Analysis of Carbon-off Setting Targets towards Sustainable Economic Development in Apparel Sector Organization in Sri-Lanka

L. F. D. de Z. Gunathilaka and K. D. Gunewardena

***Abstract*—This paper focuses on Sri Lankan apparel manufacturing industry in relation to carbon off setting targets to mitigate emissions by reviewing the industry contribution to increasing levels of atmospheric Carbon -dioxide (CO_2) which is the governing factor in global warming. This paper attempts to highlight that all stakeholders of this aspect of the industry to reduce greenhouse gas emissions and the significance of neutrality which is ever so important indeed for the entire country coming from the Industry that occupies the topmost position of its economy. The ultimate objective of this study is to review the extent of fossil fuel burning the sector is responsible and the pragmatic carbon offsetting steps taken by the apparel organizations with commitment. The findings reveal a significant relation between carbon neutrality and offsetting targets towards greenhouse gas emission. It was also revealed that in order to neutralize emissions merely buying credits is inadequate compared to in-house off settings planning. Currently there are around 270 apparel factories in Sri Lanka, among the ones in operation a sample of 50 apparel companies were selected.**

***Index Terms*—Apparel industry, global warming, emissions, carbon off-settings, carbon neutrality, Anova.**

I. Introduction

Today's garment factories no longer look like traditional factories with high walls and large roofs and a tall chimney emitting black smoke to broadcast to the people near and far that there is a factory in the vicinity. Eco Friendly concepts have been incorporated to the architecture with modern designs like soothing pastel colours, more open spaces to invite fresh air, clean and hygienic work places and rest areas for employees and beautifully laid out gardens, so much so, that one can mistakenly identify a modern garment factory today to a star class hotel. What is more important is how this conceptual change has changed the employee perception and the society as a whole. In recent years, environmental sustainability has become a key managerial issue, and both researchers and practitioners are devoting increased attention to the topic as they face the challenge of achieving a balance between environmental and business needs [1]. Moreover, the fashion industry's environmental impact is very high, particularly in relation to its global volumes; it accounts for 9.3% of world's employees and 4% of worldwide exports. The production processes, and in particular the phases of dyeing, drying and finishing, make intensive use of chemical products and natural resources and generate a high environmental impact. The textile sector has experienced significant environmental problems linked to the production process, which is characterized by the intense use of chemical products and natural resources, resulting in a high environmental impact. Several studies have investigated the potential of "green fashion" to offer a competitive advantage. For example, an inquiry into the attitudes and expectations of Finnish consumers towards sustainable textile and clothing products in 2009 showed that 62.7% of the respondents were very interested in ethical consumption and products' environmental impact, whereas 28.3% were somewhat interested (total 91%). In reporting actual ethical consumer behavior, 20.8% agreed that they behaved ethically as consumers and 57.1% agreed slightly with - this (total 77.9%).

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II. Literature Review

An extensive literature review was carried out to identify the effects of fossil fuel burning and its adverse input towards increasing carbon emission, Life Cycle Assessment in products, climate change and greenhouse gas effect in Apparel sector Organization in Sri -Lanka. Since the industrial revolution, the burning of Fossil fuels could be the major contributor to increasing carbon dioxide in the atmosphere from 280ppm to 390ppm.The climate globally is constantly undergoing changes due to a variety of factors [1].

The rise in sea level, increased acidification of the ocean and irreversible dry-season rainfall reduction in several regions are the other illustrative impacts of emissions. Scientists predict that over the present century a rise of carbon dioxide concentrations from the current levels of about 385 parts per million by volume (ppmv) to a peak of 450-600 ppmv over the present century. There has been anthropogenic global warming of 0.58C over the past century, mostly after 1980 and a rise of 1.4-5.88C has been predicted over the present century [2]. Owing to the thermal expansion of the warming ocean alone, global average sea level may irreversibly rise at least 0.4-1.0 m, if concentrations exceed 600 ppmv and 0.6-1.9m if it exceeds 1,000 ppmv. Though the necessary nature of the link between economic growth and energy use or between energy use and emissions is still being researched, it is well recognized that most scientists consider it likely that if the atmospheric concentrations of carbon dioxide (CO_2) and other so-called greenhouse gases continue to rise, the earth's climate will become warmer. Accordingly, climate change analyses necessarily involve emissions forecasts spanning several

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decades and often a century or more. The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to inform international negotiations on climate change.

Other than emissions changes in the earth's orbit is another factor for climate change. Everything appeared quite normal up until about 1950 where instead of following the cycle of upward and downward trends, the levels increased beyond any point in history and continued upward. April 2010 (set) yet another record of atmospheric CO_2 at 392 ppm was recorded. Carbon dioxide is a naturally occurring gas, a by-product of burning fossil fuels and biomass and a result of land-use changes and other industrial processes. It is the principal anthropogenic gas that is thought to affect the Earth's radioactive balance [2].

Greenhouse gases in the upper atmosphere are leading to changes in climate, and also the temperature of the earth surface. As the global temperature rises by, with considering to above mentioned fact the economical and ecological requirements vary by the region. Cotton trees are known to function as natural spongers for absorbing carbon dioxide from the surrounding. The most important factor is carbon dioxide sequestration in soil. Carbon dioxide is a naturally occurring gas, a by-product of burning fossil fuels and biomass and a result of land-use changes and other industrial processes. It is the principal anthropogenic gas that is thought to affect the Earth's radiative balance [2].

Life cycle management improves the performance and efficiency of operations, enhances stake holder's relationships, strengthen corporate credibility and enhance share holders values [3]. If any type of Organization should need to improve their product which they can introduce Life Cycle Management for businesses to enhance sustainability performance in their supply value chain [4].

Carbon footprint' is a term used to describe the amount of greenhouse gas (GHG) emissions caused by a particular activity or entity, and thus a way for organizations and individuals to assess their contribution to climate change. Understanding these emissions, and where they come from, is necessary in order to reduce them. In the past, companies wanting to measure their carbon footprints have focused on their own emissions, but now they are increasingly concerned with emissions across their entire supply chain. Supply chain GHG emissions, which include those associated with processes not controlled by the company itself, can be measured at either the company level or the level of an individual product [5]. Measuring the carbon footprint of products across their full life cycle is a powerful way for companies to collect the information they need.

The major environmental impacts of the sector today arise from the use of huge energy consumption and toxic chemicals: The sector's contribution to climate change is dominated by the requirement for burning fossil fuel to create electricity for heating water and air in laundering. Toxic chemicals are used widely in cotton agriculture and in many manufacturing stages such as pre-treatment, dyeing and printing. Waste volumes from the sector are high and growing in UK consumers send 30kg of clothing and textiles per capita to landfill each year [6]. Especially take into consideration of life cycle approach the extensive use of water in cotton crop cultivation – can also be a major environmental issue as seen dramatically in the Aral Sea region.

This paper emphasizes the need for Apparel organizations to think beyond the corporate boundaries and involve to protect the environment by minimizing greenhouse gas emission. In this context industry should not only focus on operational level emissions but think beyond to offer the society products that are enriched with true green concepts. To name a few are especially designed green factory buildings, water conservation projects, green supply chain etc. If the industry can develop and promote organically grown cotton to replace part of conventional cotton used, it will help to protect the soil from being contaminated with harmful artificial fertilizers and pesticides and preserve the existing soil as living organisms that will result in healthy plant propagation and also not pollute the natural water table [7]. For a long time environmentalist, scientist and weather forecasters has evidenced this harmful accumulation on earth surface.

McKinsey Q. (2007) stressed that but so will a more systematic approach that brings "creative destruction" to clear away market barriers and to put a price on carbon. Companies must consider their strategic options regarding climate change under the increasing pressure of the Kyoto Protocol, which came into effected in 2005. Since then, a number of businesses have adopted a more constructive stance that acknowledges the reality of climate change and their responsibility for addressing the issue [8]. McKinsey Quarterly (2007) survey of more 2,000 executives paid special attention to the gap between high levels of corporate awareness and limited actions. This gap implies that the core business case for action is weaker than claimed by the respondents. Notably, 70 percent of executives see climate change as important in corporate reputation and brand management, but relatively few companies appear to be translating the importance they place on climate change into corporate action. In addition, 51 percent of executives based in North America considered the issue of climate change in corporate strategy to be very or somewhat important, whereas the corresponding statistics for European executives was 65 percent [8].

III. Methodology

Detailed discussions and interviews were carried out with the experts in the industry to gather their views to identify and verify the factors. In the first step, questionnaires, interviews, emails, observational studies and literature were used as data sources. Questionnaires were filled by executives, managers and directors of apparel industries who were responsible for sustainability development projects and environmental related activities of their respective organizations. The feedback on the questionnaires was obtained through email or by visiting the company. The interviews were conducted when the companies were visited and sometimes there were possibilities for observational study as well. The results from this methodology of study helped to gain an overall understanding about carbon emission and carbon off setting activities of the apparel industry. Currently there are around 270 apparel factories in

Sri Lanka Therefore there is no reliable evidence on the current population size of the apparel factories in Sri Lanka. Among the ones in operation a sample of 50 apparel companies was selected representing various types of garments being manufactured and in different geographical areas. Collections of returns were completed in June 2013. Total 50 questioners were distributed among each industry out of which 40 valid questionnaires were returned.

IV. Discussion

In this Analysis a total of 40 usable samples were obtained. This sample consists of Extra Large, Large and Medium size Organizations with mix of Combination. This implies that the respondents represent the whole view of Apparel sector. Return from the research reveal that in Table I and Table II are arranged according to the Mean values from maximum to minimum questions asked on the subject of corporate sector planning towards emission reduction through carbon neutrality programs. According to that arrangement, it clearly mentions that three factors which highly effect on the subject of carbon neutrality methods in present day concept in Apparel organization. Mean 4.48, "*Measuring Life Cycle Assessment (LCA)*" is so important than all done before if we focus to neutral our off settings amount. All comments fall very close to strongly agree level, because all know about the substance of measuring LCA. Standard deviation 0.847 indicates that no big deviation all respondents when paying attention on the subject of LCA.

The second highest mean is 3.88 which indicates the "*Voluntarily engage with carbon neutrality*" which means that all respondents attitude towards voluntarily program of carbon reduction is found very essential than ever before to mitigate rising effect of greenhouse gas. Standard deviation also not exceeded big deviations which is 1.017. That indicate every organization believe that this is very important and compulsory to do in the future. Mean 3.88 mean that respondents all agree with voluntarily programs.

TABLE I: Descriptive Statistics for Carbon Off-Settings

Carbon off settings	rating	min	Max	Mean	Std.
Emission reduction programs	4	2	5	3.88	0.648
Standards to reduce emissions	7	1	4	2.35	0.662
Forecast activity related to emission reduction	6	1	5	2.4	1.598
Reduce emission at corporate level	3	2	5	4.05	0.783
Measure carbon footprint	5	2	5	3.23	0.862
Concerned about environmental matters	1	2	5	4.63	0.705
New targets for emission reduction	2	2	5	4.2	0.853
Valid N (list wise)	40				

TABLE II: Descriptive Statistics for Carbon Neutrality

Carbon neutrality	N	min	max	Mean	rating	Std.
Measuring life cycle assessment	40	1	5	4.48	1	.847
Carbon natural shipping	40	1	5	3.68	4	1.269
Get premium status	40	1	5	3.75	3	1.104
Voluntarily engage with carbon neutrality	40	1	5	3.88	2	1.017
Purchasing carbon credits	40	1	5	2.75	6	1.276
Reducing emissions in house	40	1	5	3.65	5	1.350
Does not add value to our product	40	1	5	2.40	7	1.614
Valid N (list wise)	40	1	5			

The interesting but most economical factor which highlighted through the third highest mean of 3.75 *"get premium stators"*. Researcher asked a question, your organization is interested to neutralize product foot print to get more premiums to your product? Answer was more positive and all commented yes but not strongly agreed. Result clearly mentions that all respondents attitudes towards this question is very close to neutral because today all are focusing three pal bottom line, socio economic sustainable development. Standard deviation 1.104 indicates respondents not comment in a different way all comments are parallel. The fourth highest mean is 3.68, related to the Questioner of "Carbon neutral shipping", researcher asked a question of do you prefer to deliver your products to other countries through carbon neutral shipping lines? Respondents commented within the range of neutral and agree levels. Researcher understood during the research period that majority respondents "agreed" some "Strongly agreed" and few stayed "Neutral". It clearly indicates the standard deviation which is 1.266. Fifth important fact is *"Reducing carbon emission in house",* which shows the mean as 3.65 but standard deviation 1.350. All respondents agreed to reduce emission through in house activities. Standard deviation of 1.35 means that multiplicity of ideas. Emission reduction at corporate level is no easy task. Challenging targets must be set on an annual basis. Second lowest mean is 2.75, that's indicates "Purchasing Carbon credits". Respondents disagreed or some are neutral with buying credits with comparison to results. But none on "disagreed level". It means that some organization have interest to buying credits from crediting source and off sett the foot print. Standard deviation 1.267 mentions that ideas fluctuate within considerable broad tolerance. The lowest mean 2.4 for "Does not add value to our product" and standard deviation is 1.614.All respondent strongly disagreed or disagreed with this statement also clearly explained that all respondents' ideas fluctuate within considerable broad tolerance. The

Questioner asked from respondent is, you do not involve yourselves in carbon neutrality programs because it does not add value to you product? All disagreed mean that respondents strongly agree with carbon neutrality as on important subject their products.

Findings

Carbon neutrality towards greenhouse gas emissions A one way ANOVA was conducted to check whether there is a significant relation between carbon neutrality and greenhouse gas emission. The omnibus *F*-test revealed a significant effect of group, $F(13, 26) = 2.184$, $p = 0.044$ There are significant differences among the Carbon neutrality and Greenhouse gas emission effect, at significance level 0.05. Typically, when a $p = 0.044$ ($p > 0.05$) have a statistical evidence to accept the alternative hypothesis, and instead conclude that the differences or relationships being studied are statistically significant. That's mean there is a significant difference between Carbon neutrality toward Green House gas emissions Therefore we have to accept the Alternative hypothesis (H0)3. *Carbon off setting targets towards Greenhouse gas emission* A one way ANOVA was conducted to check whether there is a significant relation between carbon-off setting programs and greenhouse gas emission. The omnibus *F* test revealed a significant effect of group, $F(9, 30) = 2.437$, $p = 0.032$ There are significant differences among the Carbon-off setting and Greenhouse gas emission effect, at significance level 0.05. Typically, when a $p = 0.032$ ($p < 0.05$), Have a statistical evidence to reject the null hypothesis, and instead conclude that the differences or relationships being studied are statistically significant. That's mean there is a significant difference between carbon-off setting programs and Green House gas effect in Selected Apparel sector organizations. Therefore we have to accept the Alternative hypothesis.

V. Conclusion and Recommendation

Apparel Industry, electricity is used mainly for lighting, running of motors and air conditioning. More than the garments stitching process electricity is used in the production of its raw material, the textile and fabrics and therefore the manufacturing process of fabric should not be isolated when looking at apparel sector influence on GHG emissions. It is encouraging to note the recognition and preference given by the buyers to factories who make a conscious effort to reduce the use of electricity. Sri Lanka is blessed with natural sun light all throughout the year and therefore for lighting all efforts must be directed at using natural day light during the day. Properly designed roofs that will allow sufficient lighting to work areas shall be a good simple start. Where air conditioners are used proper sealing of doors and windows and isolation on the roof will give good results. When not in full production planning production avoiding the peak hours where tariff charges are high could give good results. Long-term recommendation will cover the common objectives of corporate managers awareness towards the environmental sustainability in apparel industry. For a long lasting discipline to embrace our lives it must start at a young age and therefore the companies who are affected must lobby to the Government to introduce the teaching of GHC effects in our lives as part of curriculum of primary school. If so by the time the young reach working age they will be fully aware and will know the repercussions that will follow. Government must introduce certain regulations in the building approvals to compel new builders to abide to minimum eco-friendly (Green buildings) designs to maximize the use of natural light and reduce the use of electricity. Government must offer incentives like tax reductions to industries to upgrade their obsolete machines that consume more electricity. Encourage the use of solar power wherever possible. At government level incentives must be offered to all industries including apparel to use solar power. Eg: pre heat water through solar trough technology to lessen the burning of furnace oil in the boiler. Compel industries to get involved in plantation projects by offering state land free on long lease (99 years) that are not cultivated presently.

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