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# FOOD SUPPLY CHAIN DECARBONISATION: TOWARDS A ZERO EMISSION IN BEVERAGES VALUE CHAIN, A CASE OF DELTA, ZIMBABWE

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**Abstract**

The rise in carbon dioxide and greenhouse gas (GHG) emissions in general were ushered in by industrial revolution due to industrial and human activities leading to global warming which accelerated climate change and more extreme weather occurrences in recent decades (IPCC, 2021). Consequently, the UN advocated for decarbonisation to achieve carbon neutrality by 2050 (Guterres, 2020). The prime objective of this paper was to assess various measures that beverage supply chain members can utilize to achieve decarbonisation of their value chain and offer specific suggestions to the stakeholders of beverage supply chain to address carbon the emission. In the quest to attain this objective, a "Preferred Reporting Items for Systematic Review and Meta-Analysis" (PRISM) method was used. A search was done in the Scopus, ProQuest, and Google Scholar databases using keywords that had been verified by specialists as part of the study. On these subjects, publications from the top journals were chosen. 150 articles were found by the bibliographical search, which was followed by several layers of filtering. In the end, 25 publications were reviewed and analysed, with the most pertinent articles being chosen for examination. The major findings of the research were that the quantity of carbon released doubled since 2001 owing to destruction of forests, the existing global pledges are insufficient, the world has already fallen short of the 2015 climate goals, and lack of adoption of essential technology tools to reduce carbon emission. Consequently, the study recommends the adoption of industry 4.0 technology tools like Virtual reality (VR), reduction of packaging material by the beverage industry, usage of smart electric energy from renewable sources and the implementation of reverse logistics to enhance carbon neutral by 2050.

**Keywords:** Decarbonisation, Supply Chain, Value Chain, GHG emission, Zimbabwe.

## INTRODUCTION

Due to global warming, the world has seen an accelerated trend of sea level rise and more extreme weather occurrences in recent decades (IPCC, 2021). Since the industrial revolution, rising greenhouse gas (GHG) emissions from industrial and human activities have been the primary driver of climate change (Carlarne, 2019). As noted by Climate Action Tracker, (2021), the primary goal decarbonization is to eventually get rid of carbon dioxide emissions. Decarbonization is the process of lowering carbon dioxide (CO2) emissions form human activities into the atmosphere in a bid to get rid of it. Many nations

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pledged support for this aim, with the United Kingdom (U.K. Government, 2019) and the United States being the first large economies to pledge net zero by 2050, (U.S. Department of State, 2021). Recently, China, the world's top GHG producer, also promised to become carbon neutral by 2060, (United Nations, 2020). However, without coordinated action and commitment from all stakeholders, the 2°C target may be missed (Climate Action Tracker, 2021). This target was unanimously ratified by the United Nations Framework Convention on Climate Change's (UNFCCC) member states on the historic Paris Agreement in December 2015. Organizations that have made efforts to reduce GHG emissions frequently find that their direct emissions are outweighed by those produced by their supply chain networks (Plambeck, 2012). However, beverage supply chain has the chance to address these challenges using sustainable measures to meet the reduction target of emission levels. It is against this backdrop that beverage value chain should find sustainable measures to reduce the emission levels. Organizations need to have a supply chain strategy and involve suppliers and consumers from different tiers to identify the most viable strategies to reduce the overall emissions (Gong et al., 2018).

One of the organisations in beverage supply chain is Delta Corporation Limited which produces and distributes beverages in Zimbabwe. It provides lager beer, traditional sorghum beer, soft drinks (Coca-Cola, Schweppes), juice drinks, and teas and ready to drink coffees. It operates a barley malting company and produces glass containers, wine, spirits, PET, and blow-moulded plastic items (Valela, 2022). The nature of its operations results in the emission of carbon dioxide into the environment. However, Delta Beverages can achieve decarbonisation through value chain re-engineering and supply chain strategies which involve suppliers, and consumers (Gong et al., 2018). The beverage manufacturer's value chain entails primary production, which is agriculture through contract farming for 30 000 tons of barley where there are cultivation emissions, carbon emissions from its cold chain, and 22 production facilities which it is running. Some emissions also come from transportation of procured products and supplies from over 200 haulage trucks distributing their product countrywide.

## LITERATURE REVIEW

### Decarbonisation Drivers

### Carbon regulation

One of the key strategies for addressing environmental issues and enhancing environmental quality is environmental regulation (Hashmi & Alam, 2019). As proposed by the Porter hypothesis (Porter and Van der Linde 1995; Pei et al. 2019), strict and appropriate environmental regulation forces businesses to innovate, encourages them to adopt advanced production technology, directs them toward low-carbon technology innovation which result in emission reduction. The change of production to be more environmentally friendly depends on environmental legislation which is in place and its enforcement level (Balashov, 2021). However, Hashmi and Alam (2019) argue that it is the establishment of fair, universally applicable standards under net-zero rules that have

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a great likelihood of reducing carbon emission. In addition to fostering innovation toward decarbonization, net zero legislation can also produce new markets (Larsen et al., 2022).

Pörtner et al. (2022) noted that several private players in the commercial and financial sectors as well as local government and regions, have made net-zero commitments since the Paris Agreement was adopted in 2015. Fodstad et al. (2022) opine that organisations can comply with worldwide projected pathways that restrict warming to 1.5°C with minimal methane emissions from the energy sector such as coal, oil, and gas. However, to reach that target the fossil energy production should be cut by at least 64% by 2030 from 2020 levels (Pörtner, et al., 2022). A clear example regards the use of fossil fuels in OECD countries, where the legislation prohibits the expansion of oil and gas reserves, the issuance of permits for the search for new oil and gas fields (Hashmi & Alam, 2019). Consequently, it bars the new fossil fuel-based power generation. In America, a proposed regulation from the EPA was released on November 2, 2021, and it is expected to significantly cut methane emissions as well as other harmful air pollutants from oil and natural gas industry sources (Carlarne, 2019).

## Consumer carbon awareness

Consumer carbon awareness is most crucial tool in decarbonisation as their shopping decision can influence reduction of carbon emissions in supply networks (Khatibi, Dedekorkut-Howes, Howes, & Torabi, 2021). Majority of customers appreciate using carbon labels as a shopping tool which resulted in some supply chains considering eco-labelling and decarbonisation to retain customers (Birkenberg, Narjes, Weinmann & Birner, 2021). These organisations can also gain from a more favourable public perception that offers them a competitive edge, and a smaller carbon footprint for products may result in immediate energy savings that could also lower production costs (Wen, Zhou, & Zhang, 2018).

Xia et al. (2018) noted that increasing numbers of consumers are considering how their individual consumption can aid in tackling global warming. Labels that tell customers how much CO2 a product emits or whether it is carbon neutral act as crucial decision-making aids in this strategy (Climate Awareness Report, 2021). Taking on climate action through shopping entails altering consumption habits generally as well as selecting climate-neutral products (Wen, Zhou, & Zhang, 2018). This involves, for instance, choosing foods that are locally produced and emit less emissions, favouring goods made largely of recycled materials, and limiting wasteful spending (Khatibi, Dedekorkut-Howes, Howes, & Torabi, 2021).

Customers can use their purchasing power to pressure businesses to cut their CO2 emissions and expand their product line of environmentally friendly goods (Khatibi, Dedekorkut-Howes, Howes, & Torabi, 2021). A survey by Climate Partner (2021) showed that more than 90% of consumers thought taking climate action was very important while 50% of respondents were interested in learning about a product's CO2 emissions particularly food and cosmetics. The survey also indicated that more than 60% purchased ecologically friendly products. The results are a clear indication that consumer carbon

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awareness can be a major driving force behind decarbonisation and corroborated by existing literature which links carbon emission reduction to consumer awareness (Rondoni, Agnese, & Simona Grasso, 2021, Thøgersen, 2021, Canavari, & Coderoni, 2020) and Ellahi, Jillani, & Zahid, 2023).

### Response to fuel price volatility

The correlation between energy costs and carbon emissions is another obvious factor driving decarbonization (Brear, Baldick, Cronshaw, & Olofsson, 2020). In supply chains, there is typically a straightforward win-win situation with measures to reduce fossil fuel use to lower costs (Do, Nepal, & Jamasb, 2020). Additionally, Frankel (2021) noted that in an operating context where there is a continued significant energy price volatility, reduced fossil fuel consumption can reduce the exposure to volatility in the cost base. The decrease in the consumption of fossil fuel owing to sharp increase in energy costs when Russia invaded Ukraine in 2022 could contribute to carbon emission reduction. For example, the highest price for American crude oil since July 2008 was attained in 2022 when it reached $130 with a record high of €345 per megawatt-hour being recorded by European Union natural gas futures (Larsen et al., 2022). This scenario reduced the consumption of energy which may ultimately reduce carbon emissions as it forced governments to look at alternative sources and to establish some cleaner energy sources (Frankel, 2021).

As noted by Larsen, Wimberger, King and Houser (2020) higher and more unpredictable energy prices in the long run will serve as a stimulant for national and international initiatives to decarbonize the electricity networks, which is essential for achieving climate change targets. Investments in clean energy are becoming more appealing due to the benefits of decarbonization as well as the ability to shield the global economy from the fluctuations in energy prices brought on by geopolitical upheavals (Larsen et al., 2022).

### Adverse effects of climate change on logistics

The normal balance of nature is being disturbed because of warming temperatures over time, which is altering weather patterns. Humans and all other kinds of life on earth are at significant risk from this adverse climate trend (Climate Awareness Report, 2021). Bridges, ports, roads, and other essential transportation infrastructure are all extremely sensitive to issues brought on by climate change (Loboguerrero, 2022). This means that weather occurrences brought on by climate change pose an existential threat to some of the most crucial logistics infrastructure on the planet, thereby prompting decarbonisation measures to curb it (Halldórsson, & Kovács, 2010).

Pörtner, et al., (2022) observed that there wasv a significant connection between climate change and the freight transportation sector. They noted that one of the major contributors to global carbon pollution is the freight sector which accounted for 8–10% of global carbon emissions. Pató (2015) argue that logistics professionals must be aware of this loop and how to avert it, given how intricately linked and interdependent freight transportation and climate change are. It is therefore necessary to consider how to halt the process before it is too late. Every logistics stakeholder must develop a cleaner and greener system to

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protect the environment due to such interactions with each other and set up self-sustaining measures (Loboguerrero, 2022).

The availability of agricultural raw materials can suffer greatly with higher temperatures (Climate Awareness Report, 2021). Temperatures that are comparatively steady and moderate in earth's most important agricultural producing zones are essential to the world's supply chains, especially those in the food and beverage sector. The global agriculture economy is already beginning to experience pressure because of the accelerating pace of climate change, and this affects availability of farm produce to feed the manufacturers (Halldórsson, & Kovács, 2010). The most notable example is in farming where farmers are currently enduring more prolonged droughts, hotter temperatures, and flooding than ever before because of changing patterns of rainfall and temperature rise (Climate Awareness Report, 2021). Additionally, a sizeable portion of this disruption can be attributed to the food system itself. According to the EU's scientific advisory body, 37% of the world's greenhouse gas emissions are attributable to global food production and distribution.

## Low Carbon Intervention Strategies

Theory and evidence suggest various strategies that can be implemented to secure reduction in supply chain carbon emissions. These strategies may include supply chain mapping, strategic investments in energy-efficient technologies, public relations campaigns to modify behaviour, carbon pricing and reverse logistics (Martins, & Pato, 2019; Laurila, 2021, Alba, 2022, and Mubarik et al., 2023).

### Supply Chain Mapping

A joint effort to map the supply chain is the first step in understanding the environmental effects of the whole supply chain. Supply chain mapping is critical in that some activities outside your own organization may frequently be responsible for the greatest environmental impact (Xu et al., 2019). With its ability to provide light on the environmental effects of each link in the supply chain, supply chain mapping is a useful tool for companies trying to cut their carbon footprint (Mubarik et al., 2023). They argue that strategic decision-making, stakeholder participation, and the execution of focused interventions are made possible to accomplish sustainability objectives.

Martins, and Pato, (2019) postulate that to create a supply chain map, the original source of each product component, the companies involved, their relationships with one another, the materials and energy used at each stage of the supply chain, the manufacturing processes used by the focal company, the product deliveries and transportation activities throughout the entire supply chain, and reverse flows such as disposal, recycling, and waste. Xu et al. (2019) contend that procurement of products made in more efficient and eco-friendly factories can reduce carbon emissions. As noted by Danish Environmental Protection Agency (2010), the phases of textile wet processing, especially dyeing, and fibre production, whether using oil-based synthetic fibres or cotton fields, has the greatest

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negative effects on the environment. Hence, supply chain mapping can aid in identifying such red flag areas and create some countermeasures.

Mubarik et al. (2023) posited that having a thorough understanding of the entire lifespan aids in decision-making for reducing emissions. Organizations can evaluate each stage's energy efficiency by mapping the supply chain. Xu et al. (2019) postulates that businesses can find possibilities to switch to renewable energy sources and put energy-saving measures in place by analysing the energy sources they use and the efficiency of their processes. Transportation optimization, or cutting emissions and fuel consumption, can also be achieved by mapping the routes taken by vehicles along the supply chain (Mubarik, et al., 2021). This can be grouping shipments together, switching to fuel-efficient vehicles, or looking at other options.

## Supply Stream data gathering

To achieve the best outcome out of supply chain mapping, organisations should ensure there is comprehensive gathering of data across the supply chain (Xu et al., 2019). This enables organizations to have a better understanding of its crucial upstream value-creating processes by visualising the whole supply chain (Laurila, 2021). Supply chain mapping is helpful for the business to know the impact of the chain by understanding the upstream steps in value creation in terms of products or services, the suppliers from direct suppliers all the way to raw material producers, activities taking place within the supply chain, and where production and services originate (Mubarik, et al., 2021). Nimsai, Yoopetch, and Lai (2020) argue that this plays a critical role in gathering information about each activity of direct suppliers and sub-suppliers.

Mubarik et al. (2023) posit that an effective system is required to collect, validate, and transmit emission data among various participants in a value chain. The degree of confidence among value-chain partners in each other's ability to share and act on the relevant data determines the success of supply chain mapping (Nimsai, Yoopetch, & Lai, 2020). Tracking the emissions from suppliers is not only an important step in calculating the emissions from the value chain, but it also necessitates cooperation and partnership between many actors (Weiß, Hajduk, & Knopf, 2017). To adopt sustainable practices, lower emissions, and improve logistics and transportation procedures, organizations can collaborate with their suppliers which can enable members to achieve their short, medium, and long-term decarbonisation objectives (Laurila, 2021).

## Reverse Logistics

Reverse logistics comprises different zero waste processes like remanufacturing, refurbishing, recycling, reuse, and asset recovery (Wang, He & Jiang, 2019). Hence, engaging in reverse logistics operations ensures the supply chain a certain level of green. Increases in recycling and reverse logistics activity adoption have the potential to reduce $CO_2$ emissions. Pörtner et al., (2022) argue that by diverting volume from garbage, the supply chain can reduce carbon emissions from incineration and landfills.

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Reverse logistics also lessen the need for new resources and the accompanying carbon emissions from operations like as raw material extraction and processing (Alba, 2022). There are significant opportunities to reduce emissions through increasing recycling of waste, for example metals, plastics, papers and using fewer packaging materials. As noted by Pörtner et al., (2022) the potential reduction in CO2 emissions from bringing recycling rates around the world up to best-in-class levels is roughly 84 mega-tons per year.

It is important to note that when it comes to the low-carbon transition, reverse logistics can be quite important. There are already well-established recycling value chains in many nations, as well as more effective systems for the collection, sorting, and processing of wastes and materials that cannot be recycled or repaired (Wang, He & Jiang, 2019). As noted by Alba (2022) recycling initiatives may ultimately have a big influence. For instance, in the US in 2010, the recycling of packing containers reduced CO2 emissions by almost 8.4 million tons.

## Carbon Pricing

This is a concept of putting a price on carbon whereby those organisations who meet their reduction target can be incentivized while those who increase their emission are taxed (Best, Burke & Jotzo, 2020). With a growing movement among nations and businesses to charge for carbon pollution to reduce emissions and spur investment in cleaner alternatives it has gained widespread recognition (Ramstein et al., 2019).

Green (2021) posits that emissions trading systems (ETS) and carbon taxes are the two primary methods which are used in of pricing carbon. In this scenario, Tvinnereim et al. (2018) suggest that the overall amount of greenhouse gas emissions is capped by an ETS, often known as a cap-and-trade system, which also gives low-emitting sectors the option to sell any spare credits they have to higher-emitting organisations. A greenhouse gas market price is established by an ETS by generating supply and demand for emissions allowances (Ramstein et al., 2019).

By establishing a tax rate on greenhouse gas emissions or the carbon content of fossil fuels, a carbon tax immediately establishes a price on carbon (Green, 2021). A carbon tax differs from an ETS in that the decrease in emissions it will produce is not predetermined, but the carbon price is (Ionescu, 2021). The carbon pricing is an effective method of reducing carbon emissions as it includes both incentives and negative sanctions to the supply chain members (Ramstein et al., 2019).

Best, Burke and Jotzo (2020) content that carbon pricing aids in redistributing the weight of the harm back to those who caused it and have the power to mitigate it. A carbon price sends an economic signal and allows polluters to choose whether to stop their polluting activity, reduce emissions, or continue to pollute and pay for it (Ramstein et al., 2019). Instead of only mandating who should reduce emissions and where, it also allows for greater flexibility (Green, 2021). The overall environmental goal is met in this way in the most adaptable and affordable manner possible for society. New, low-carbon economic

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growth drivers are fuelled by the carbon price, which also promotes clean technology and market innovation (Ionescu, 2021).

## Usage of alternative sources of energy

The substitution of fossil fuel energy is very critical now than ever before. Policy makers, development financiers should place emphasis on coordinating the expansion of clean energy technology with the reduction of fossil fuel use (Fodstad et al., 2022). A robust investment in clean energy rather than the supply of fossil fuels offers a more comprehensive solution to reducing emissions. The investment in alternative sources of energy accelerates the energy transition to a renewable energy future which is essential for the goal of decarbonizing the global economy. It goes without saying that renewable energy must be fully funded to transition if the dream of the phasing out fossil fuels is to be realized (Dia et al., 2019). Comprehensive plans for achieving net zero transition should include targets for purchasing renewable energy such as wind, solar, hydro.

As transportation consumes a lot of energy, it will be crucial to the energy transition. Buses, lorries, and cars with zero emissions that are fuelled by green hydrogen or batteries should be the focus of governments and private organizations around the world (Dia et al., 2019). The use of hydrogen as a low-carbon energy source is possible. Hydrogen can be used as a fuel to help decarbonize the entire system, strengthen network resiliency, and hasten the transition away from fossil fuels (Cook, 2022). Electric or hydrogen fuel cells are being used more frequently to power buses, trucks, and cars, but too often a lack of infrastructure for charging and inadequate energy network capacity is delaying adoption (Fodstad et al., 2022). To support the future generation of roads, governments and private firms must implement infrastructure and development policies.

As noted by Cook (2022) clean energy generation has been thrust to the forefront as governments take on the task of meeting ambitious national emissions objectives considering the Paris Agreement from 2016 and the 26th United Nations Climate Change Conference of the Parties in Glasgow in November 2021. Cross-disciplinary, cross-sector, and cross-national cooperation are necessary for a successful energy transition (Fodstad et al., 2022). This is because energy decarbonization must consider several elements and requires support from industry, government, and cities. In-depth scenario planning is required to support a resilient energy transition at the national and local levels. With some of the most ambitious renewable energy infrastructure in the world, including wind generating projects off the coasts of America and Asia, and new solar PV and offshore wind technologies being underway as these energy sources are becoming more efficient (Dia et al., 2019).

GHG emissions in the European Union have decreased by 32 % between 1990 and 2020 owing to enhancements in energy efficiency and the composition of the energy mix being the primary factors contributing to the long-term decline in overall GHG emissions. With a goal of becoming climate neutral by 2050, the EU is a bold participant in the international campaigns to combat climate change and lower GHG emissions. This is illustrated on the diagram below.

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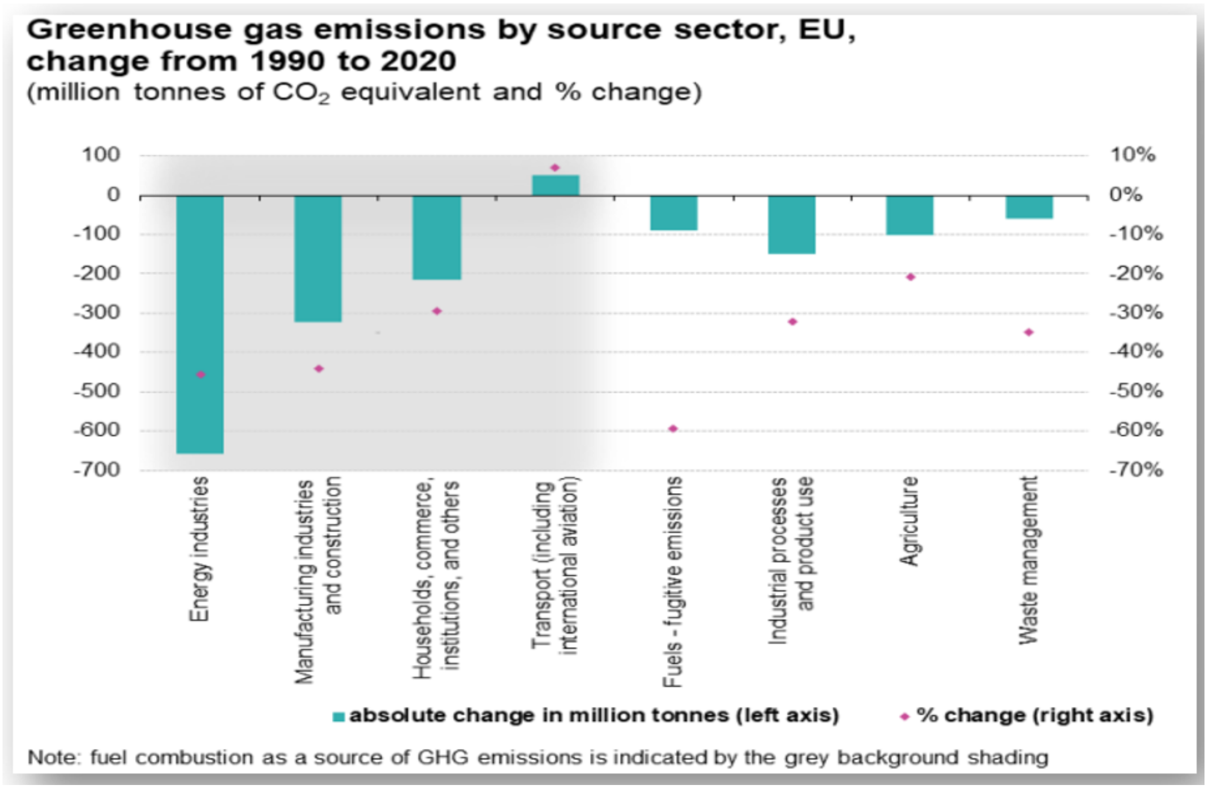


**Figure 1: Greenhouse gas emissions**

Source: Eurostat (2022)

## Carbon Neutrality

Carbon neutrality which is also known as Net zero in its simplest form, refers to reducing greenhouse gas emissions to as close to zero as feasible, with any leftover emissions being reabsorbed from the atmosphere, for instance by oceans and forests (Schreyer et al., 2020) The evidence from science is unequivocal in stating that a 1.5°C global temperature increase is necessary to avoid the worst effects of climate change to maintain a liveable Earth (Gil & Bernardo, 2020). The Earth is currently 1.1°C warmer than it was in the late 1800s, and emissions are still rising. These emissions must be cut by 45% by 2030 and reach net zero by 2050 to keep global warming to 1.5°C, as stipulated in the Paris Agreement (United Nations Climate Action, 2022).

As noted by Pörtner, et al., (2022) land use change and agriculture-related deforestation account for around 11% of yearly global greenhouse gas emissions, decreasing the efficiency of the world's carbon sinks. This suggests that unless deforestation is stopped by 2025, the world cannot achieve net zero by 2050 (Schreyer et al., 2020). It follows therefore that global efforts to reach net zero depend on the protection and restoration of nature by organisations working in the agriculture, forestry, and land sectors.

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Many businesses, especially those in energy and resource-intensive industries like heavy industry, face an enormous technological and financial difficulty in achieving net zero for Scope 1 and Scope 2 emissions (Gil & Bernardo, 2020). With its ambiguous carbon-accounting and monitoring procedures, tackling Scope 3 adds another level of complexity. While Scope 3 emissions are created in the upstream and downstream value chains, Scope 1 and Scope 2 emissions under the Greenhouse Gas (GHG) Protocol are emissions produced directly by businesses or indirectly through the purchase of energy (Spiller, 2021). These challenges can be reduced by collaborating with clients, supply chains and trade associations (Schreyer et al., 2020). As noted by Spiller (2021) a decarbonisation route exercise which uses relatively simple actions like product and logistics optimization and supplier purchases of low-carbon energy can reduce 30 percent of all Scope 3 emissions.

### The Study Gap

The decarbonization process is what effectively supports the comprehensive rollout of decarbonization strategies, which are necessary to achieve carbon neutrality. Previous studies on decarbonisation used a blanket (one size fits all) approach and did not specifically address the decarbonisation interventions from a process perspective of developing countries and their emerging companies. Consequently, it is unclear how beverage supply chains in developing countries can sustainably reduce carbon emissions. Hence, this requires a holistic approach. Furthermore, existing literature lacks a comprehensive review on the role of the procurement organisations and other stakeholders in encouraging supply chains to reduce carbon emissions. Therefore, the current study has conducted a systematic literature review to close this gap. Another important and important component of study is that it makes a timely intervention as the world is aiming to achieve carbon neutrality by 2050.

Consequently, a comprehensive literature review was conducted on food supply chain decarbonisation in the developing countries for exploratory analysis and a deeper understanding to answer the following research queries:

Q1. What are the most influential measures that beverage supply chain members can utilize to reduce carbon emission of their value chain?

Q2. How can the decarbonisation measures be implemented sustainably by beverage supply chains and achieve carbon neutrality?

## METHODOLOGY

The study employs Systemic Literature Review (SLR) methodology to get a thorough insight into the various measures that can be used to reduce carbon emission in the developing countries' beverage supply chain.

Some researchers, Tranfield, Denyer, and Smart, (2003); Shamseer et al. (2015); Silvestri et al. (2020); and Reza et al. (2021) have recommended SLR as a

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comprehensive literature review framework. An overview of the SLR process followed in this study is shown in **Table 1**.

The researchers only cited the most pertinent articles related to the topic to develop a repeatable and objective search procedure. The three categories keywords that the authors used to locate the most pertinent papers are shown in Figure 2. The study used the Moher-developed "Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA)" framework, and Figure 3 shows the flowchart. The most pertinent articles on the Decarbonization of beverage supply chains, as specified in the PRISMA standards, were extracted using the drafting process.

## FINDINGS AND DISCUSSION

For the thematic and descriptive analyses, twenty-five articles were included. The literature study revealed that quantity of carbon released into the environment doubled since 2001. There are no clear policy interventions are aimed at reducing GHG emissions in the beverage sector in Zimbabwe. Most of the literature was looking at GHG emissions in general without a particular focus on beverages value chain. This position was also shared by Sithole et al. (2023) who noted that some specific sectors were not catered separately.

The study found that Delta beverages can measure and manage scope 1 and scope 2 emissions quite easily. However, scope 3 emissions are more challenging as they happen upstream, which limits its control. Since this group includes the great majority of our emissions, it is imperative to learn how to address them more successfully. It was found that emissions are mostly produced by transportation and logistics in beverages value chain including manufacturers, distributors, retailers, and consumers. Sithole et al. (2023) also observed that high concentrations of CO were realised from emissions from the transport and logistics sector.

The study established that there are farmers who are contracted to provide agricultural products whose farming practices add to emissions through the management of manure, the application of fertilizers containing nitrogen, and the burning of crop residue. This is line with a study by O'Dell et al. (2020) which found that agricultural activities accounted for a high percentage of the total emissions.

Most of the beverage operations are not run by renewable energy supply. Some used packaging materials from the beverage supply chain contributed to emissions as result of burning at the downstream supply chain. This is line with a study by Dombo and Maredza (2007) who noted that flammable items (paper, plastic, and textiles) make up 43% of garbage on average.

The publications' descriptive analysis is shown in the ensuing subsections.

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**Table 1: Systematic literature review summary**

| **Phase 1** | **Research question** |
|---|---|
| Formulating of the research questions | Q1. What are the most influential measures that beverage supply chain members can utilize to reduce carbon emission of their value chain?<br>Q2. How can the decarbonisation measures be implemented sustainably by beverage supply chains and achieve carbon neutrality? |
| **Phase 2 and Phase 3** | Electronic databases |
| | Scopus (scopus.com), ProQuest (proquest.com), Google Scholar (scholar.google.com) |
| | Database setting<br>Journal articles<br>Book chapters<br>Conference proceedings<br>English language only |
| Search period | 2022 – 2023 |
| Method | PRISMA |
| **Phase 4**<br>Assessment of findings | **Analysis segment**<br>Iterative compilation of the documents |
| **Phase 5**<br>Reporting of findings | **Synthesis segment**<br>Emerged perspective and results are extracted from documents and discussion |

Source: Literature analysis (2023)

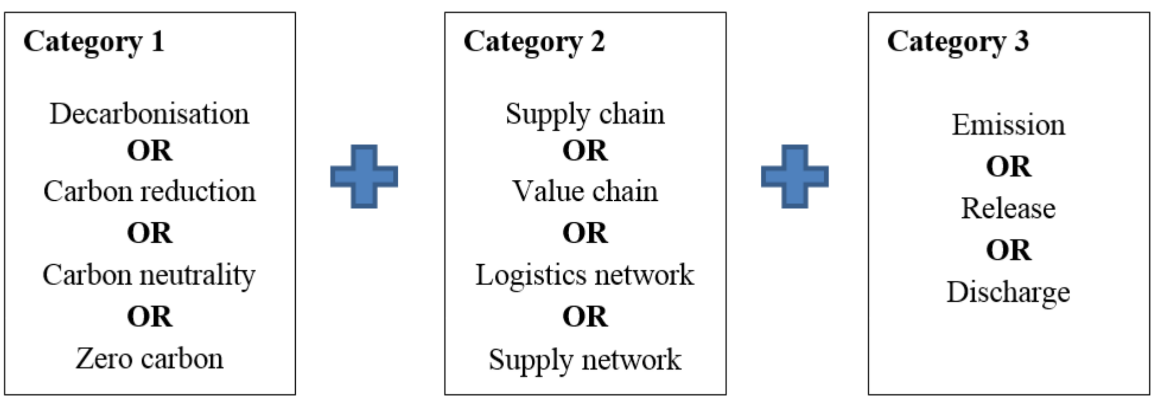


**Figure 2: Literature search key words**

Source: Authors (2023)

## The study limitations

Due to the complexity of the beverage value chain, it was difficult to fully capture and understand its systemic dynamics. The existing literature might be skewed toward particular study designs, which could distort our knowledge of the decarbonization initiatives throughout the beverage value chain as a whole. A Systematic Literature Review (SLR) normally concentrates on published academic research, leaving out important perspectives from professionals in the sector, decision-makers, or other stakeholders who could have first-hand knowledge and expertise in the field. On the other

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hand, the conclusions and suggestions might only apply to Delta, Zimbabwe, and might be difficult to apply in other areas which could restrict the study's wider applicability.

### Future studies

Several directions for future research become apparent when utilizing a systemic literature review (SLR) technique to examine research in the field of beverages supply chain decarbonization, with a particular focus on the beverages value chain in Delta, Zimbabwe. Future studies may examine how policy interventions affect emissions, sustainability, and economic aspects to determine how effective current or proposed carbon reduction strategies are in the beverage value chain in Delta, Zimbabwe. Additionally, by examining the influence of customer decisions on the decarbonization activities in the beverage value chain and methods to encourage eco-friendly consumption, they can investigate consumer attitudes, preferences, and behaviours about environmentally sustainable products.

## CONCLUSION AND RECOMMENDATIONS

In conclusion, Delta's dynamic beverage value chain is making a steady progress toward zero emissions, which will need constant cooperation, creativity, and flexibility. Through the application of the knowledge gained from this comprehensive assessment of the literature, policymakers, industry participants, and scholars can work together to design focused approaches that harmonize ecological sustainability with local socioeconomic growth. The need to decarbonize the beverages supply chain, especially in the beverage supply chain is crucial and intricate for achieving a resilient and sustainable future. Utilizing a systematic literature review approach, the goal of this study was to shed light on the body of current information and offer suggestions for how to get Delta beverage, Zimbabwe closer to zero emissions.

A dedication to long-term sustainability and a coordinated effort from all stakeholders are necessary for the implementation of the study recommendations. Delta, Zimbabwe, may make great strides toward establishing a zero-emission beverage value chain by taking a holistic approach and incorporating these recommendations into strategic planning. For a start, there is need for consumer education initiatives to increase knowledge of how beverage choices affect the environment. Customers are supposed to be given the information they need to make wise choices that promote sustainability, including choosing goods with smaller carbon footprints.

Delta beverages can apply circular economy concepts to the beverage value chain through encouraging packaging waste reduction in beverage production and distribution, creating a closed-loop system for resources, and developing products that are recyclable. Additionally, some agricultural products are purchased straight from contracted farmers, such as sorghum and maize. Delta should motivate these farmers to adopt carbon emission reduction methods through capacity-building initiatives like energy-efficient technologies, use of electric energy from renewable sources such as hydro, solar and

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wind, as well as best practices to create sustainable agriculture for lowering carbon emissions.

The study also recommends the adoption of industry 4.0 technology tools like virtual reality (VR), usage of eco-friendly packaging designs, and revamping of reverse logistics for its packaging materials to enhance carbon neutrality. The value chain stakeholders should also set absolute emission reduction goals for the short-, medium-, and long-term goals which can guide them in pursuit of carbon reduction. It should adopt renewable energy supply across its operations through wind and solar installations at its facilities.

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