

## **A review on green logistics practices in the select Indian manufacturing sector**

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### **Abstract**

Concern for environmental sustainability has become very crucial among manufacturing companies and practitioners as the pressure for ecological care has increased. The manufacturing enterprises that sell products nowadays cannot withstand themselves in the evolving market by just greening the manufacturing operations; also, all the activities across the logistics need to be green. This paper aims to provide an investigation of green logistics practices in the select Indian manufacturing sector (oil and gas). Also, it involves the environmental performance-based selection of crucial activities for green practices and the ranking of several green logistics activities in transportation, warehousing, packaging, and value-added services. The outcomes were based upon a questionnaire-based survey on 116 responses obtained from the officials/ managers of the logistics companies working for the manufacturing sector (oil and gas) in north India. This study summarizes the best possible green logistics practices that need to be considered during downstream logistics activities in the select manufacturing sector (oil and gas). Such empirical studies could help the management of this sector to make strategic decisions about the implementation of green logistics practices for achieving the environmental goals in downstream logistics activities.

### **1. Introduction**

In today's era, the environmental issues are critical concerns for all countries all over the world. Therefore, organizations need to deal with these issues as they are continuously under pressure to perform environmentally responsible activities. Obligation to the natural positive and friendly environment has become a significant and necessary variable. Logistics is one such domain that leads to a negative effect on the environment. Due to globalization, logistics activities have increased enormously. On the global platform, the logistics market will reach a value of USD 6,300 billion by 2024, with a CAGR (compound annual growth rate) of 4.9% during 2019-2024. However, until 2018, the global logistics market has been reached a value of USD 4,730 billion. (Group, 2019). As per the report of IBEF Knowledge Centre, the logistics sector in India is also expanding with a high growth rate. As per one of the prominent domestic rating agencies of India, the logistics industry of India is currently estimated to be around USD 160 billion and it is estimated to have a growth rate of up to 10 percent in the future. This sector growth is a development over the compound annual growth rate (CAGR) of 7.8 percent at which the industry had grown during the last five years (IBEF, 2018).

Logistics system is generally claimed as one of the significant contributors to overall greenhouse gas (GHG) emission and energy consumption in the world (Kim and Han, 2011; Oberhofer and Dieplinger, 2014; Murphy and Poist, 2003; He et al., 2017). The transportation sector, which is one of the major logistics activity is responsible for 24% of CO<sub>2</sub> emission in Europe (. Similarly, in the US, out of the total GHG emissions, 26% of emissions are from the transportation sector, and it's the second largest after the electricity sector (He et al., 2017). Due to a large amount of energy consumption during logistics activities, lots of toxic gases (carbon dioxide, sulfide, nitride, harmful dust, etc.) are emitted, and waste is produced, which is damaging the environment (Zhang and Li, 2014). In the context of India, the sources of CO<sub>2</sub> emissions are fuel combustion, energy industries, manufacturing, construction industry, all kind of transport, and other sectors. Table 1.1 shows the value of CO<sub>2</sub> emissions (In a million tons) in India by different sectors. Road transport plays an important role and accounts for 121.1 million tons of CO<sub>2</sub> emissions (King, 2011).

**Table 1.1 CO<sub>2</sub> emissions by different sources of Combustion in India (King, 2011)**

<b>S.No.</b>	<b>Parameters</b>	<b>Value (In a million tons of CO<sub>2</sub>)</b>
1)	Total CO <sub>2</sub> emissions from fuel combustion	1427.60
2)	Energy Industries	50.70
3)	Manufacturing and Construction	652.80
4)	All Transport	147.40
5)	Road Transport	121.10
6)	Other Sectors	576.70

Stakeholders are now increasing the pressure on the firms to take responsibility for adverse and harmful effects on the environment caused by their logistics activities. As a result, the manufacturing enterprises are incorporating new strategies and green policies in their businesses for a better environment and fewer carbon emissions. They need to focus on the environment and to take it as a responsibility to move towards a low- carbon economy and reduce the carbon footprint of the country. In developed countries, Green Logistics has become popular in recent times. Although in developing countries, it is still in a preliminary stage and needs more attention. It had been discussed that the developing countries are still lacking in promoting and implementing green practices in

## **2. Literature Review**

The logistics activities aim to achieve customer satisfaction with maximum profits and minimum costs. The term was initially used in many reports of the manufacturing enterprises. But, now the term logistics has been used in combination with the "green" by creating a new term called "green logistics." Green logistics are the logistics practices and strategies which are carried out to reduce the environmental footprint, minimize the freight energy, reduce transport, packaging, and waste management (Rodrigue et al., 2012). Green logistics includes the activities that would enable the growth of green logistics, the advancement of green growth, and also helps in achieving sustainable development, however, the high level of uncertainty of factors which affect the green logistics, it becomes necessary to explore and evaluate the practices and performances of GL (Zhang et al., 2020). Green logistics can be considered as the advancement of the existing logistics, which emphasizes the performance of activities involved in logistics in an environmentally friendly way to comprehend the growth of logistics and economy while preserving the available and existing resources and protecting the environment with the ill effects of the activities (Zang, W., et al., 2020). A survey from EyeforTransport reveals that around 25% of sampled companies across the US, Europe, Gulf countries, and the Asia Pacific were collaborating with third-party logistics services to help their overall image to be more environmentally friendly or to move their green projects forward. While another 27% were studying the possibility to do this in the future. The adoption of the green logistics leads to the reduction of the negative impacts of logistics operations on the environment such as gas emissions, noise, and waste, and thus helps to achieve the balanced development of the triple bottom line approach i.e., in the economy, society, and environment.

In current times, complexities in the business environment have forced the logistics activities in a way that they have to make these activities and processes greener and more environment friendly by including initiatives that take into consideration the environmental effects of their processes (Vinodh et al., 2016; Garza-Reyes, 2015a, de Oliveira et al., 2018). This has led the practitioners and scholars to examine the strength of the environmental practices to protect the environment and ensure the steadiness of the firms through improved profits. The survey report EyeforTransport shows the various GL practices commonly adopted worldwide are route planning to reduce vehicle mileage, enhancing energy efficiency, and creating green warehousing and distribution centres. As per the estimation, eight percent of the worldwide energy associated carbon emissions are initiated from freight transport of the logistics activities. As the worldwide increase in global warming and deterioration in the environment, the use and adoption of green and low carbon logistics modes are in development widely across the globe. Lee & Klassen (2008) describe green logistics as an organization's activity taking into account the issues related to the environment and integrating these activities into supply chain management. Green Logistics helps in changing the environmental performance of suppliers and customers (Lee & Klassen, 2008). Climate

change has been associated with human activities and due to the increased demand for non-renewable fuels or fossil fuels by social and economic activities has led to damage of the ecological environment. The decreasing environmental conditions and global warming have forced both manufacturing as well as logistics companies to restructure their operations for achieving cleaner and greener production by optimizing the warehousing, distribution and other activities which leads to a reduction in carbon footprints.

Green Logistics is a set of supply chain management practices and strategies that reduce the ecological carbon footprints during transportation, packaging, and distribution activities (Stolka et al., 2018). Environmental sustainability leads to difficult challenges for researchers in the coming years, among which the major challenges are logistics and freight transportation are considered most crucial. The concept of green logistics has gained attention in the last few years. Therefore, many researchers have examined green logistics and its related issues by conducting the surveys and expert interviews with people employed in the logistics companies at different posts such as interviews with managers, and logistics providers. Green Logistics also helps to move towards sustainability in ecological, economic, and social terms. The majority of these activities include transportation, warehousing and distribution, packaging, and other value-added services (new activity addition). Table 2.1 shows the various activities of green logistics as per the literature review.

**Table- 2.1 Defining Green Logistics activities (Source: Kaaria and Asaari, 2016)**

S.No.	Logistics Activity	Description
1.	Green Transportation	It is an approach for managing delivery with the use of green vehicles that improve the environment, economic and social performance, e.g., use less fuel, backhauling, clean vehicles and natural green vehicles, etc.
2.	Packaging	It is an approach of using packaging material that improves the environment, economic and social performance, e.g., use recyclable material, reuse materials, green packaging material, minimize waste and use of material and time to unpack, etc.
3.	Warehousing and Distribution	It is an approach of optimizing energy for inventory/storage, reducing movement, energy-efficient lighting system, utilize warehouse layout and inventory strategy, energy-efficient building, etc.
4.	Value-Added Services (derived from Green Management System)	It is an approach of developing strategic planning, control, and inclusion of value with utilization of the latest tools and technology for green logistics that improve the environment, economic, and social performance.

Green practices help in balancing cost and environmental aspects. It is not very uncommon to observe that the reduced emissions can be possible with only a marginal cost increase (Zhanga and Zhaob, 2012 and, Kim et al., 2009). Keeping in mind the contribution of the manufacturing sector in the growth of the Indian economy, authors feel the need for research to motivate the Indian manufacturing enterprises towards adapting the procedures of greening the logistics activities in the greater interest of the global ecological framework. It is also evident that most manufacturing enterprises are not very rich in resources, and the majority of these are located in distant places from the target markets.

The parameters such as CO2 emissions, usage of energy, waste, and losses, etc. Few authors have also suggested that intermodal freight transportation is an evolving area that requires different models than unimodal transport. In a real-life study performed by Janic (2011), an effort was made to evaluate the environmental effects of creating a multimodal transport node out of an airport by linking the airport to the rail transport network. Authors have analyzed road transport operations in view of economic and ecological aspects and also evaluated the shifting scenario from road transport to rail transport to improve the energy efficiency. Multi-objective (maximum profit and minimum emission) mathematical models were proposed by Li et al. (2008) for the optimization of distributor locations by considering the cost of transportation and carbon emissions during transportation. Piecyk and McKinnon (2010) have considered five-factor types viz. structural factors, commercial factors, operational factors, external factors, and functional factors that affect carbon intensity of fuel and found the most significant factors for carbon emissions in road transport. Based on the above literature, significant activities of Green Transportation Practices have been identified which were discussed and finalized with the five senior managers of the oil and gas sector and are listed below (Table 2.2):

**Table -2.2 Activities in Green Transportation Practice**

Sl. No.	Green Practices	Description	References
1.	Standardization of the Trucks	‘Standardization of the trucks’ means all heavy-duty trucks use the same engine, transmission, and tires. Standardization of truck sizes is essential to improve efficiency and reduce losses. Thus, it ultimately improves the environment by more inter-utilization of parts.	Thiell et al., 2011; Sarkis & Yoo, 2011
2.	Clean Vehicles	‘Clean vehicles’ mean to push for electric vehicles, biofuels that are sustainably grown, and lower carbon emission. The alternate and clean technologies are deployed to achieve emission reductions to a large extent	Thiell et al., 2011; Coignard et al., 2018; Meirlo et al., 2017; Wada, 2009

3.	Wireless Technologies	Many 'wireless technologies' have been developed in the last few years to meet the increasing needs of high-speed wireless communications in transportation. These evolving technologies will efficiently impact the operation of transportation of logistics	Mondragon et al., 2012; Taniguchi et al., 2020; Bibri, 2008; Zhou et al., 2011
4.	Backhauling	'Truck backhauling' leads to the reduction of empty truck-miles by having drivers haul loads on the back trips. This is economical and environmental friendly as well.	Ubeda et al., 2013; Yu & Dong, 2013; Juan et al., 2014
5.	Scheduling	'Vehicle scheduling' is a crucial step of the public transport planning process because it is directly related to fixed cost and labor cost. It is desirable to minimize the number of vehicles used and operational costs and thus reducing the wastage of resources.	Ubeda et al., 2013; Ceder, 2001
6.	Optimization	Transportation routes are defined to minimize the cost of inbound or outbound shipments. 'Optimization' of routes, as well as the load distribution, is crucial to achieving economy and ecology efficiency in logistics.	Wong et al., 2018
7.	Freight Consolidation	'Freight consolidation' refers to the process of combining multiple packages or partial loads together into one fleet headed to a shared destination, This allows companies to use fewer loads and get orders to their destinations more efficiently and cheaply. Load consolidation has several other benefits related to the environment.	Baykasoglu and Kaplanoglu, 2011;
8.	System Monitoring Devices	'System monitoring devices' is an application that provides innovative services relating to different <b>modes of transport</b> and management of and enables users to be better informed and make the environment also better.	Litescu, 2016; Causevic 2018

Authors such as Dey et al. (2011), Rao and Holt (2005), and Porter and Vanderlinde (1995) have presented different researches on the sustainability and environmental considerations in the firms to decrease risks and to recover the competitive state of the firm. The various green industrial buildings and various innovative handling methods are generally linked with green warehousing. Therefore it is significant to study green warehousing practices of logistics as it helps in bringing a positive effect on the environment, society, and economy. Also, as the pressure and environmental concerns are increasing due



to carbon footprint, the need for green warehousing practices within the logistics industry is of leading priority. It is a vital element in the logistics system after transportation .

Furthermore, researchers have approved that the practice of green warehousing is crucial as it leads to the safety and comfort of workers in warehouse environments (Green Building Index, 2017; Laosirihongthong et al., 2013). Much focus has been given on the above logistics practices for greening the environment. In an innovative study presented by Palanivelu and Dhawan (2011), several green warehouses with minimum emissions were discussed. These warehouses can be made by installing energy-saving equipment, using refined lighting systems and solar installations. In another work by Iakovou et al. (2010), an analytical model was proposed to investigate the economic and environmental effect of locating a part of production operations near the serving markets. Table 2.3 lists warehousing activities from the literature.

**Table -2.3 Activities in Green Warehousing Practice**

Sl. No.	Green Practices	Description	References
1	Reconditioning and reuse of Pallets	Pallets are the most generally used item for material handling in warehousing and are very crucial in logistics systems. Durable materials and is specially designed for multiple trips and extended life. This would ultimately help to achieve a better environment.	Yong et al., 2014 Carrano et al., 2014
2	Clean Material Handling	'Clean material handling' has been implemented by many companies to improve their environmental performances. This activity has been identified as an essential practice in the reduction of energy consumptions.	Facchini, 2015; Thiell et al., 2011
3	Innovative Handling	The deficit in carbon emission due to material handling activities can be obtained through policies such as using smart automatic pickers, energy-efficient material handling equipment, etc.	Yong Z et al., 2014; Carli et al., 2020
4	Process Optimization	The energy can be saved through process optimization by order picking (approx. up to 55% of the total energy for warehousing can be saved).	Boenzi et al., 2016
5	Minimizing Inventories	The minimization of the inventory in the warehouse will both affect the storage space and materials handling activities within warehouses. The reduced stocks lead to less GHG emissions.	Bowerson et al., 2013; Roy, 2010; Fichtinger et al., 2015
6	Low Carbon Storage	'Low carbon storage' refers to less carbon dioxide storage at point sources such as power plants. Sequestering carbon dioxide from the atmosphere and depositing it where it will not enter the atmosphere,	Li et al., 2017; Thiell et al., 2011; Freis et al., 2016

Under the domain of green logistics, green packaging is another important issue which has been given importance in the literature. Green packaging is sometimes also referred to as "ecological packaging,"

which is defined as environmentally friendly packaging that should be entirely made by plants, can be other use, should be degradable, and promote positive and sustainable activities. Green packaging is said to be hurtless to the environment and also to human health (Liang and Jie, 2008). Thus, green packaging practices are suitable ecological activities that should lead to reuse, recycle, and do not cause pollution in the environment during the life cycle of the product (Zhang and Zhao, 2012). Some efforts regarding the minimization of waste weight by reducing packaging volume were also discussed in the literature. It was found that the packaging corresponds to 23% of all waste weight. It is also found that reduced packaging saves the environment as all packages have to be transported among retailers and waste processors. Authors, such as Zhang and Zhao (2012), emphasized the role of government in the development of new and innovative green packaging materials. They also suggested standardizing the packaging materials with the active participation of government and established institutions.

**3. The perspective of the Indian Manufacturing Sector:** Manufacturing is the backbone of any country and plays an important role in modern society, as everything from knitting textiles to oil extraction to steel production falls within this sector. In India, the manufacturing sector has been a high growth sector, and recent years have shown tremendous rise and have given global recognition to the economy. By the year 2022, India would become the fifth largest manufacturing country in the world. The government is all set to attain a 25 percent GDP share and 100 million new jobs in the manufacturing sector in 2020 (IBEF, 2020). The logistics involved for the sector are mostly unorganized and fragmented with more than 7 million freight vehicles plying on the road and carrying a volume of almost 1325 billion ton-km (Biyani, 2017).

The Manufacturing Industries are divided into many ways depending upon the factors. On the basis of the raw materials used, the manufacturing industries are divided as below:

- *Agro Based Industries:* Cotton, Wool, Jute, Sugar, Tea, Coffee, Silk, Textile, Rubber, etc.
- *Mineral Based Industries:* Iron and steel, Aluminium, Cement, Oil & Gas, etc.

The global economy is highly dependent on the Oil and Gas (O&G) sector. However, this sector has a high negative impact on the environment and society (Gardas et al., 2019). The oil and the gas sector involve compound elements that range from oil exploration sites to the fuel stations. This supply chain has three verticals, namely upward, middle, and downward. The upward vertical consists of survey & manufacture, whereas middle system is a system of distribution that comprises of pipelines and tankers transporting crude oil to refinery plants. The downward vertical is the last and stage, which includes the major logistics activities like marketing, wholesaling and retailing (Inkpen and Moffett, 2011). Oil and



Gas sector is a major part of the global logistics system including international and national transportation, export/import services, material handling inventory and its control, etc. Hence, this sector offers scope for a typical model for the suitability of environment friendly activities in Logistics. This is one of the rationale to consider this sector as a candidate for green logistics practices implementation studies in Indian context.

The population in India is also increasing at a very fast pace which has already reached a value of 130 Crore. This huge increase in population in India has put considerable pressure on the existing and available nonrenewable resources and thus influence changes in the climate. Further, the oil and gas sector is one of the most polluting sectors in the world (Abubakar, 2014) and so does it is in India due to its logistics activities of the downward vertical. It is thus necessary that active implementation of sustainable practices in the oil and gas logistics activities which will help solving the environment problems. Therefore, the implementation of Green Logistics Practices in the logistics activities of the oil and gas sector of India will be beneficial towards resolving some of the environmental and social issues in the sector.

In India, during the finale of Transporters Meet, the Minister of Road Transport and Highways, Shri Nitin Gadkari had said that the transport and logistics companies should move towards green logistics to reduce pollution as the government is planning for strict pollution norms. He also said that certain changes are inevitable to be done in the logistics activities of companies working for the oil and gas sector. The changes suggested by him include the adoption of LPG as a future fuel, the use of electric vehicles for freight, etc. The event was organized by hindubusinessline.com, along with Indian Oil Corporation Limited (IOCL) and Mahindra Automobile Limited (Bureau, 2020). Therefore the shift towards green logistics along with sustainable development has become the most ethical and necessary obligation towards the society and the country. Thus, as the Oil and Gas sector has a considerably harmful effect on environment as well as on society, it needs to be studied carefully to reduce pollution.

Besides the above, in literature, the emphasis was given on improving the upward stream and middle stream only. However, downward stream logistics issues have always been ignored. Having discussed earlier in this section, the size of oil and gas logistics in India, the pollution caused by these activities requires more considerable attention in today's scenario. Besides having a massive scale of logistics activities in this sector due to a large number of retail outlets, still very few green logistics based research studies are found in the literature.

#### **4. Research Methodology**

The systematic approach, which includes generalization and the preparation of the theory, is termed research. As such, the term 'research' is the systematic method consisting of the problem definition, data collection, analyzing the facts, and then giving certain conclusions by either giving solutions(s) of the concerned problem or by some generalizations through specific theoretical formulation. The research methodology of the study consists of exploratory research design in the concept of green logistics for packaging practices and explored it systematically with the support of Literature Review (by way of various sources like national and international journals, sources from the internet, research reports, magazines, etc.). This helped to get in-depth knowledge and understanding of the Green Logistics and various parameters and factors associated with it in the case of the Indian manufacturing sector. The exploratory analysis is used to determine the level at which logistics companies of Oil and gas sector have information about different Green Practices in their logistics activities. This, therefore, helped in collecting the desired amount of data required to carry out our research work. In our research, the data collection is done by framing practices of green packaging practices in logistics by different logistics companies of the oil and gas sector in the northern region of India as responses. At the time of the research, a total of 45 companies were listed and empaneled under logistics services working for the select company of the Indian manufacturing sector.

#### **5. Conclusion and Future Scope**

The relevant conclusions and meaningful recommendations are associated with good quality research. Conclusions should be in relation to the various objectives of the study, which makes the research relevant. This study is about green logistics practices for green logistics practices in the context of the Indian Manufacturing Industry (Oil and Gas sector).

Green logistics highlights various practices followed to reduce the environmental problems of logistics operations, especially related to greenhouse emissions, transportation, packaging, warehousing, and to achieve sustainability among the economy, environment, and society. As the contribution of the manufacturing sector in the growth of the Indian economy, the need for research to motivate the Indian manufacturing enterprises towards adapting the procedures of green logistics in the greater interest of the global ecological framework. The study included four parameters of practices for green logistics activities, namely green logistics transportation, green logistics warehousing, green logistics packaging, and green logistics value-added services. The first practice is green logistics practices, which are one of the most important activities of logistics, as discussed in the literature review chapter 2. There are eight critical activities considered in this study for Green logistics transportation and thus analyzed to know the rank on the basis of importance (Table- 5.3). The respondents rated the '*Optimization of the Routes*' as the

most important Transportation practice for green logistics with a mean value of 4.8707. Findings reveal that the route of transportation should be optimized so that neither the fuel nor the time is wasted. The respondents rated 'GLPT-6 Backhauling' as the second most important transportation practice with a mean value of 4.8017. Backhauling aims at increasing the resource utilization of logistics companies by as it converts empty miles into revenue-generating miles. Thus companies should focus on the reduction of empty trucks. Therefore the recommendations suggested by the research say that the logistics companies should focus more on the 'Optimization of routes' and 'Backhauling' during transportation activities of logistics. The next practice discussed is green logistics warehousing, and ranking of six critical parameters are considered in this study and thus analyzed based on importance. The respondents rated 'GLPW2 Clean Material Handling' as the most important Warehousing practice for green logistics with a mean value of 4.3103. This suggests that logistics companies should start using better and cleaner material handling equipment in the warehouse. This is followed by 'GLPW-6 Low Carbon storage' ranked as second and the most important practices, with the mean value of 4.3017. In the category of practices, the next is *green logistics packaging*, as packaging also generates a large amount of waste in the environment and thus is an important green logistics practice. The respondents have ranked 'GLPP-4 Environmental Messages on the packaging' as the most important packaging practice for green logistics with a mean value of 4.1724. The findings show that the packaging practice of writing messages and quotes related to the environment and thus informing the customers about the environment should be focused upon as important green logistics practices. There are various important activities of Logistics that come under the domain of Value-added services. These are not direct logistics activities, but they are associated activities that, if carried out, will improve the green effect of Logistics.

Although the identification and ranking of green logistics practices seem very advantageous the implementation of these practices in the manufacturing sector is not always easy and obvious. The conviction of shifting to green practices in the logistics activities appears to be cumbersome for a few activities. To do this, as a future scope it would be beneficial to do inferential study by relating and analyzing the performance parameters with the practices which would ease the implementation of these green practices.

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