on climate-sensitive natural resources, and vast coastlines where all major cities and the majority of the population reside (USAID, 2017). It is located in the western Pacific Ocean, surrounded by naturally warm waters that will likely get even warmer as average sea-surface temperatures continue to rise--which is exactly happening in the Philippines over the last decade (The Climate Reality Project, 2016). Sea levels in the Philippines are rising faster than the global average, increasing the hazard posed by storm surges and threatening permanent inundation of low-lying areas (USAID, 2017). Roughly 30 years from now, major cities in the National Capital Region could likely be submerged as coastal flooding is anticipated to become extensive worldwide by 2050 due to climate change. These were the findings of a study released by Climate Central, which also observed that rising seas could likewise erase some of the world's coastal cities due to increasingly higher tides. Metro Manila cities such as Manila, Navotas, Malabon, Pasay are likely to be affected by coastal flooding. In Central Luzon, Bulacan is threatened to be underwater by 2050 (Philippine Daily Inquirer, 2019).

### **The Effects of Anthropogenic Activities on the Factors that Constitute Climate Change**

According to the Centre for Research on the Epidemiology of Disasters, 315 cases of natural disasters around the world were recorded in 2018, mainly climate-related: 16 cases of drought, 26 cases of extreme temperature, 127 cases of flooding, 13 cases of landslides, 95 cases of storms and 10 cases of wildfire, affecting 68.5 million people and economic losses of a total of \$131.7 billion. Human-induced emissions are directly interfering and amplifying the impact of natural system emissions. It is evident that human-induced climate change is a major driving

force behind many natural disasters occurring globally (Fawzy et al., 2020) Figure 1 summarizes the relevant climate issues contributed by anthropogenic activities.



**FIGURE 1**  
**RELEVANT CLIMATE ISSUES CONTRIBUTED BY ANTHROPOGENIC ACTIVITIES**

Climate change is aggravated by human-induced stresses. In the U.S., the extraction of natural resources; the production, transport, and disposal of goods, and the provision of services account for an estimated 29% of 2006 U.S. anthropogenic Greenhouse Gas (GHG) emissions (U.S. Environmental Protection Agency, 2009). GHG generated from fossil combustion in industries and cars is the leading cause of the earth's rapidly changing climate. Other anthropogenic sources include the burning of forests and the clearing of land. Apart from CO<sub>2</sub>, CH<sub>4</sub> is released to the atmosphere from agriculture, industry, and wastes from homes and businesses. The major anthropogenic sources of atmospheric CH<sub>4</sub> are livestock farming, rice cultivation, the burning of coal and natural gas, the combustion of biomass, and the decomposition of organic matter in landfills. Future trends are particularly difficult to predict partly due to an incomplete understanding of the climate feedback associated with CH<sub>4</sub> emissions. Also, it is difficult to predict how, as human populations grow, possible changes in livestock raising, rice cultivation, and energy utilization will influence CH<sub>4</sub> emissions (Encyclopedia Britannica, 2020).

Livestock like cattle, sheep, and goats produce methane as a by-product of anaerobic microbial digestion in their gut. Benavides and colleagues (2019) revealed in their study that the contribution of greenhouse gases emitted by livestock practiced in tropical areas indicates that the emission intensities vary between medium and high, due to low productivity of animals, poor quality of food, and lack of knowledge about appropriate technologies for the zone.

Rice cultivation is considered to be among the highest sources of atmospheric methane. This gas is produced from the decay of non-fossil organic materials as a result of activity by anaerobic bacteria in rice paddies. Methane emissions from rice paddies will continue to increase as the human population progresses. To meet the projected rice needs of the increasing world population, it is estimated that the annual world's rough rice production must increase to 760 million tons (a 65% increase) in the next 30 years. This will increase methane emissions from rice-fields if current technologies are kept (Minami & Neue, 1994).

The concentration of CH<sub>4</sub> is lesser compared to CO<sub>2</sub>. In the United States of America, CH<sub>4</sub> accounted for 10% of the total GHG emissions in 2018. The dominant gas is CO<sub>2</sub> which comprises about 81% or 6,677 million metric tons of CO<sub>2</sub> (Environmental Protection Agency - EPA, 2020). Although CH<sub>4</sub> is of lesser concentration than carbon dioxide, it absorbs 20 to 30 times as infrared and accumulates in the atmosphere about twice as fast as carbon dioxide. This fact poses a greater concern to humankind in addressing issues related to climate change-

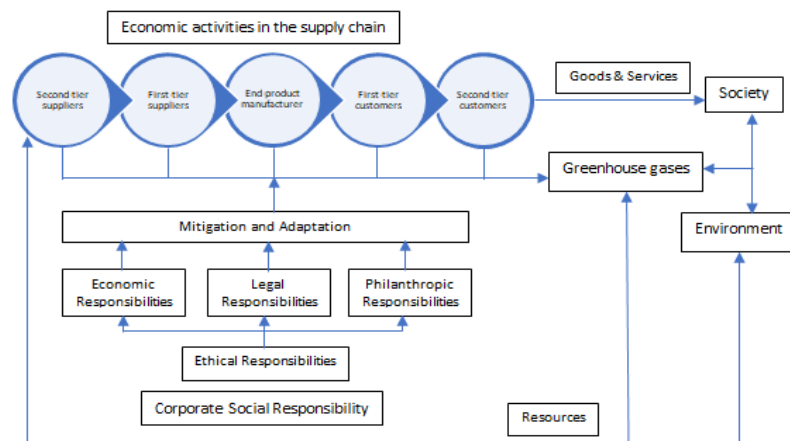
meeting the growing demand of people for food dependent in agriculture while controlling methane emissions to the atmosphere.

As the earth’s atmosphere heats up, it collects, retains, and drops more water, changing weather patterns and making wet areas wetter and dry areas drier. Higher temperatures worsen and increase the frequency of many types of disasters, including storms, floods, heatwaves, and droughts. These events can have devastating and costly consequences, threatening the access to clean drinking water, damaging property, creating hazardous-material spills, polluting the air, and finally, leading to loss of life (Denchak, 2017). In recent years, tropical storms have affected the Philippines more often with higher intensity and severity. Notably, the deadliest storm on record in the Philippines is Typhoon Haiyan, known locally as Typhoon Yolanda, which was responsible for more than 6,300 lost lives, over four million displaced citizens, and \$2 billion in damages in 2013 (The Climate Reality Project, 2016).

Dait (2015) studied the impact of climate change on the agriculture sector of the Philippines and observed that temperature change has an inverse relationship with the change in output. Specific findings include: Gross production value (in million US\$) of Philippine agriculture decreases by 19.21 million US \$ for every 10C increase in temperature; it lowers by 0.24 million US \$ for every 1 mm increase in precipitation, but as number of precipitation days increases, the gross production value increases by 1.24 million US \$. An increase in daily temperature as measured by the difference between the daily maximum and minimum temperature would decrease gross production value by 5.74 million US \$. +Meanwhile, since agriculture plays a critical role in the country’s economic growth and development, it was recommended that heavy investment in research and development on the most appropriate adaptation interventions needs to be done, covering the development of drought-resistant crops and promoting the development of water resources management infrastructure.

**CSR in Climate Change Mitigating Framework**

The major goal of this paper is to propose an integrating framework that uses CSR as an approach to mitigating climate change. In the development of the framework, the concepts of sustainable development and supply chain management were integrated to form an integrative perspective. Figure 2 shows the proposed framework.



**FIGURE 2  
CSR IN THE SUPPLY CHAIN AS CLIMATE CHANGE MITIGATOR**

## CSR and Sustainable Development

Global climate change is threatening to disrupt organizational operations due to reduced resource supply and the potential for a displaced workforce and customer base, inter alia, all these factors increase healthcare costs, disrupt access to and lead to higher costs for supply chain materials, among others. CSR is a well-known and widely used term in business, government, NGOs, and academia, but there is little agreement about what it means and what it entails (Agudelo, Johannsdottir & Davidsdottir, 2019; Allen & Craig, 2016) The following definition of CSR is a synthesis of the common definitions found in literature according to Hopkins (2006): CSR is a process concerned with the economic, financial, and environmental responsibility of a corporation (private, public or NGO) towards its stakeholders to achieve sustainable development in societies, while preserving its profitability (Klarin, 2018). Allen and Craig (2016) asserted that an organization's economic (activities related to value creation and financial performance), social (activities that impact on society), and environmental (corporate environmental management efforts) performance are interconnected. Of these three dimensions the social dimension, often constrained by the economic dimension, is most closely related to the issues commonly associated with CSR.

Carroll (2016) defined CSR in terms of four responsibilities that encompass the economic, legal, ethical, and discretionary (philanthropic) expectations that society has of organizations at a given point in time. Businesses have an economic responsibility to the society that permitted them to be created and sustained. Society has not only sanctioned businesses as economic entities, but it has also established the minimal ground rules under which businesses are expected to operate and function. The normative expectations of most societies hold that laws are essential but not sufficient. In addition to what is required by laws and regulations, society expects businesses to operate and conduct their affairs in an ethical fashion. Corporate philanthropy includes all forms of business giving. Corporate philanthropy embraces a business's voluntary or discretionary activities. Philanthropy or business giving may not be a responsibility in a literal sense, but it is normally expected by businesses today and is a part of the everyday expectations of the public. Although ethical responsibility is depicted in the pyramid as a separate category of CSR, it should also be seen as a factor that cuts through and saturates the entire pyramid.

Keys, Malnight & Graaf (2009) suggested three principles that focus on creating value for business and society: 1) Concentrate CSR efforts on areas where the business not only can gain a deeper understanding of the mutual dependencies but also in which the highest potential for mutual benefit exists; 2) Build a deep understanding of the benefits, both from a business and a societal perspective; 3) Find the right partners to build long-term relationships that have a greater opportunity of being successful and sustainable.

Hopkins (2006) pointed to key CSR trends, including the strategic approach to CSR, scalability of programs, emphasis on supply chains, big impact CSR initiatives in focused areas, government regulation, and social value branding, among others. The attempt to refocus CSR as a mitigation tool for climate change has led to the postulation of the green theory which serves as a warning to corporations for being unresponsive to climate change and environmental degradation. The green theory is a novel thinking concerning people's rights, justice, citizenship, good governance, and the environment. In the developing world, it is difficult to monitor CSR through legislation although adoption of green policies involving responsible production techniques, and disclosures of carbon footprint are required (Raimi, Akosile & Adebaw, 2016).

Many businesses pursue CSR activities that can best be termed pet projects, as they reflect the personal interests of individual senior executives. While these activities may be presented with much noise and fanfare, they usually offer minimal benefits to either business or society. In the middle, there are efforts that can make both sides feel good but that generate limited and often one-sided benefits. With philanthropy, for example, corporate donations confer the majority of benefits on society (with potential but often questionable reputational benefits to the business). Similarly, in what's best referred to as propaganda, CSR activities are focused primarily on building a company's reputation with little real benefit to society, some cynics suggest that this form of CSR is at best a form of advertising—and potentially dangerous if it exposes a gap between the company's words and actions (Keys et al., 2009)

## **Supply Chain**

Du Toit & Vlok (2014) wrote that interest in Supply Chain Management (SCM) has steadily increased since the 1980s when companies started to realize the benefits of integration and alignment with suppliers. At first, the focus of SCM was on how to make central elements within a company's Supply Chain (SC) more efficient. The focus then shifted from efficiency within a single company's SC to the effectiveness of the entire SC, which includes a company's suppliers, customers, and partners. Du Toit & Vlok (2014) pointed to the many different definitions of SC and cited several authors. These definitions consider the links of different businesses and business activities in the supplier-manufacturer-distributor-customer roles in all processes involving the transformation of raw materials into finished products and their consumption.

## **Mitigation and Adaptation**

Climate change is a global problem with many dimensions – science, economics, society, politics, and moral and ethical questions. According to NASA Global Climate Change (n.d.), climate change involves a two-pronged approach: mitigation and adaptation. Mitigation is the reduction of emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere by either reducing the sources of these gasses or enhancing the sinks that accumulate and store these gases. The goal of mitigation is to avoid significant human interference with the climate system, and “stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner”. Adaptation involves adjusting to actual or expected future climate. The goal is to reduce our vulnerability to the harmful effects of climate change (like sea-level encroachment, more intense extreme weather events, or food insecurity). It also encompasses making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions).

## **Concrete and Sustainable CSR Initiatives to Mitigate Climate Change**

Acknowledgment of climate change realities started in 1979 during the first world climate conference in Geneva where technical and scientific experts reviewed climate change caused by natural and human systems as well as its impacts. Considered a critical step taken was the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in

1992. Enforced in 1994, the UNFCCC has been the main driving force and facilitator of climate action globally, to stabilize greenhouse gas concentrations in the atmosphere (Ogle et al., 2014). Commitments were made by developed countries to implement national policies to limit anthropogenic emissions and enhance greenhouse gas sinks. In 1997, the Kyoto protocol was adopted—which took effect in 2005—introducing further emission reduction commitments and laid out all related policies, monitoring and reporting systems, and mechanisms. Two project-based mechanisms were introduced: clean development mechanism (allowing developed countries to invest and develop emission reduction projects in developing countries, to drive sustainable development in the host country as well as offset carbon emissions of the investing party) and joint implementation mechanism (allowing developed countries to develop similar projects). Furthermore, an emission trading mechanism was also introduced to facilitate the trading of annually assigned emissions. Emission reduction has mainly been achieved through the introduction of renewable energy, energy efficiency, and afforestation/reforestation-related projects (Fawzy et al., 2020)

Fawzy, et al., (2020) reviewed the literature and found three main climate change mitigation approaches, albeit theoretical: conventional mitigation efforts, negative emissions technologies, and radiative forcing geo-engineering technologies. Conventional mitigation efforts refer to de-carbonization technologies and techniques reducing CO<sub>2</sub> emissions, *i.e.* renewable energy, fuel switching, efficiency gains, nuclear power, and carbon capture storage and utilization. Negative emissions technologies are techniques potentially deployed to capture and sequester CO<sub>2</sub> from the atmosphere, *i.e.* bioenergy carbon capture and storage, bio char, enhanced weathering, direct air carbon capture and storage, ocean fertilization, ocean alkalinity enhancement, soil carbon sequestration, afforestation and reforestation, wetland construction and restoration, as well as alternative negative emissions utilization and storage methods such as mineral carbonation and using biomass in construction). Radiative forcing geo-engineering technologies alter the earth's radiation balance through the management of solar and terrestrial radiation, *i.e.* stratospheric aerosol injection, marine sky brightening, cirrus cloud thinning, space-based mirrors, surface-based brightening, and various radiation management techniques.

According to the U.S. Environmental Protection Agency (2009), climate change is primarily the result of GHG emissions, and its effects will worsen over time if not regulated. Immediate action related to mitigation measures is required. Mitigating climate change is about reducing the release of GHG emissions. In the industry sector, energy use and industrial processes account for much of the emissions (OECD Environment Directorate and International Energy Agency, 2003, 2002). The EPA Center for Corporate Climate Leadership (n.d.) shared a wide range of strategies available to help organizations reduce their GHG emissions, *i.e.* energy efficiency, renewable energy, supply chain, waste reduction, and diversion strategies, reduce methane emissions, and increase fuel efficiency in transportation and logistics. Also, materials and land management are considered concrete measures for reducing GHG emissions.

Materials management refers to how material resources are managed as they flow through the supply chain while land management describes how land is managed and uses open space and habitat, food, natural resources, and places for people to live, work, and recreate. In the supply chain, specific initiatives in terms of materials management can be pursued by organizations. This includes source reduction (reduction of the number of materials entering the supply stream), reuse (reuse of a product by its original user or someone else), recycling (collecting recyclable materials, sorting and processing them into raw materials such as new products), energy recovery (the process of obtaining energy from waste through a variety of processes, *e.g.*, combustion), and disposal (the placement of waste on land or underground, including proper disposition of a discarded or discharged material). In terms of land



management, organizations can pursue land protection (prevent land from becoming contaminated), sustainable land use (use of land in such a way that preserves its value for future uses), preserving pristine land resources (minimize green space development), and land revitalization (cleanup, ecological restoration, and sustainable reuse of contaminated land while avoiding the development of Greenfields) (U.S. Environmental Protection, 2009).

## CONCLUSION AND RECOMMENDATION

CSR has been criticized for being superficial and ‘cosmetic’ due to the perceived low-level impact that organizations produce through their initiatives. The literature reviewed in this paper has shown evidence that efforts have been spent on addressing the climate change issue. However, there is a need for organizations to examine their CSR and consider a more serious approach to addressing the environmental problems that their economic activities create.

In this paper, CSR is taken as a management concept that focuses attention on the responsibility of organizations to address GHG emitting anthropogenic activities in the supply chain. Internet resources have produced enough evidence to link supply chain activities to GHG emissions which aggravates climate change. Organizations participating in any supply chain must deliberately recognize their ethical, economic, legal, and philanthropic responsibilities to achieve sustainable development. The proposed framework developed shows CSR as an approach, through mitigation and adaptation, to reduce supply chain-GHG emissions. Such a framework at its operational level needs full cognizance of the difficulties and challenges encountered by various establishments and firms that were empirically investigated. The following paragraphs take note of the evidence with recommendations afterwards.

Sustainable development maybe achieved when concrete actions are taken by all supply chain participants to reduce GHG emissions in all human activities in the processes within. Organizations irrespective of sizes, large or Small AND Medium Enterprises (SMEs), can consider business strategies identified in this paper for their CSR initiatives to support the economic, social, and environmental principles of sustainable development (Torugsa, O’Donohue & Hecker, 2012). In this process, firms may show reactive responses to meet the pressure of legal or economic demands whenever arises, or they may proactively engage in CSR. In the Environmental Management (EM), the proactive course of actions incorporate systemic environmental concerns into organizational objectives and strategies (Haden, Oyler & Humphreys, 2009; Jabbour, 2010) while SMEs are found to be reactive responding to new legislation and social as well as market demands. Similar reactive behavior is also observed in the SMEs engagement (or failing to engage) in EM in developing countries (Brío & Junquera, 2003; Hillary, 2004; Luken & Van Rompaey, 2008; Parker et al., 2009; Perez-Sanchez, Barton, & Bower, 2003; Roberts, Lawson, & Nicholls, 2006; Van Hemel & Cramer, 2002; Zhang, Bi, & Liu, 2009). The above behavior demonstrates greater challenges for SMEs in adopting CSR strategies compared with large companies (Demuijnck & Ngnodjom, 2013; MacGregor & Fontrotona, 2011).

The integrated framework of CSR must take note of the asymmetric EM barriers, difficulties and limitations that SMEs in developing countries may face in adopting EM practices within different industry and country contexts (Chan, 2008; Luken & Van Rompaey, 2008; Puppim de Oliveira, 2008b; Van Hemel & Cramer, 2002) preventing the SMEs from improving their environmental performance (Hillary, 2004). These barriers are classified into a firm’s internal and external barriers, the former deals with limitations inherent in the operations of smaller companies such as lack of financial and organizational resources devoted to EM (Brío & Junquera, 2003). Further, they have limited capacity for innovation along with the absence

flexible production processes, to face the changes in the external environment (Perez-Sanchez et al., 2003). In addition, they lack support for the training of company employees in EM (Brío & Junquera, 2003; Hillary, 2004). Other internal difficulties relate to deficient implementation of EM practices, as their managers are not necessarily environmentally aware along with difficulties in getting proper and timely access to cleaner technologies (Perez-Sanchez et al., 2003). External barriers that otherwise could assist small enterprises improving their EM practices (Brío & Junquera, 2003) are institutional environment, when firms have to face economic uncertainty; other factors are absences of environmental laws and policies at the national level, and specialized service providers/business associations.

Public policies and social pressure can, however, help SMEs externally to overcome the above barriers (Lai & Wong, 2012). Zhu & Geng (2013) conducted a study on the supply chain practices for energy saving and emission reduction among Chinese manufacturers. They found that firms irrespective of sizes will be able improve to their environmental performance provided there are effective environmental policies, government actions, and public sector incentives; these factors played as catalysts.

The integrated CSR framework needs consideration of adapting traditional EM instruments for SMEs with a purpose to develop EM systems aiming to estimate the environmental impacts of SMEs (Fresner, 2004; Heras & Arana, 2010; McKeiver & Gadene, 2005; Moss, Lambert & Rennie, 2008; Parker et al., 2009; Perez-Sanchez et al., 2003; Seiffert, 2008; González-Benito & González-Benito, 2006).

The CSR integrated framework should take cognizance of and adhering of the EM practices in company operations in following areas. They are (a) the planning, organization, direction, and control of behavioral and corporate aspects of EM; (b) environmental improvements of products and production processes; and (c) practices for internal and external communication of the company's environmental improvement initiatives and results (González-Benito & González-Benito, 2006).

Along with international agreement, coordinated policies and social mobilization involving consumers and producers representing every concerned sector need to be effective to fight against global climate warming (Andrade & Puppim de Oliveira, 2015; Munasinghe, 2010). In the context of CSR, Torugsa, et al., (2012) observed that large companies have been the target of most of the global and national policies and regulations aimed at greening business, although SMEs are known to contribute significantly to GHG emissions. This necessitates an urgent rethink of how EM concerns might be addressed to mitigate climate change impacts caused by SMEs. Weinhofer & Hoffmann (2010) define a business strategy for mitigating global warming as a behavioral pattern on the part of firms which aims at managing its GHG emissions.

Based on the review of Weinhofer & Hoffmann (2010) and further following Puppim and Jabbour (2017), we feel that the integrated CSR framework should incorporate three business strategies for climate change. They are: (i) to compensate for CO<sub>2</sub> emissions, there is a need for a short-term strategy involving an acquisition of additional CO<sub>2</sub> emission capacity by trading emissions and/or investments in projects; (ii) for CO<sub>2</sub> reduction, a midterm strategy is required involving reductions in the pattern of CO<sub>2</sub> emissions of the existing production process and/or a reduction in the pattern of CO<sub>2</sub> emissions of a product during manufacturing and consumption; and finally, (iii) to become CO<sub>2</sub> independent, a long-term strategy is called for the development or adoption of a production process that is free from CO<sub>2</sub> emissions along with the development of goods free of CO<sub>2</sub> emissions during their production and consumption. The assertion is that after adopting these business strategies (conceived within the integrated framework of CSR) would help combat climate change and improve the quality of business operations of SMEs.

## REFERENCES

- Agudelo, M., Johannsdottir, L., & Davídsdottir, B. (2019). A literature review of the history and evolution of corporate social responsibility. *International Journal of Corporate Social Responsibility*, 4(1).
- Andrade, J.C.S., & Puppim de Oliveira, J.A. (2015). The role of the private sector in global climate and energy governance. *Journal of Business Ethics*. Advance online publication.
- Benavides, R., Guerrero, H., & Mateus, D. (2019). Livestock greenhouse gas emissions under grazing conditions in the tropic. *Revista Investigación Agraria Ambiental*, 10, 91-106.
- Brío, J.A., & Junquera, B. (2003). A review of literature on environmental innovation management in SMEs: Implications for public policies. *Technovation*, 23, 939-948.
- Carroll, A. (2016). Carroll's pyramid of CSR: Taking another look. *International Journal of Corporate Social Responsibility*, 1(3).
- Chan, E.S.W. (2008). Barriers to EMS in the hotel industry. *International Journal of Hospitality Management*, 27, 187-196.
- Dait, J. (2015). Effect of climate change on philippine agriculture. *International Journal of Science and Research*, 4 (9), 1922-1924.
- Demuijnck, G., & Ngnodjom, H. (2013). Responsibility and informal CSR in formal Cameroonian SMEs. *Journal of Business Ethics*, 112, 653-665.
- Denchak, M. (2017). Global climate change: What you need to know? Natural Resources Defense Council.
- Du Toit, D. & Vlok, P. (2014). Supply chain management: A framework of understating. *South African Journal of Industrial Engineering*, 25(3), 25–38.
- Encyclopedia Britannica (2020). Causes of global warming.
- Environmental Protection Agency-EPA Center for Corporate Climate Leadership (n.d.). GHG reduction programs & strategies.
- Fawzy, S., Osman, A., & Doran, J. (2020). Strategies for mitigation of climate change: A review. *Environmental Chemistry Letters*, 18, 2069–2094.
- Food and Agriculture Organization-FAO (2001). Plantations as Greenhouse Gas mitigation: A short review. Report based on the work of P. Moura-Costa and L. Aukland. Forest Plantation Thematic Papers, Working Paper 12. Forest Resources Development Service, Forest Resources Division. FAO, Rome.
- Fresner, J. (2004). Small and medium sized enterprises and experiences with environmental management. *Journal of Cleaner Production*, 12, 545-547.
- Global Environment Facility-GEF (2020). Climate change mitigation.
- González-Benito, J., & González-Benito, O. (2006). A review of de determinant factors of environmental proactivity. *Business Strategy and the Environment*, 15(2), 87-102.
- Haden, S.S.P., Oyler, J.D., & Humphreys, J.H. (2009). Historical, practical, and theoretical perspectives on green management: An exploratory analysis. *Management Decision*, 47, 1041-1055.
- Heras, I., & Arana, G. (2010). Alternative models for environmental management in SMEs: The case of Ekoscan vs. ISO14001. *Journal of Cleaner Production*, 18, 726-735.
- Hillary, R. (2004). Environmental management systems and the smaller enterprise. *Journal of Cleaner Production*, 12(6), 561-569.
- Hopkins, M. (2006). What is corporate social responsibility all about? *Journal of Public Affairs*.
- Jabbour, C.J.C. (2010). Non-linear pathways of corporate environmental management: A survey of ISO 14001-certified companies in Brazil. *Journal of Cleaner Production*, 18, 1222-1225.
- Keys, T., Malnight, T., & Graaf, K. (2009). Making the most of corporate social responsibility. McKinsey Quarterly, published in December 2009.
- Klarin, T. (2018). The concept of sustainable development: From its beginning to the contemporary issues. *Zagreb International Review of Economics and Business*. 21. 67-94.
- Lai, K., & Wong, C.W.Y. (2012). Green logistics management and performance: Some empirical evidence from Chinese manufacturing exporters. *Omega*, 40, 267-282.
- Luken, R., & Van Rompaey, F. (2008). Drivers for and barriers to environmentally sound technology adoption by manufacturing plants in nine developing countries. *Journal of Cleaner Production*, 16(1), 67-77.
- MacGregor, S.P., & Fontrodona, J.P. (2011). Strategic CSR for SMEs: Paradox or possibility? *Universia Business Review*, 30, 80-95.
- McKeiver, C., & Gadene, D. (2005). Environmental management systems in small and medium business. *International Small Business Journal*, 23, 523-537.
- Moss, J., Lambert, C.G., & Rennie, A.E.W. (2008). SME application of LCA-based carbon footprints. *International Journal of Sustainable Engineering*, 1(2), 132-141.

- Munasinghe, M. (2010). Can sustainable consumer and producers save the planet? *Journal of Industrial Ecology*, 14(1), 4-6.
- Mathez, E. & Smerdon, J. (2018). *Climate change: The science of global warming and our energy future*, (2nd Edition). Columbia University Press, New York.
- Miller, G. & Spoolman, S. (2013). *Principles of Environmental Science*. Cengage Learning Asia Pte Ltd, Philippines.
- Minami, K. & Neue, H. (1994). Rice paddies as a methane source. *Climatic Change*, 27, 13–26.
- Myria, A. & Craig, C. (2016). Rethinking corporate social responsibility in the age of climate change: A communication perspective. *International Journal of Corporate Social Responsibility*.
- NASA Global Climate Change (n.d.). Responding to climate change.
- Ogle, S., Olander, L., Wollenberg, L., Rosenstock, T., Tubiello, F., Paustian, K., ... & Smith, P. (2014). Reducing greenhouse gas emissions and adapting agricultural management for climate change in developing countries: Providing the basis for action. *Global Change Biology*, 20, 1–6.
- Organisation for Economic Co-operation and Development-OECD (2003). International energy agency policies to reduce greenhouse gas emissions in industry - successful approaches and lessons learned: Workshop Report.
- Organisation for Economic Co-operation and Development-OECD (2002). Strategies to reduce greenhouse gas emissions from road transport: Analytical Methods.
- Parker, C.M., Redmond, J., & Simpson, M. (2009). A review of interventions to encourage SMEs to make environmental improvements. *Environment and Planning C: Government and Policy*, 27, 279-301.
- Perez-Sanchez, D., Barton, J.R., & Bower, D. (2003). Implementing environmental management in SMEs. *Corporate Social Responsibility and Environmental Management*, 10(2), 67-77.
- Puppim de Oliveira, J.A. (Ed.). (2008b). Upgrading clusters and small enterprises in developing countries: Environmental, labor, innovation and social issues. Hampshire, UK: Ashgate.
- Puppim de Oliveira, J.A., & Jabbour, C.J.C., 2017. Environmental management, climate change, CSR, and governance in clusters of small firms in developing countries: Toward an integrated analytical framework. *Business & Society*, 56(1), 130-151.
- Philippine Daily Inquirer (2019, November 7). Rising sea levels likely to sink metro manila cities by 2020.
- Roberts, S., Lawson, R., & Nicholls, J. (2006). Generating regional-scale improvements in SME corporate responsibility performance: Lessons from Responsible Northwest. *Journal of Business Ethics*, 67, 275-286.
- Raimi, L., Akosile, O., & Adebunwa, A. (2016, October 6). *Corporate social responsibility and climate change*. Geography and You.
- The Climate Reality Project (2016). How is climate change affecting the philippines?
- Seiffert, M.E.B. (2008). Environmental impact evaluation using a cooperative model for implementing EMS (ISO14001) in small and medium-sized enterprises. *Journal of Cleaner Production*, 16(14), 1447-1461.
- Torugsa, N.A., O'Donohue, W., & Hecker, R., 2012. Capabilities, proactive CSR and financial performance in SMEs: Empirical evidence from an Australian manufacturing industry sector. *Journal of business ethics*, 109(4), 483-500.
- Tucker, L., & Sherwood, L. (2019). Understanding climate change: Grades 7-12. NSTA. National Science Teachers Association, New York.
- United Nations Industrial Development Organization-UNIDO (2021). What is CSR?
- U.S. Agency of International Development-USAID (2017). Climate change risk profile: Philippines.
- U.S. Department of Energy (December 1999). *Emission and reduction of greenhouse gases from agriculture and food manufacturing*. A summary white paper developed by office of energy efficiency and renewable energy office of industrial technologies.
- U.S. Environmental Protection Agency-EPA (September, 2009). *Opportunities to reduce greenhouse gas emissions through materials and land management practices*. Developed by office of solid waste and emergency response.
- Van Hemel, C., & Cramer, J. (2002). Barriers and stimuli for ecodesign in SMEs. *Journal of Cleaner Production*, 10(5), 439-453.
- Weinhofer, C., & Hoffmann, V.H. (2010). Mitigating climate change—How do corporate strategies differ? *Business Strategy and the Environment*, 19(2), 77-89.
- Zhang, B., Bi, J., & Liu, B. (2009). Drivers and barriers to engage enterprises in environmental management initiatives in Suzhou Industrial Park, China. *Frontiers of Environmental Science & Engineering in China*, 3, 210-220.
- Zhu, Q., & Geng, Y. (2013). Drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers. *Journal of Cleaner Production*, 40(3), 6-12.