Exploring Initiatives to Measure and Reduce Carbon Footprints Across Indian FMCG Supply Chain

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Abstract

The present paper describes an empirical analysis conducted over the supply chains of some Indian FMCG companies with the objective to assess the extent of initiatives towards measuring and reducing carbon footprints throughout the supply chains. The Indian FMCG sector is the fourth largest sector in the economy with an estimated size of Rs. 1,300 billion, which has shown significant annual growth of about 11% per annum over the last decade.

In order to reduce the overall carbon footprints of industry and thereby minimise the generation of greenhouse gases so as to address climate change, this research is intended to identify the initiatives to reduce carbon footprints throughout the integrated supply chains of FMCG companies, which pervade all strata of society and all verticals of industry.

Collecting the data over the supply chains of five major FMCG companies in India, the research carried on a data analysis coming up with the conclusion that in the current landscape there are significant initiatives to reduce carbon footprints in the areas of inbound logistics and production. The initiatives on outbound logistics, storage & distribution, and packaging are still not significant enough. However, the system of measuring the carbon footprints, if implemented, would significantly achieve reduction of carbon footprints in all of the five areas considered: inbound logistics, production, outbound logistics, storage & distribution, and packaging logistics.

Keywords: Carbon Footprints, Fast Moving Consumer Goods, Supply Chain, Indian

Introduction

As observed by market analysts of Indian industry, the Indian FMCG sector constitutes fast-moving consumer goods (FMCG) which are products that are sold quickly and at relatively low cost. Examples include non-durable goods such as soft drinks, toiletries, and grocery items. Though the absolute profit made on FMCG products is relatively small, they are generally sold in large quantities, and so the cumulative profit on such products can be substantial (Pricewaterhouse Coopers, 2013).

The Indian FMCG sector is the fourth largest sector in the economy with an estimated size of Rs. 1,300 billion. The sector has shown an average annual growth of about 11% per annum over the last decade. Unlike the developed markets, which are prominently dominated by few large players, India's FMCG market is highly fragmented and a considerable part of the market comprises of unorganised players selling unbranded and unpackaged products. There are approximately 12-13 million retail stores in India, out of which 9 million are FMCG kirana stores (Vohra, 2013).

India's FMCG sectors' significant characteristics can be listed as strong presence of multinational companies, well established distribution network, intense competition between the organised & unorganised players, and low operational cost. Easy availability of important raw materials, cheaper labour costs and presence across the entire value chain gives India a competitive advantage (Vohra, 2013).

Mushrooming Indian population, particularly the middle class and the rural segments, presents the huge untapped opportunity to FMCG players. Growth is also likely to come from consumer 'upgrading' in the matured product categories like processed and packaged food, mouth wash etc. A distinct feature of the FMCG industry is the presence of international players through their subsidiaries (HLL, P&G, Nestle), which ensures innovative product launches in the market from their parent's portfolio.

Our country has a varied agro-climatic condition which enables to offer extended raw material base suitable for many FMCG sub-sections like food processing industries etc. India is the one of the major producer of livestock, milk, sugarcane, coconut, spices and cashew and is the second largest producer of rice, wheat and fruits & vegetables. Similarly, India has an abundant supply of caustic soda and soda ash, the chief raw materials required in the production of soaps and detergents, which enables the household section of the industry to excel and grow. The accessibility of these raw materials gives India the locational advantage.

Labour cost in India is amongst the lowest in emerging Asian countries. Easy raw material availability and low labour costs have resulted in a lower cost of production. Many multi-nationals have set up large low cost production bases in India to outsource for domestic as well as export markets.

FMCG sector caters to consumers at the very bottom of the economic pyramid and hence is directly affected by various demographical and geographical factors persisting in a country. A clear distinction can be observed based on the culture, geographical, political, and social conditions of a nation. FMCG sector strategies work differently in developed, developing and under developed economies (Prahalad & Hart, 2002).

India being a highly populous country with utmost diversity is a case of challenge for FMCG firms. The major factors the FMCG industry needs to be aware of are discussed below (Anderson & Billou, 2007).

Availability

One of the biggest challenges of serving consumers is to ensure availability of products and services. Unlike in the developed world, distribution channels in India is fragmented or non-existent and the task of simply getting products to people can be a major hurdle to overcome. Consider the challenge facing companies wishing to target low-income consumers in India's 627,000 villages, which are spread over 3.2 million square kilometres. In many parts of the country, roads are little more than rutted dirt tracks and in the monsoon season these can be literally washed away. In the north, roads to isolated villages cut across snow-covered mountain passes that can be closed for weeks at a time. The time to cover even small distances under such conditions can be long, stretching supply chains and adding cost. So, while there might be a market of more than 700 million poor Indians, delivering goods and services to them is not easy.

Global fast-moving-consumer-goods company Unilever believes that poor countries could well hold the key to the company's long-term profitability. The company anticipates that by 2010, half of its sales will come from the developing world, up 32 percent from at the turn of the millennium. Hindustan Unilever Ltd, the giant of India's US$13.8 billion consumer goods market, is a model for that shift and has spent years developing a distribution system which enables its products to reach even the most isolated BOP consumers. To access far-flung towns and villages, Hindustan Unilever distributors use auto rickshaws, bullock carts, and even canoes.

Affordability

The second hurdle to overcome in serving BOP (bottom of pyramid) consumers is to ensure that products or services on offer are affordable. BOP consumers have low disposable incomes and products may also need to match the cash-flows of customers who frequently receive their income on a daily rather than weekly or monthly basis. Two-thirds of Indian villagers are in the bottom income band, making them acutely sensitive to price, and more than two-third of their income is typically spent on food. Other products such as soaps, scents, shampoos and even telecommunications services must be purchased with the meagre income that is left over. In India, companies such as Procter & Gamble and Unilever served the poorest segments with fast-moving consumer goods, by developing low-priced micro-packs for daily necessities such as shampoo, soaps, cigarettes and food. While these "sachets" did not represent the most economical way of purchasing goods, they met the needs of consumers in terms of low purchase price

Acceptability

The third challenge in serving BOP markets in developing countries like India is to gain acceptability for the product or service. Therefore, there is a need to offer products and services that are adapted to the unique needs of both customers and distributors. Because of lack of electricity and refrigerators in many of its markets in the developing world, Coca-Cola provides simple ice-boxes to help its distributors keep products cool. Considering the hair grooming habits followed by Indian women, HLL decided to create a cheap general-purpose soap with special ingredients for healthy hair. The highly successful new soap was called Breeze 2-in-1, and distribution was targeted at smaller towns and rural areas.

Industry and Carbon Footprints

Industry has observed that we are moving from a world of abundant, cheap energy to a world of limited and expensive energy (Hartmann, 2004). A major part of the energy that powers industry today, and therefore their supply chains as well, is based in fossil fuels, whose supply is finite and availability will be a challenge.

In addition to the shortage of energy availability that lie ahead, industry is also facing growing evidence that we are entering an era of potentially extreme climate change. As observed by the Intergovernmental Panel on Climate Change (2007), "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea levels."

Analysing the impacts of climate change, scientists have hypothesized a wide range of potential effects, such as increased flooding and coastal erosion, reduced quality and quantity of drinking water and food supplies, increased frequency and intensity of storms and wildfires, increased animal and plant species extinctions, and increased destruction of natural ecosystems (Beamon, 2008).

In recent times, Asia has witnessed a phenomenal economic growth. New industries have risen and populations and incomes have increased. However, along with this development, demand for energy, transportation needs, and land use have increased in an unprecedented way, accelerating fossil fuel use and deforestation. These features have put a tremendous burden on the environment and must have surely contributed significantly to climate change. In other words, Asia is "fast becoming a major source of GHG emissions" (ADB, 2007).

Recent studies have shown that a major part of world's manufacturing will be carried out in the Asian region in the next couple of decades (sector-based public policy in the Asia-Pacific region, US-AEP, 1999). This could be because of a variety of reasons such as proximity to raw materials, proximity to huge markets, economic cost considerations of labour, and a perceived lack of rigidity in the regulatory structure requiring strict compliance to environmental norms. Since Asia is bound to have a substantial contribution in this manufacturing process, because of the presence of numerous multinational companies and other large organisations in this region, it becomes very important that this manufacturing process employed in these companies be sustainable and GHG free. There is even another trend observed in this region. A large part of the manufacturing required to produce the products and services in the large corporations is now getting subcontracted to their suppliers who carry out the manufacturing and packaging, with the parent company only acting as the quality check and the marketing arm. Thus for overall sustainability and greening of industry, which heavily depends on making all operations GHG free, it is of utmost importance that companies as well as their associated supply chains carry out the initiative to measure and reduce their carbon footprints (Rao, 2002).

In order to control and limit the GHG emissions in all industries operating in the country, or reduce the carbon footprints emanating from all segments associated with the industry and its supply chains, measuring of carbon footprints across all operations appears to be a workable and integrative approach to address climate change.

One of the key reasons which have been widely accused of contributing exponentially to global warming are "industries" involved in fossil-fuel consumption in industrial chimneys, thermal power plants, manufacturing processes, and vehicular transportation. These factors indicate that the role of industries now would be towards taking up initiatives to sustainable development, so as not to add to the already existing climate change (Bhushan, Zanwar, Jain and Rao, 2017).

Industry now would need to act as catalyst for activity and commitment to the climate change cause, take responsibility for innovative GHG capturing plants with better and improved design for energy efficient technology, free of GHG emissions, and lead, promote and campaign for organisations and individuals to be involved in public work towards preventing the perils of climate change (Halady and Rao, 2010).

Because the FMCG sector overlaps all strata of Indian consumers and the associated markets it becomes extremely important for the country to limit the carbon footprints generated by this sector all across its operations. Increasing greenhouse gaseous concentration in the atmosphere is perturbing the environment to cause grievous global warming and associated consequences. Following the rule that only measurable is manageable, mensuration of greenhouse gas intensiveness of different products, bodies, and processes is going on worldwide, expressed as their carbon footprints.

FMCG Supply Chain and Carbon Footprints

A supply chain in any industry can be characterised as the production of raw materials, their transfer to and through various processing steps, and finally the final product shipping and receiving. Each step requires a review of combustion/ energy emissions, waste disposal emissions, transportation energy costs and emissions, and packaging related emissions. It's not enough to simply reduce the energy we use. Organisations must reduce carbon emissions across the supply chain. All organisational activities have some direct or indirect impact on the firm's carbon efficiency. This makes enterprises become environmentally sustainable. Unlike conventional supply chains, such supply chains are designed to ensure that value creation, rather than risk and waste, accumulates at each step, from design to disposal and recovery.

In order to reduce carbon footprints in the industry, traditional energy efficiency and carbon management initiatives consider the operations of a single company or even single location. In comparison, the supply chain approach goes beyond a single-focus initiative and adopts an integrated approach to cover specific processes from multiple sites and multiple companies participating in a single supply chain. This allows the full carbon footprint for each product to be created.

This integrated methodology considers life-cycle analysis techniques (LCA) often used in industry for sustainability initiatives. The United Nations Environment Programme (UNEP) describes LCA as "…the process of evaluating the effects that a product has on the environment over the entire period of its life cycle… extraction and processing; manufacture; transport and distribution; use, re-use and maintenance; recycling and final disposal".

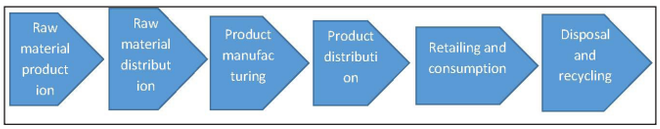

Fig. 1: Different Stages of Industry Supply Chain where Carbon Footprints Need to be Measured

Source: Carbon Footprints in the Supply Chain, the Next Step for Business, https://www.carbontrust.com/news/2013/04/make-business-sense-of-scope-3-carbon-emissions/

Carbon footprints in FMCG are the total set of greenhouse gas emission caused at various steps in supply chain. This process in a supply chain encompasses best practices in reducing carbon emissions across the supply chain, from materials sourcing through product design, manufacturing, distribution, delivery and finally, end-of-life recycling. Typical supply chain management requires organisations to optimise various metrics ranging from costs, levels of service, inventory levels and more. Organisations that pursue a green model of business must be mindful of CO_2 emissions in their operations. The basic steps in a SCM are transformation and transportation. At each step, there is carbon generation. Figuring out ways to make plants and distribution sites more energy efficient and to decrease distance in transportation network can help to achieve two goals - a leaner, more cost-effective supply chain and a reduced carbon footprint.

The integrated supply chain which will achieve a reduction in carbon footprint, will emphasize renewable fuel sources, as non-renewable sources become more scarce and expensive. There are many different technologies being forwarded for different applications, including those based on hydrogen, solar, wind, and ethanol.

However, renewable sources of energy often have some significant barriers to be used widely in supply chain as well as in industry in general. Using solar energy is still relatively expensive (though prices are expected to fall) and solar cells still currently require fossil fuels to

manufacture. Hydrogen power is challenging to produce efficiently on a large scale, difficult to store, and difficult to transport (Wise, 2006). While wind power is clean, its cost remains relatively high for the resultant (and often intermittent) power output (Steffen, 2006). If and when these and/or other alternative fuels become scalable and cost-competitive, they will play critical roles in powering future supply chains (Beamon, 2008).

Some green supply chain initiatives taken by a FMCG companies in India (Mazumder and Chatterjee, 2007):

- On the warehousing front the warehouse contractors are advised to work on better insulations of walls of the warehouse so that it leads to less energy consumption.
- Replacing the lighting systems with energy efficient lights. LEDs, smart and movement sensing lighting systems can lead up to energy savings of 90%.
- Since transportation is a major cost component in the overall logistics cost of a FMCG company, organisations are working on improving the fuel efficiency of the trucks. They are trying to reduce the idling time of trucks on transit. They are working on pickup strategies of trucks while delivery.
- A paper and packaging conglomerate has taken a step further wherein they have been engaging local communities to grow trees according to the demands of the local ecosystem which they later consume in their paper and packing plants.
- A major foods company begins using spent coffee grounds and biogas from wastewater to fuel its boilers and enlists its entire supply chain to reduce energy consumption and cost within a global logistics initiative.

Thus, when the company would optimise the whole supply chain and not some its parts, the value delivery of the supply chain will be greatly enhanced in terms of tangible and intangible social and environmental benefits and also address major issues such as climate change.

There are many reasons why industry sectors should be involved to address climate change related initiatives. Throughout their past operations industry has generated huge amount of greenhouse gases that contributed to global warming/climate change. Not only do corporations have a significant climate footprint, but the impact of climate change on their own business landscape as well as on society and communities at large, has been noticeable (Patenaude, 2011). Through their production process using coal and other non-renewable fossil fuels, unlimited use of scarce resources like water and electricity, using huge industrial appliances that generate GHGs, non-renewable lighting, transportation & distribution systems which generate greenhouse gases, corporations in the private sector have been a major cause of global warming and climate change, whose effects are being felt today. Thus it is of utmost importance that private sector organisations develop awareness and take up initiatives to use industrial activities which minimise the generation of GHGs and do not further enhance the effects of climate change any more (Rao, Pulupudi, & Sen, 2017).

In the past, companies were solely motivated by profit making strategies and a very little care was taken for society, environment and community, but with changing market, increasing competition, and increasing awareness among the people, CSR (corporate social responsibility) comes in light which involves every responsibility an organisation should have for society, community, environment and customers. According to Moir, (2001) CSR is a term defined as the responsibility of an organisation for its workplace, people, ethics, human rights, society, marketplace, and environment. In the recent scenario this comprises very critical assets for any business to run in this.

It is clear that consumers, in tandem with governments and even investors, expect companies to become more environmentally conscious. A recent survey conducted by the Economist Intelligence Unit, was designed to show the increased level of awareness as well as the operational changes taking place as more companies go 'green'. According to the survey, 52% of the companies report that they are implementing some form of green-minded supplier qualification. An additional 39% say that they have plans in the near future.

There are currently two key fundamental business drivers for FMCG brands to address carbon management (Waller, 2016).

1. Cost Reduction: Information on the carbon emissions of suppliers can constitute a good indicator of the efficiency of that supplier, particularly when compared between competitors. This provides a useful negotiating tool in driving down the costs of suppliers that may be capable of improvements in production efficiency,

thereby increasing business margins and minimising the supply chain emissions for the FCMG brand.

2. Market Differentiation (From mind share to heart share to planet share): As a result of measuring and reporting carbon emissions, FMCG brands can differentiate themselves and their products in the marketplace from those not providing such information. This creates a new and unique angle to drive sales particularly in areas where customers are increasingly concerned with sustainability impacts.

Keeping the above two drivers in mind the current research focuses on identifying company Initiatives to reduce carbon footprints across different phases of FMCG supply chains and also determine what would enable these initiatives to be implemented so that reduction of carbon footprints is actually achieved in such FMCG supply chains.

In the research model, it is hypothesized that awareness to measuring the carbon footprints across supply chain might lead to implementation of actual initiatives to reduce the carbon footprints. The importance of using systems to measure organisational performance has long been recognised in the field of operations management. Melnyk, Stewart, and Swink (2004) emphasise that any performance measurement system or "metrics" provide the essential links between strategy, execution, and desired performance within an organisation. Though the development of measuring procedure has proven to be a challenge, companies still have a great opportunity to use them to measure what they are doing, and to identify gaps between actual performance and the desired standards.

Research Model and Definitions of Variables/Constructs

Our research model intends to (1) assess and measure the initiatives to reducing the carbon footprints in FMCG supply chain, (2) assess if measuring of carbon footprints is indeed happening, and (3) determine if the initiative to implementing measuring systems actually lead to the reduction of the carbon footprints. The constructs we intend to use for this are:

Initiatives to Reduce Carbon Footprints in Inbound Logistics

Procurements from suppliers and sourcing play a role in reducing carbon footprints in the supply chain. Purchasing from suppliers who are energy efficient, who use organic fertilisers, and use recyclable materials and materials that are biodegradable and use more energy-efficient processes and less toxic material will reduce carbon footprints.

This construct encompasses carbon footprint contribution of varied raw materials used, investing on transportation of raw materials from suppliers to the company to reduce carbon emissions, working in collaboration with suppliers to reduce carbon emissions etc.

Initiatives to Reduce Carbon Footprints in Outbound Logistics

This construct encompasses initiatives such as investing on transportation of products from company to retailers/ consumers to reduce carbon emissions, measuring carbon emissions from various modes of transportation, planning out the usage of each vehicle to its best in back and forth trip in terms of capacity and technology used with the intention of reducing carbon footprints.

Initiatives to Reduce Carbon Footprints in Production or Internal Logistics

There are many ways to reduce carbon in a manufacturing plant. A closer look at the power source is an excellent start. For example, two plants that consume the same amount of energy may have completely different carbon footprints. That's because one uses hydro-generated electricity while the other operates with coal-generated electricity. Looking beyond the source of energy, there are ample opportunities to reduce consumption. How is water consumed as a resource throughout the production stages? How efficient are your plant layout and production plans? How much inventory is produced in excess of what's needed? Streamlining production steps and reducing toxic materials and harmful emissions can each have a significant impact on how green the supply chain is. This is done by implementing Zero Emission Strategy and complying to Six Sigma methodology etc.

Thus, the initiatives considered under this construct comprise company initiatives such as using carbon efficient techniques implemented in production line, using alternative/ renewable sources of energy deployed, ensuring regular maintenance of machineries, efficient boilers etc.

Initiatives to Reduce Carbon Footprints in Storage/Distribution Centres

The operations involved in storage of FMCG goods is an integral step in supply chain and attributes to the carbon footprints calculation and greenhouse emission. For example, if the storage included chilling the goods, we can calculate the emissions caused over that period of time and attribute the corresponding amount of emissions to those goods. Before leaving the distribution centre, the goods get disaggregated into cases and those cases and shipped to different retailers. The cases may have differing footprints from this point because, for example, of the different transportation distances and the different cooling time. A distribution centre failure generates extra distances for delivery of goods which in turn leads to extra costs and also high carbon emissions in transportation. It is proposed that the location of additional storage capacities should be in the vicinity of existing production facilities and also production capacities should be concentrated. This shall reduce the carbon emissions to a great extent.

Initiatives to Reduce Carbon Footprint in Packaging

Large packages take more energy to produce. Larger the package, the less shipment consolidation is possible. Fortunately, new packaging materials and designs make smaller package volumes possible while providing the same level of strength and product protection. Improved package designs like using biodegradable substances to package will also reduce overall carbon footprints. "(Exploring the Green Supply Chain management: A Technical Review, 2013)".

Initiatives to Measuring of Carbon Footprints

If we cannot measure, we cannot reduce. Measurability refers to carbon labelling each product with an estimate of the total amount of Carbon emitted across its supply chain, from raw material source to final point of sale or use. This information will help the elements in supply chain to be aware about the products' carbon intensity and can aggregate the emission eventually. Measurability is largely based on techniques developed within the field of life cycle assessment to collect energy and greenhouse gases emissions data. Particularly for energy-intensive stages across the supply chain we can construct a mass balance for the supply chain to ensure that all raw materials, waste, energy and emissions are accounted for, and finally calculate the carbon footprint of a product supply chain. "(Consumer Buying Behaviour toward Carbon Labelling (FMCG) in Tesco Supermarket, 2012)".

Research Question

The research question to be pursued in this empirical exercise was to assess to what extent FMCG companies:

(1) implement the initiatives to reducing the carbon footprints in FMCG supply chain.

(2) implement measuring of carbon footprints.

(3) determine if the initiative to implementing measuring systems actually do lead to the reduction of the carbon footprints in Indian FMCG companies.

The constructs used in the proposed conceptual model are:

(1) initiatives to reduce carbon footprints in inbound logistics.

(2) initiatives to reduce carbon footprints in production/ internal logistics.

(3) initiatives to reduce carbon footprints in outbound logistics.

(4) initiatives to reduce carbon footprints in storage/ distribution centres.

(5) initiatives to reduce carbon footprints in packaging.

(6) initiatives to measure carbon footprints.

The individual variables (items in the questionnaire) comprising each construct were as follows:

Construct 1: Initiatives to Reduce Carbon Footprints in Inbound Logistics

(1) My company checks the carbon footprint contribution of the varied raw material sources used.

(2) Company has done suitable investment on transportation of raw material from suppliers to the company to reduce carbon emission.

(3) Company works in collaboration with suppliers to reduce the overall carbon emissions.

(4) Company switches to different modes of transport when sourcing goods based on carbon emission.

(5) Company uses streamlining transshipment and logistics from suppliers to reduce carbon emission.

Construct 2: Initiatives to Reduce Carbon Footprints in Production/ Internal Logistics

(6) Company uses carbon efficient techniques implemented in production line.

(7) Company uses alternative sources of energy deployed (renewable sources).

(8) Implementing the 3 R's (reduce/ reuse/ recycle).

(9) Company is adapting ISO 14000 to streamline activities.

(10) Company is ensuring that natural light is used where possible in order to reduce demand for lighting.

(11) Company is ensuring regular maintenance of machineries.

(12) Company is using efficient boilers.

(13) Company is carrying out regular energy audit to identify where it is being lost.

Construct 3: Initiatives to Reduce Carbon Footprints in Outbound Logistics

(14) Company has done suitable investment on transportation of raw material from company to retailers/consumers to reduce carbon emission.

(15) Company measures carbon emission from various modes of transportation- road, rail, ship.

(16) Company plans the usage of each vehicle to its best in back and forth trip in terms of capacity and technology used to run the vehicles.

(17) Company initiates optimising transportation to customers/retail stores.

Construct 4: Initiatives to Reduce Carbon Footprints in Storage/ Distribution Centres

(18) Using efficient sorting system reducing carbon footprints.

(19) Using transportation system integrated with suitable storage.

(20) Implementing cross docking (minimising storages between stages in logistics).

(21) Using conditioning techniques (freezing, cooling).

Construct 5: Initiatives to Reduce Carbon Footprints in Packaging

(22) Company uses of eco-friendly materials for packaging goods.

(23) Company measures the energy involved in packaging large sizes of goods.

(24) Company measures the wastage involved in packaging goods.

(25) Company uses recyclable products for packaging goods.

(26) Company uses suitable investment in using packaging materials emitting less carbon gases.

(27) Company uses equipment for packaging which are fuel-efficient and eco-friendly.

Construct 6: Initiatives to Measure Carbon Footprints

(28) Company uses good techniques available to collect energy and greenhouse gases emission data.

(29) Company considers it convenient to measure the carbon footprints.

(30) Company finds cost incurred to measure the greenhouse gases emission is low.

(31) Company finds that it is easy to record the greenhouse gas emission at each phase.

(32) Company finds it convenient to measure carbon footprints of individual raw materials.

(33) Company finds it feasible to change the process if there is high greenhouse emission.

(34) Company finds it is good to label the total carbon footprint in final product sold to end customers/ retail stores.

Using these six constructs, the following hypotheses were set up.

H1: There is significant initiative to reduce of carbon footprints in inbound logistics in FMCG supply chain.

H2: There is significant initiative to reduce of carbon footprints in production/ internal logistics in FMCG supply chain.

H3: There is significant initiative to reduce of carbon footprints in outbound logistics in FMCG supply chain.

H4: There is significant initiative to reduce of carbon footprints in packaging related activities in the FMCG supply chain.

H5: There is significant initiative to reduce of carbon footprints in storage & distribution related activities in FMCG supply chain.

H6: There is significant linkage from measuring of carbon footprints to each of the above five constructs.

Using the variable definitions as explained above, the following conceptual framework was postulated for H6 which would need to be validated through empirical analysis subsequently.

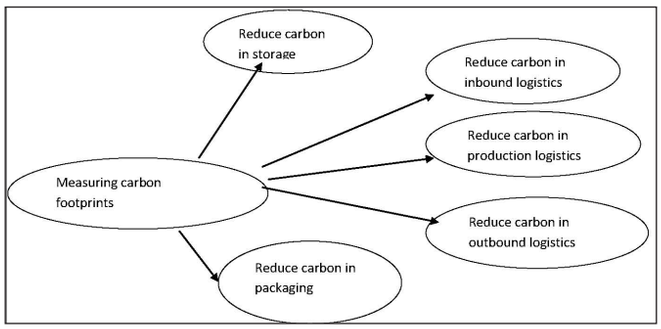

Fig. 2: Conceptual Framework for H6 with Six Constructs

Data Collection Methodology

The variables which the research intended to measure were defined above in the theoretical context and these needed to be identified in the context of managing carbon footprints. Thus, the research aimed to study the FMCG companies currently involved in extensive supply chains by conducting exhaustive surveys using questionnaires and possible in-depth interviews. Based on the sample data collected the ways to reduce the greenhouse gas emission would be identified, simultaneously maintaining the efficiency also in supply chain operations..

Data Collection and Sample

As part of the data collection, secondary data was assimilated by reviewing reports, following forums and scanning though the literature available. Thereafter a questionnaire was developed to use while conducting the survey. For the primary data it was proposed to conduct manual survey of at least 50 managers and employees with a good experience in supply chain operations and management of 5 FMCG companies. Totally 54 respondents were surveyed. These respondents were working in the FMCG organisations with a good experience in supply chain operations. The organisation considered are ITC, Dabur, Cavin Kare, and Cadbury.

90% of our respondents lie in age group 22-35, and 10% in 35 -58. The annual income distribution lies as 42% with Rs. 6-9 lakh while 58% > Rs. 9 lakh.

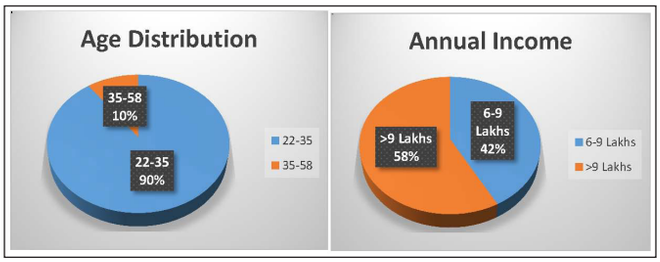

Fig. 3: Distribution of Age and Annual Income

Results from Data Analysis

Results on Extent of Initiatives to Reduce Carbon Footprints on Five Constructs

Cronbach's Alpha

From the data collected on 54 respondents, the empirical research first computed the Cronbach's alpha for the

constructs relating to reduction of carbon footprints in the inbound logistics area, production area, outbound logistics area, storage/ distribution area, and packaging area. The value of Cronbach's alpha would indicate whether the variables under each construct would measure similar themes.

Table 1: Cronbach's Alpha of Constructs

Construct	Cronbach's alpha
Reduce carbon footprints in inbound logistics	0.776
Reduce carbon footprints in production/ internal logistics	0.716
Reduce carbon footprints in outbound logistics	0.560
Reduce carbon footprints in storage/distribution centres	0.806
Reduce carbon footprints in packaging	0.786

The Cronbach's alpha levels were quite high with the exception of its value for outbound logistics. However, the level was still acceptable because > 0.5.

Descriptive Statistics to Assess the Significance of Initiatives Existing to Reduce Carbon Footprints in the Five Areas

First, the mean levels obtained for the five constructs were considered (rated on a 5-point scale, strongly disagree, disagree, neither agree nor disagree, agree, strongly agree). Tables 2 and 3 provide these results.

Table 2: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
inboundcarbon	54	2.7222	.83866	.11413
productioncarbon	54	2.7546	.91178	.12408
outboundcarbon	54	2.5494	.70683	.09619
storagecarbon	54	2.6605	.83300	.11336
packagingcarbon	54	2.6620	.78331	.10660

Test of Mean for Each of the Five Constructs

Next, a one-tail t test was conducted with a test value of 2.5 (higher than disagree).

Table 3: One-Sample Test

	Test Value = 2.5					
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
inboundcarbon	1.947	53	.057	.22222	-.0067	.4511
productioncarbon	2.052	53	.045	.25463	.0058	.5035
outboundcarbon	.513	53	.610	.04938	-.1435	.2423
storagecarbon	1.416	53	.163	.16049	-.0669	.3879
packagingcarbon	1.520	53	.134	.16204	-.0518	.3758

Thus, the initiatives to reduce carbon footprints in the production area exist significantly at 5% level of significance.

The initiatives to reduce carbon footprints in the inbound area exist significantly at 6% level of significance.

The carbon reducing initiatives at other areas are not significant.

For the measuring of carbon initiatives, Tables 4 and 5 give the mean level and t-significance (with a test value of 2.5).

Table 4: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
measuringcarbon	54	2.5037	.68376	.09305

Table 5: One-Sample Test

	Test Value = 2.5					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
measuringcarbon	.040	53	.968	.00370	-.1829	.1903

Thus the measuring of carbon footprints is not significant at all, implying the FMCG companies are not measuring carbon footprints in their supply chains.

Thus the hypotheses H1 and H2 are supported. H3, H4, H5 are not supported at all.

Results Relating to Validating H6: There is Significant Linkage from Measuring of Carbon Footprint to Each of the above Five Constructs

Regression Analysis between Measuring Carbon Footprint and Each of the Five Constructs

In order to assess the link between carbon measuring initiative and actual reduction of carbon footprints a series of regression analysis was conducted to see which independent/ predictor variables such as measuring carbon footprints significantly correlated with a chosen dependent variable such as reduction of carbon footprints in the inbound area. Five different regression models were used to validate each of the five hypotheses. The dependent variables for each of them are presented in Table 6. The independent variable was the same for all five runs.

Table 6: Dependent Variables

Independent Variable	Dependent Variable	R	F-significance	Beta	constant
Measuring carbon	Inboundcarbon	0.617	0	0.757	0.827
Measuring carbon	Productioncarbon	0.505	0	0.673	1.07
Measuring carbon	Outboundcarbon	0.695	0	0.718	0.752
Measuring carbon	Storagecarbon	0.578	0	0.704	0.899
Measuring carbon	Packagingcarbon	0.644	0	0.738	0.814

The above series of regression analyses shows that the initiative of measuring carbon footprints would significantly and positively impact the carbon reducing initiatives at inbound logistics area, production, outbound logistics, storage & distribution, and packaging areas, at 1 % level of significance.

Interpretation of Results

From the descriptive analysis, one may observe that Indian FMCG companies have initiated significant efforts to reduce carbon footprints in their production area and in the inbound logistics area. As companies commit to reduce the carbon footprints of the products and services they provide, they invariably look to their suppliers to align their efforts with the company's sustainability goals.

As observed by EPA (United States Environmental Protection Agency), more than three quarters of the greenhouse gas (GHG) emissions associated with many industry sectors come from their supply chains (EPA, 2010). For that reason, a growing number of leading FMCG companies all over the world, are engaging their suppliers about managing GHG emissions. The US federal government is putting in efforts to do so, as it responds to Executive Order 13514 - Federal Leadership in Environmental, Energy and Economic Performance - issued by President Obama in October 2009. This order calls for all federal agencies to measure and reduce the GHG emissions associated with their own operations and also seeks to reduce the carbon impacts of the products and services that agencies purchase from vendors and contractors. The US government too is taking initiative toward engaging key suppliers within its supplier base by encouraging the suppliers to measure and report their GHG emissions, with the view of incorporating emissions.

Also, it is well known that customers of major manufacturing companies do not distinguish between the company operations and their supply chains. Perhaps because of this notion major companies in our country are making a significant effort to engage their suppliers in the inbound logistics in addition to make their own operations GHG free.

This is the exact result which has emerged in our data analysis, that FMCG companies are indeed putting in significant efforts to reduce carbon footprints in their production and inbound logistics.

As far as initiatives to reduce carbon footprints in outbound, storage and packaging areas are concerned, the initiatives are still not significant enough but one may only hope that here also the reduction initiatives would get implemented, without which the integrated supply chain cannot be GHG free.

For the second part of the data analysis, one observes that there exist significant positive linkages between implementing a system of measuring the carbon footprints and actual reduction of carbon footprints in all five areas of concern in the supply chain which are inbound logistics phase, production, outbound logistics phase, storage & distribution, and packaging phase.

This finding validates the usefulness of measuring carbon footprints and urges all FMCG companies to implement the measuring, so that they are able achieve actual reduction of the carbon footprints in every phase of the supply chain, in its entirety.

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