CORPORATE SOCIAL RESPONSIBILITY AND CARBON AND WATER FOOTPRINT OF FOOTWEAR INDUSTRY

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Abstract : Some of the raw materials such as chemical based adhesives, chromium tanned leather, synthetic rubbers and plastics that are used in the footwear manufacturing are all harmful and potentials for global warming. The manufacturing and disposal of these materials release greenhouse gases, as well as toxic pollutants which can negatively impact human health and natural ecosystems. The scale of the footwear industry contributes to environmental problems significantly. The problems associated with footwear production and flux to the waste stream is expected to increase as the footwear industry grows progressively. The main objective of the study was to understand the carbon and water footprints of the footwear industry and how Corporate Social responsibility programs of the footwear companies can minimize the pollution of the ecosystem**.**

IndexTerms **- CSR, Carbon Footprint, Water Footprint, Footwear, manufacturing**

I. INTRODUCTION

In today's trade condition, successfully thriving of a business in economic terms is not enough. This is because of the fact that challenges related to sustainable development has come to the fore. The companies are expected to amalgamate both environmental and social concerns strategically in their day-to-day operations and in their relationship with various stakeholders apart from making profit and customer satisfaction so that they may be able to deal with the concerns raised for their sustainable development (Rathonyi et.al, 2015). The contribution of the economic factors in this regard could be to derive at a solution of the challenge imposed. The phrase 'Global warming' has raised serious concerns world-wide to the extent that people have now become aware of other concepts associated with it, termed as the 'Carbon Footprint' or 'Greenhouse Gas footprint (CHG)' and 'Water Footprint'. Many researches and studies are being made in this account on varied products and processes all over the world. Footwear industry is one of them. Since ancient ages, human beings have used footwear as a protective shield for the foot from accidents and infection.

The manufacturing process of the raw materials, that go into the making of footwear use plenty of chemicals, technology and biotechnology which have led to become a source of air, water and solid pollutants. Also, the functional life of a footwear is somewhat short and decreases gradually due to fast changes in consumer fashion trends and market. This generates a large cascade of footwear waste, which is often disposed by means of landfills. In order to protect the environment and attain sustainability, the corporates ought to feel responsible to find strategic solutions to the environmental and societal challenges that is created by the virtue of the processes they tend to follow (Vasilescu et.al., 2010). This responsible corporate behavior or Corporate Social Responsibility (CSR) has become a legal regulatory movement and this legal binding has created ripples of interest in academic research, public debates and entrepreneurial networks (Hedigar, 2010).

2. CORPORATE SOCIAL RESPONSIBILITY

The concept of corporate social responsibility is not new. Earlier its practice was more of philantrophic in nature. A significant exponent, the general definition of CSR as suggested by the World Business Council for Sustainable Development (WBCSD) is "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce" (WBCSD 2002). Hediger (2010) studied and analysed various explanations on CSR from business point of view and concluded that CSR was a means for the businesses to improve on its credibility and to enhance its reputation amongst the stakeholders and was no longer interpreted as a burden on the resources or as a wasteful activity (Holme and Watts, 2000). Hence CSR represents a world trade of globalization and stiff competition.

According to the European Commission (2001), while the companies generate profit out of the business, they should also volunteer their contribution to an unpolluted environment and healthier society by integrating CSR as a strategic investment in their vision, mission and objectives statements. The International Business Leaders Forum (IBLF) has taken the definition of CSR to a different dimension. The forum stresses on the term Corporate Social Responsibility as "*transparent practices on human rights issues, business standards, health and safety of the employees, education and leadership development, disaster relief and environment*". Certain authors like Waddock (2004) and Walker (2010) regard CSR to be a subset of company's responsibilities towards the community stakeholders and society in which it operates. There is a heavy pressure on the business to address and respond to social concerns and this has proved to be an influencing aspect in many modern business models. The other various definitions are also similar in the respect that a sustainable and healthy balance must be maintained between economy generation, environment and society by all corporates.

3. FOOTWEAR MANUFACTURING PROCESS

The footwear industry is considered as a diverse manufacturing sector due to wide variety of materials it employs to make product ranging from various types and styles of footwear to more specialised shoes. A single footwear may contain 65 discrete components, may require 360

processing steps for assembly and approximately 40 different types of materials might be suitable for use in the footwear manufacturing .The manufacturing process of the footwear industry begins like in all other industries, with the pre-production check on the raw material for its quality and quantity. In some cases even before the material arrives in the factory, it is checked for its compliance with set standards that had been agreed upon at the supplier's premises. Some of the various raw materials that are required for the shoe production are leather, synthetic or textile, fashion and functional accessories (buckles, zips, buttons, eyelets etc,)soles, threads, laces, unit boxes, cartons and other packaging matrerial, chemical solvents, adhesives amongst other products.

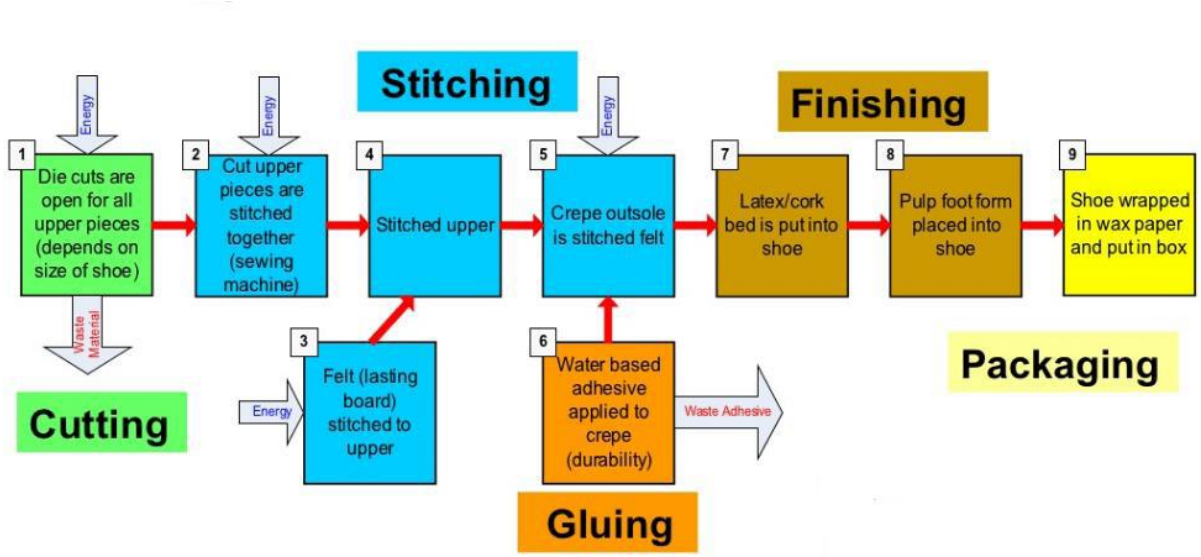


Figure1: Depiction of manufacturing of one style of footwear

The actual production process can vary from style to style, but for the sake of clarity general steps to the completion of the footwear is discussed as below:

a) **Cutting section:** After the designing of footwear and all the required patterns made, the leather /synthetic / textile materials as required are cut in the cutting section according to the patterns either by machine with the help of spring steel cutting dies or by hand with the tin made patterns, depending upon the required quantity of the footwear to be made. Leather can be cut both by hand or machine but as individual components . The cutting of synthetic and textiles, however can be done in layers and this process can only be done by machine. After cutting, stamping operation is done on the cut component for sizing and identifying it with article number. The cut components are checked for quality and then transferred to the second section called as closing or stitching.

b) **Closing or stitching section:** The received cut components undergo many processes like:
   i) Skiving: A process to remove substance of leather from the edges so that two components can be stitched together without creating bulkiness.
   ii) Rivetting: Punching in eyelets for tying laces
   iii)Topline treatment: Putting foam, cord or stiffner in those components that will form the top outline of the shoe.
   iv) Stitching: Attaching of components together so that the footwear upper takes the 2-dimensional shape. Brand logo is also attached here to the socks component.

   There are other operations in the closing department depending upon the style and requirement. The section uses elastics, tapes, reinforcement materials, nylon or polyester threads, adhesives both water based and chemical and some other synthetic materials in the process.

c) **Component section:** This comprises of all those components namely, sole (leather or synthetic), heel, insole, toepuff, counters etc., which is an integral part of footwear making but is a process that is independent. That means, all the components can either be manufactured inhouse or in an independent firm irrespective of any sequence of footwear manufacturing to be followed, except that these should be complete before the stitched upper is moved on to the next process called as lasting where all the components of shoes are assembled to give footwear the required shape.

d) **Lasting or assembly section:** All the components and the upper are assembled and the footwear gets its shape here in this section with the help of a mould called as last. The last is a standardized replica of a human foot and the footwear conforms to it. The processes here require elastomer adhesives, chemicals for treatment (wiping or halogenation) of the soles and the upper for proper attachment to each other when adhesive is applied to them, staples, tacks, nails and screws, heat (ranging between 90ºC to 250ºC) and steam of distilled water. Apart from this mechanical process like roughing and buffing is done on the lasted upper brfore adhesive application so that sole bonding takes place properly. These operations are done by rubberized or metal wires and emery paper respectively. After the soles are attached to the lasted upper, the whole shoe is either left to cool down under normal temperature or passed through a chilling machine having a temperature variance of -5ºC to -10ºC. This operation is also known as 'curing operation'.

e) **Finishing section**: Following the sequence, the complete shoe then proceeds to the finishing section. In this section, any minor faults that may have occurred during the whole process of conversion into a 3-dimensional footwear is rectified here with the aid of repairing crayon, wax and shoe polishes and finishes. The shoe mould or the last is taken off the shoes. After final quality checking of the pair, the shoe is then price tagged. Other usage, maintenance instructions are also tagged onto the shoes and finally the shoes are packed with waxy paper and put into a cardboard unit box. They are further packed inside corrugated carton boxes and sealed and packed ready for shipment to the customers' destination.

4. CARBON FOOTPRINT IN FOOTWEAR INDUSTRY

Carbon Footprint is defined as "A measure of the impact our activities have on the environment in terms of the amount of greenhouse gases we produce. It is measured in units of carbon dioxide" (timeforchange.org, 2018). The other gases that are emitted are measured in terms of carbon dioxide equivalent (CO_2e).

The global annual production of footwear is roughly 25 billion pairs of shoes or approximately34 million per day. The waste shoes are used either for landfilling or burnt. Also since they are non-degradable, they become a major source of environmental pollution and pollute the air (Cheah et al., 2013). Footwear manufacturing requires use of varied raw materials viz., leather, synthetic materials, rubber, textiles etc. The characteristics of the material that goes into the shoe manufacturing will vary. On a larger perspective, the average approximate composition of footwear materials are 25% leather , 6% textiles and fabrics , 7% polyurethane, 7% rubber, 14% ethylene vinyl acetate, 8% poly vinyl chloride, 16% thermoplastic rubber, metal 5% and some other minor components (Staikos et al., 2006). Various surveys and studies made concluded that on an average, one pair of running shoes produces approximately 14kg of CO2 emissions through its value chain. The materials procurement and manufacturing stages have the biggest environmental impact. Approximately 68 percent of the environmental burden is from the manufacturing stage. An average of approximately 65 parts are needed to complete one pair of shoes, and an average of approximately 360 manufacturing proces (Staikos et. al., 2007).

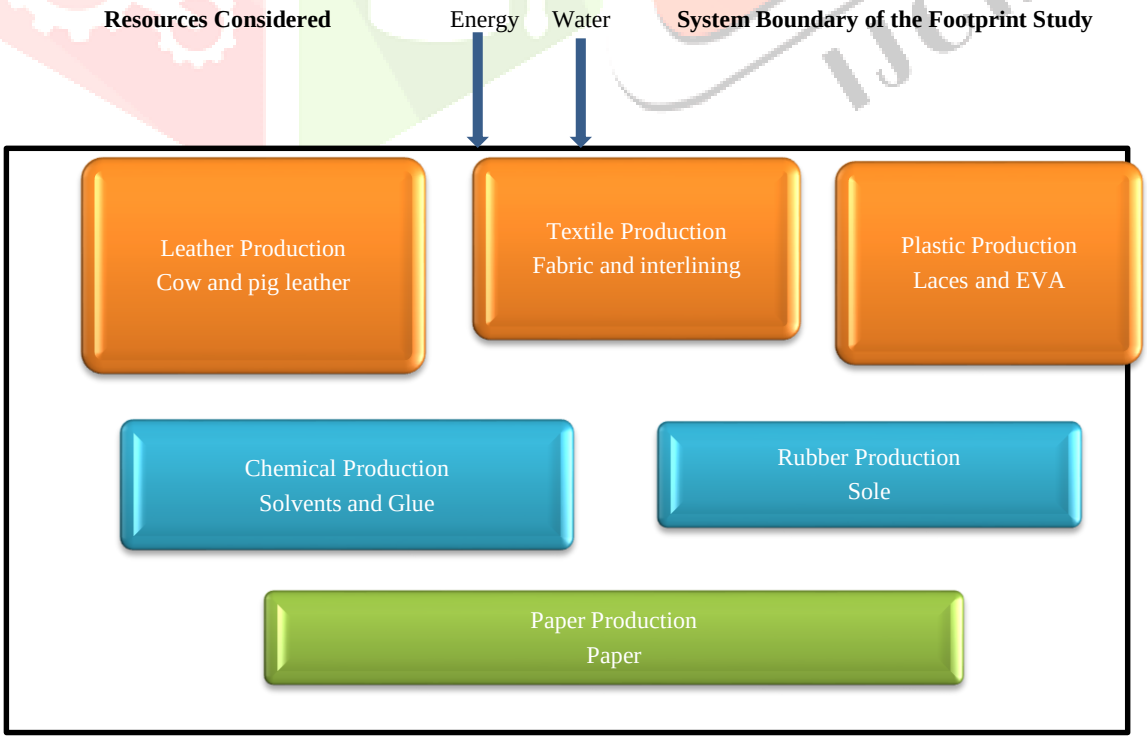
To comprehend the significance of carbon footprint in the footwear industry, it is necessary to understand the stakeholder theory, which states that "stakeholder is any group or individual who can affect or is affected by the achievement of the organization's objectives" In the footwear industry, manufacturing activities carried out by the supply chain and the footwear factory cannot relate to only within the premise walls but relates to groups that extend beyond the periphery of the industry. This definition falls in line with the European Union's new definition (2011) of Corporate Social Responsibility, that accounts for the 'responsibility of the enterprises for their impacts on society'.

Several studies have been made to check on the emission of carbondioxide or its equivalent on various types of footwear. Out of all of them, 4 studies viz., Gottfridsson & Zhang (2016), Muñoz (2013) , Albers et al. (2008) and Carlsson-Kanyama & Räty (2007) were considered for comparison with one another. A significantly high contribution to the total environmental impact is seen to have made from leather and leather footwear.

	Gottfridsson & Zhang (2016)	Muñoz (2013)	Albers et al. (2008)	Carlsson-Kanyama & Räty (2007)
kg CO2 per kg of leather	25	12	55	-
kg CO2 per pair of leather footwear	11	3.2	7.51	15

Table1: Comparative analysis of the environmental impact (CO2-emissions) from leather and leather footwear

The figure below gives a more clearer picture of how to apprehend the carbon footprint study of the footwear industry



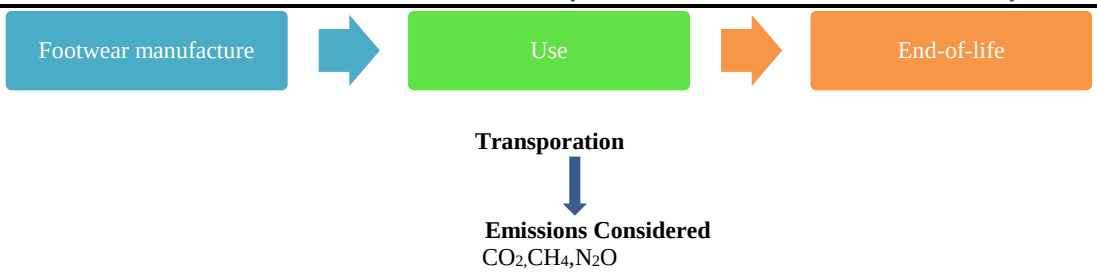


Figure 2: Schematic diagram of the footprint study of the footwear industry

The values found for CO2-emissions in different types of footwear in all the four considered studies were compared to each other (Table 2). The study by Carlsson-Kanyama & Räty (2007) presented CO2-emissions for different types of shoes. The results were presented according to an economic basis in form of kg CO2-emissions per USD. Also, values from other textile shoes were added from a footprint study involving three different models of sports shoes (NIKE Inc 2014). The textile shoe from Albers et al. (2008) is completely made from natural and recycled materials, whose value is lower.

	Waterproof footwear (Rubber boots) [kg CO2 per pair]	Textile shoes (Sports shoes) [kg CO2 per pair]	Leather shoes (Leather boots) [kg CO2 per pair]
Gottfridsson & zhang (2016)	5.39	2.35	11
Carlsson-Kanyama & Räty (2007)	5.23	3.71	6.54
NIKE Inc (2014)	-	10.8 – 13.8	-
Albers et al. (2008)	-	1.68	7.51

Table2: Comparative analysis of the environmental impact (CO2-emissions) from differenr types of footwear

5. WATER FOOTPRINT IN THE FOOTWEAR INDUSTRY

Water footprint is a measure to find out the amount of water consumed and polluted by the manufacturing process (Hoekstra et.al., 2002). In many countries of the world, water scarcity and extraction, allocation and preservation of water reserves have always been a critrical matter but have been somehow low on priority in the governmental agenda. Most manufacturing processes including footwear, have a water footprint. Majority of the styles in footwear manufacturing involve a large number of raw materials. Though there are certain footwear styles that use single materials viz., plastic sandals, but these occupy a very small space in the world market. 'Sneaker', a sports shoe is made up of more than 20 components such as uppers, lining, foams, fasteners, reinforcement and soles. Thus this increases the complexity of the entire supply chain of the footwear materials. The advent of globalization saw the closing down of the footwear manufacturing base in the west and move towards South East Asian countries, particularly China and India, where there has become a shortage in the availability of safe drinking water owing to industrial pollution, climate or due to lack of infrastructure, thus creating a critical situation. Moreover tanning process carried out in Africa has raised major concern as there is critically a limited water supply.

Traditionally, rather than from the footwear making companies, the main area of possible pollution linked to the footwear industry comes mostly from the raw material producers. The manufacture process of leather, textile, synthetic materials and other chemicals and adhesive lead to the generation of waste water, which cannot be released without proper treatment and this has created a negative effect on the environment. Presently many tanneries and chemical companies have made efforts and invested resources significantly to reduce the impact of their operations on the environment, thus making the footwear manufacturing supply chain more 'environmentally friendly' than it had been before.

Water extraction and water pollution are the main results of industrial water usage. The water supply required for production process is normally extracted from a nearby lake or river. This not only impacts the size or flow from the source but also affects vegetation, animal life and human population who rely on that source of water. After extraction and usage of the water, the industrial processes returns it back to the source. As in the other industries, the footwear supply chain, such as tanning of leather, dyeing of textile materials and bleaching and pulling of cellulosic materials, returns the water after usage to the water supply from where it was taken. As the discharged water contains harmful chemicals and suspended solids, (Adesola et al., 2016; Iqbal et.al.,2014; Ullah et al., 2013) many countries have imposed limits on it by making the installation of the post process water treatment plants compulsory in order to check on the biological activity, temperature and pH content of the water before releasing it back in the environment.

However the actual footwear manufacturing processes is not highly water demanding though they may be labour intensive. Although it may be considered as very small, the process of 'heat setting' uses the most water during the actual shoemaking phase. Heat setting is a critical process which uses heat and humidity (high velocity moist air) to impart the 'fixed' shape to the footwear upper and relaxes the strain and stress resulting from the pulling of the footwear upper on to the last. At the outset, the heat setting process required water boilers to generate steam, which could not be recovered and the vapours escaped into the atmosphere. However with new advanced technology, both consumption of electricity and water has been significantly reduced, wherein the water vapours are condensed and water is recycled, thereby reducing the new water input.

Leather is one of the materials that is predominantly used in the manufacturing of footwear, be it formal, casual or sportswear. Most of the water is used in its conversion from skin to hide at the tanning level which involves many distinct processes. These processes produce waste water that is carcinogenic with many substances such as salts, organic matter, dyes and tanning agents and are the main source of water pollution. It becomes all the more important that the tanneries ensure instalment of high standard of water treatment plants to significantly reduce the waste water discharge and use the recycled water back into the tanning process. However, leather is treated as a by-product of the meat and dairy industry. It is argued that the water consumed in the rearing of the animals should not be treated as a part of total water footprint for the leather raw materials.

Some of the other natural material that go into the manufacturing of footwear is wool and cotton. Wool requires plenty of water in animal rearing and feedstock growing. Irrigation of Cotton plant and processing of the fibres requires estimated global water consumption of 250 trillion litres per annum (waterprint.org). Growing of cotton may lead to contamination of run off water due to the pesticides used for its protection, also its processing to manufacture white cloth involves use of heavy use of water and bleach which is a potential pollutant. Dyes and supplementary processing chemicals that are used to manufacture coloured cloth also creates environmental concerns. The industry is however making sincere efforts to minimize the usage and recycling of water for the requirement of the manufacturing process. To a large extent, the industry is utilizing various methods such as, oxidative, physical and chemical process, neutralization, precipitation, adsorption and filtration to de-pollute of environment (Abbas et al., 2015; Iqbal and Bhatti, 2014). One good aspect with respect to footwear is that it does not consume water for the purpose of washing which is more associated more with water footprint of clothing and household textiles. Only a very small proportion of mainly textile based footwear might require washing and that too infrequently.

6. CONCLUSION

To conclude, for footwear production, the carbon and water footprint are largely associated with the production processes of raw materials either natural and synthetic primarily used in the uppers, linings, components and reinforcing materials. Many of these processes have the potential to cause significant pollution if not controlled adequately. More innovations and research and development have to be done towards building up of efficient production processes and creating new technology to prevent pollution. Both water and energy resources have to be taken into consideration along with other environmental concerns such as consumer waste at the end of product life. Footwear Stalwarts like Adidas Group, Nike and Puma have already shown their environmentally conscious behaviour by taking steps through their CSR programmes to implement reduction of carbon and water footprints, e.g. cleaner production, reduction of waste, energy, recycling material, ecofriendly designs and producing environmentally friendly products and green footwear. The industry will stand a better chance of being accepted by the communities of the regions in which it operates, when it warranties efficient production processes and usage of modern technology to ensure minimised pollution.

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