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AN APPROACH TOWARDS SUPPLY CHAIN CARBON FOOTPRINT MANAGEMENT IN TEXTILE SECTOR

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ABSTRACT

Nowadays international environmental legislature and multinational cooperation showing their concern on carbon emission from the global supply chain network. The global textile network is very dynamic due to continuously changing customer taste, fashion, habits and high disposable income leads to generates huge waste and becomes responsible for carbon emission mainly in developing nations. This research work focuses on carbon emission register from the various stages such as raw material procurement, knitting, weaving, distribution, transportation in the supply chain of the textile sector. This research study concluded that process-level allocation methodology should be used in order to encounter the carbon emissions from every stage of the product life cycle and capture the carbon footprint emission from the activities of all the stakeholders independently in the entire supply chain. This paper discusses some plans to mitigate carbon emissions from the supply chain network of the textile sector and suggests the textile companies to the adoption of green policies and updating of green technology and their efficient implementation in various stages of the textile supply chain network. This type of approach can satisfy the environmental sensitive consumer, on one hand, on the other hand, it will help to fulfil the company's corporate social responsibility and helps in achieving economic sustainability by identifying competitive advantages.

Keywords: *Carbon Footprint Management, Supply Chain, Textile, CSR, Green Policies.*

Introduction

In today's scenario, the textile industry stood at second position in the world after oil production as a major pollution contributor. Due to increasing environmental awareness in society various governments, businesses, pressure groups, and NGOs setting environment sustainability as a top priority. According to the 'journal of nature climate change' data, the emissions of total greenhouse gases from the solely textile industry are estimated by nearly 1.2 billion tonnes from all around the world which are more than the total emission of all those international flights and maritime shipping combined. The developing nations are more responsible for greenhouse gas emissions and carbon footprinting. According to the United Nations Framework Convention on Climate Change, the total emissions in the textile sector of the world are expected to rise by more than 60 percent by 2030. The pollution spur in this sector due to huge demand worldwide, shorter span and life-cycle, complex supply chain from primary producer to ultimate retailer, and limited recycling option availability. The Ellen MacArthur Foundation report pointing out that nearly USD 500 billion value clothing lost every year due to 'barely worn and rarely recycled ' which can further lead the world textile industry accounting for a quarter of the world's carbon budget by 2050 which is very alarming.in the 21st century where greenhouse gases, carbon footprint, and energy conservation, global warming are today's buzzword and nation's governments become more concerned about the environment due to consequential long-term devastating effects of irreversible climate change on the environment and habitat. Our mother earth becomes warm and polluted due to emissions of greenhouse gases such as carbon dioxide, nitrous oxide, methane and fluorocarbons as the main contributor to global warming. the top three pollutants of the world are the United States, China, and India, those are responsibly raising the atmospheric temperature by 6 percent releasing nearly 600 metric tonnes yearly emission.

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In simple terms we can understand carbon footprint in the sense that the footprint we leave on sand while we walk on the sand, in the same context of carbon footprint relates to the amount of carbon released into the air in production and consumption of fossil fuel due to the activities of manufactured goods, materials, roads, woods, and transport service, thus carbon footprint is the total amount of carbon released into the air due to the fuel consumption in various activities. On the basis of economic activities, we can differentiate carbon footprint in two categories, primary footprint encounter the direct carbon emissions due to electricity production, energy conservation, heating, and transportation while the secondary footprint relates to indirect carbon emission in the environment due to product lifecycle and their sustainability. The Indian textile industry is one of the major contributors to the second type of carbon footprint emission due to dependency on fuel for electricity, steam, and transportation for the production of textiles. It is expected that the Indian demand for textile to grow USD 220 billion by 2020, which further proportionately enhance the impact on carbon footprint.

This paper is basically structured to introduce the carbon footprint emission in the textile supply chain. To serve this purpose section 1 introduces the research problem, section 2 of this paper concentrated on brief and up to- date review of the literature on carbon footprint issues related to its measurement and evaluation in the supply chain is presented/. In the next section I try to propose a new integrated approach to manage strategic carbon footprint management in the supply chain, especially in the textile sector. Finally, this paper talks about conclusions and way forwards to control global footprint emission and recommendations discussed for future research in this area.

Review of Literature

Nowadays, carbon footprint can be used as a tool to calculate and assess the emission of greenhouse gases from the production process or from the entire life cycle of the product. At the textile industry level, the carbon emissions from manufacturing are mainly depended on the product life cycle, nature of the product, the length of the supply chain, technology adoption in production and management of the product.

Xin Li, Lizhu Chen, Xuemei Ding (2019) states that as the textile and apparel sector generate huge amount of greenhouse gas emissions, To resolve this, the author suggested **process-level allocation methodology** for carbon footprint calculation in the textile sector because of allocation methodology directly affect the data collection and system boundary. In a case-study It was observed that ironing (40%) and sewing (35%) processes are the major emitters so that author suggested energy-saving equipment should be chosen to reduce greenhouse emissions and improving the textile and garment production efficiency is feasible to reduce carbon footprinting in production process by adopting new technology and management optimization. The author concluded that process-level allocation is a feasible method and helpful in addressing the problem of carbon footprint emission in the textile process.

An interview with **Deborah Wynne (2019)** pointed out EU- funded European Clothing Action Plan in order to address the problem of “Fast Fashion” which caused massive production of cheap clothes for taste changing consumer which ultimately generate surplus apparel production and their disposal lead to intensified fossil fuel and water waste. To resolve this, the EU comes up with the EU garment initiative by linking waste apparel with paper production in order to furnish UN Sustainable Development Goals. Belkis Cakar, Serdar

Aydin, Gamze Varank, H Kurthlus Ozcan (action (2019) author developed a model to calculate the embedded carbon, water, and energy footprint throughout the food supply chain in Turkey which can be used to access the linkage between food waste and carbon footprint emission in the food supply chain.

TN Malini, Shilpa Ajay (2019) highlighted on the sustainability management through supply chain processes like procurement, operations, warehouse development and distribution, use and maintenance of product, disposal or recycle and reuse of product, reverse supply chain to reduce carbon emission for sustainable development.

Tariq Aljuneidi, Akif Asil Bulgak (2019) suggested the development of a reverse logistics network model and reduce the transportation distance between different supply centres by integrating Hybrid manufacturing-remanufacturing system to address carbon footprint, facility location, and the material flow aspect in the supply chain.

Methodology Framework Adoption of CFM in Textile Sector

It is evident that all the above research papers, case studies, and interviews focussed on carbon footprint management in the supply chain of products and emphasize upon carbon footprint management and assessment in the supply chain by using various product life-cycle tools and techniques. The textile

sector is a very dynamic sector nowadays and a major contributor to greenhouse gas emissions, there is a lack of systematic efforts towards carbon footprint management respective to the entire supply chain of production in the textile sector. To serve this purpose, this paper proposes an integrated methodology framework for account the carbon footprint in the entire supply chain in this sector. In order to define, capture, evaluate and manage the carbon emission in the product life cycle, several steps are proposed during the product life cycle, as well as given an insight about reduction, evaluation and monitoring of carbon emissions across the supply chain. The methodological framework is divided into two strategic parts in which one deals with analysis of the company's internal and external environment followed by setting up strategic goals in each stage of product life cycle whereas another phase deals with strategic decision making for the implementation and execution of the strategy in order to check the carbon footprint emission in product life cycle in textile sector. There is a brief introduction to the steps involved in the process:

- **Systematic Analysis and Adoption of the Major International Legislative Frameworks and Global Trends in Carbon Footprint Management and Their Application in the Textile Sector:** Over the last few decades, various international governments showing their concern on global warming and carbon footprint management and developing various regulatory interventions. Hence, it should be the utmost priority of a company to strictly follow enacted international environment regulation and plan their policies accordingly, while concerning the mitigation of the industrial carbon footprint at the production level. The Kyoto Protocol is an international protocol which obliges the member countries to reduce their greenhouse gases emission in industrialization process and provide a mechanism in which member countries can trade their emission quotas by receiving credits in emission reduction and finance their credit in developing countries. This kind of approach is a very innovative in which one side it penalized the developed nation for their larger emission and rewarding developing nation on the other hand. In addition, the EU ETS came up with the largest international cap-trade system which incentivizes power stations, industrial plants and commercial airlines operating in Europe by facilitating the trading of emission allowances within the cap. In a developing nation like India where globalization gave a border market to the textile sector, it is necessary to the development of lengthy transportation facilities without neglecting the carbon emission for achieving a substantial reduction in global emission of carbon footprint by 2050.
- **Development of Green Supply Chain:** It is important to adopt those policies and practices which can help textile units to reduce the adverse impact on the environment. fulfill improve sustainability and to 'green' their supply chain, various multinational organizations have already adopted and implemented green practices in the production process which ultimately helps in the reduction of carbon footprint in the supply chain. Now, It is required of adoption such practices in the textile sector is very prominent. indicatively, the development of greenhouse gas emission management systems in the supply chain of the textile sector can help in monitoring both direct and indirect emissions associated with relevant supply chain activities and evaluate to compare the reduction of emission from past years. another method to go green is the adoption of renewable energy resources in the production process and transportation which can ultimately help in reducing carbon emissions. The development of a time-bound environmental action plan can also be seen as a tool to reduce energy utilization and carbon emissions at the production stage in the textile sector.
- **Development of the Strategic Model and Alignment of Company's Goals with Supply Chain for Better Carbon Footprint Management:** In this step companies should take into account those goals and objectives which company wants to achieve and such goals should accordingly set to serve the purpose so as to manage the carbon footprint of company's supply chain in order to reduce adverse environmental impact. For this, textile companies should change their traditional business goals and should shift their focus on how carbon footprint emission will impact their profitability and operational efficiency. This will lead to the emergence of new strategies such as the development and implementation of the green supply chain in synergy with new environmental goals. Subsequently, one hand will reduce carbon footprint emission across the supply chain, on the other hand, companies get fulfilled their corporate social responsibility programs. By adopting this route, the textile companies not only able to achieve economic sustainability as a prime objective but also achieve environmental sustainability by creating green competitive advantages in the marketplace in an improved manner.

- **Identification of Crucial Activities and Role of Stakeholders in the entire Supply Chain Network:** This step can be divided into two parts. the first one deals with a thorough mapping of the entire supply chain of textile companies which further followed by plotting of those activities which mainly contributes to the greenhouse gases emissions and the other part deals with the identification of all the stakeholders and define their role and responsibility clearly in the entire supply chain. In the textile companies, while considering the product life cycle for carbon footprint management, the textile companies should take into account the carbon emissions from all supply chain stages, from procurement of raw material to the disposal of waste and recycling and identify those crucial activities which contribute to carbon emission and rank them accordingly. For example, the manufacturing phase accounts the majority of carbon emission due to high energy requirements in weaving and transportation accounts for nearly 18% of the total greenhouse gas emission and rank them accordingly. As we consider carbon footprint management in the textile supply chain context, textile companies should extend their view towards all the stakeholders (weavers, suppliers, logistics manager, third-party provider etc.) in the supply chain network, identify their role and responsibilities and clearly define them with their strengths and weaknesses as well as any new opportunities for further improvement.
- **Measurement of Carbon Footprint in the total supply chain of the textile company:** It is suggested that in this step the textile company should calculate the total carbon footprint emission from each activity separately as well as from the whole process The textile company should also focus on that the right mechanism should be used while data gathering and ensure their accurate implementation, ensure that all the roles and responsibilities of all the stakeholders are clearly defined and delegated in all the departments, all the necessary tools and techniques for measurement are acquired and verified, establishment of well defined, accurate and reliable procedures for measurement of carbon footprint in every stage and ensure the proper communication channel for sharing the results to the rest of the supply chain stakeholders. In the next step for the calculation of carbon footprint emission and its measurement, carbon accounting should be performed with life-cycle oriented tools and techniques that quantify greenhouse gas emission such as Greenhouse Gas Protocol Which classify the greenhouse gas emission in two categories The emission occurs due to sources owned and controlled by textile company itself recognized as direct emission. The other one is indirect emission, which is purchased and borrowed by textile company externally such as emission from electricity, purchased raw material, hired transportation.
- **Evaluation of the Results and Restructuring of the Goals:** In this stage, it is suggested that the textile company should check the end results and verify which activity is responsible for high greenhouse gas emissions and plot them as critical activities due to the high concentration of carbon emission from such activities. The textile company should keep in mind while evaluation that which kind of activities are responsible for carbon emissions such as if carbon emission is a kind of direct emission then the company is exclusively responsible for managing and controlling the company's carbon emissions. On the other hand, if the final results indicate that the carbon emission is from indirect activities or it is indirect emission then the company needs to securitize its relationship with external stakeholders in the supply chain. Now, the textile company needs to restructure its goals accordingly and communicate the same with the rest of the supply chain.
- **Decision Making for Supply Chain Carbon Footprint Management:** This step includes the decision-making process in order to manage the carbon footprint in the company's supply chain. The manager of the company took into account the earlier steps while making decisions regarding what kind of strategies should be implemented in order to counter the carbon emissions in the supply chain and how the supporting procedure should efficiently be implemented. The manager should be responsible for deciding the correct methodology for reducing the direct carbon emission from internal supply chain activities such as procurement, production, and packaging. The company manager should also make a decision regarding the indirect carbon emission from external supply chain activities such as energy consumption, transportation, distribution to the final retailer. The company's manager should align all the activities in the supply chain and ensure that the implementation of a final decision should coordinate with entire supply chain stakeholders, which is very important for harmonized strategic planning and long-term relationship.

- **Periodically Monitoring of the Supply Chain's Carbon Footprint:** apart from the official declaration in every year, it is required to monitor the procedure and activities more frequently rather than publishing them in one year and furnish the carbon emission report to the regulatory authority regularly. To serve this purpose, the company's manager should evaluate the information independently and communicate the same within the company, between the company and supply chain partners. As all the stakeholders are a crucial contributor to carbon emission in the textile supply chain, their cooperation is prominent for the efficiency of the entire effort.
- **Regular Upgradation of the Decisions: Due to the Continuously Changing Global Environment and Climate Change Forcing** The international environmental legislators to change their policies in order to combat the adverse effect on mankind and mother earth. It is the prime responsibility of the textile company to evaluate and update its policies periodically and take necessary decisions accordingly. The textile companies should adopt green technological advancement in the production process for further reduction of carbon footprint across the supply chain. Apart from them, textile companies always keep in mind environmental consideration with economic consideration and should develop an environmental-profitable action plan such as contracts with environmental concerning organization, development and advancement in green technology, promotion of recycling of waste material and used cloths with a target of safe and clean supply chain.

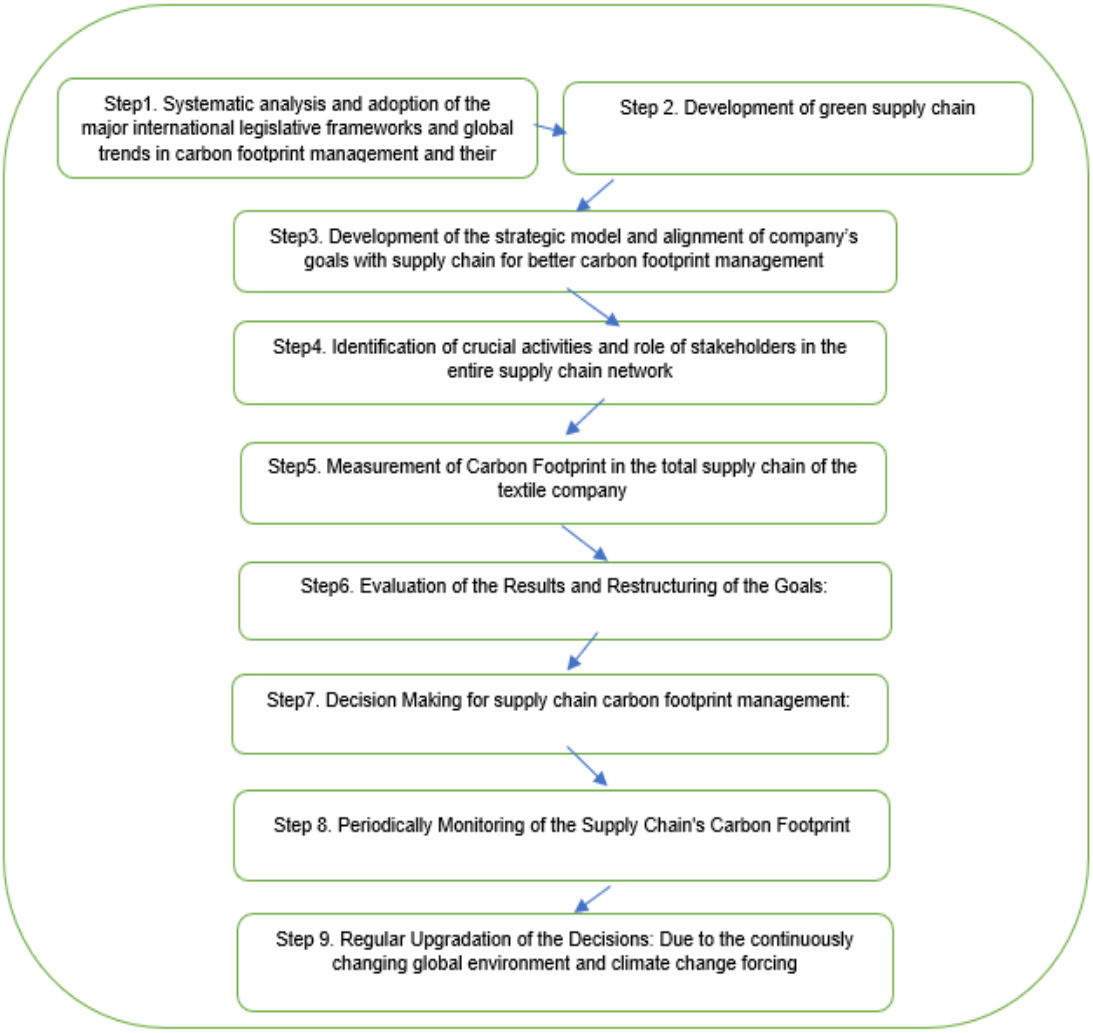

Figure1: The Supply Chain's Carbon Footprint Management of the Textile Sector

Conclusions

This research paper is primarily concerned about the carbon emission from the various stages of the supply chain of the textile sector. The researcher proposes a systematic methodological framework that can be implemented in the textile sector to reduce carbon emission. This research paper can help the textile companies' manager to take environment-friendly decisions and encourage management of the supply chain network at various stages. This framework has enough adaptability to apply in any form of organisation to ensure environmental sustainability.

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