SUSTAINABILITY THROUGH BUILDING OF GREEN FACTORIES

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Abstract

Establishment of Green Factories (GF) is considered as an effective mean of mitigating the negative impacts of industrial development. Yet in Sri Lanka, the voluntarily adaptation for such approach is hardly seen among the manufacturing companies, mainly due to their lack of awareness on the potential benefits and costs. Therefore, this study attempts to determine the effects of a GF on environmental benefits, employee perception and performance, and economical advantage to the company by selecting two factories (i.e. GF and a comparable normal factory) of an apparel manufacturer in Sri Lanka. Data were collected from equal numbers of randomly selected 60 factory floor employees and 20 factory floor staff in two factories using a self-administered questionnaire and interviews in addition to company records as secondary data.

The results revealed that there are many benefits of GF to environment, employees, and economy of the company. The GF achieves environment sustainability through providing eco-friendly indoor and outdoor workplace environment; optimizing resource performance, including energy and water; and reducing, recycling and reusing wastes. In the GF, every employee enjoys fresh air, better light, comfortable surroundings, and beautiful outdoor views of intact nature. This improves employee health, wellbeing and productivity. The company is benefited economically from reducing costs; improving employee productivity and quality of work; reducing employee absenteeism rate and turnover; and improving brand equity.

Key words: Green factory, employee performance, sustainability

1. Introduction

Sri Lanka has turned into a global player in the apparel production and exports becoming a major supplier for many leading fashion brands. The apparel sector is the major manufacturing sector in Sri Lanka employing nearly 300,000 people i.e. 48% of the total employees of the manufacturing sector (Department of Census and Statistics, 2012). It is responsible for 3.2% of the Gross Domestic Production (GDP) and 40% of the total export earnings (Central Bank, 2012). In 2010, there were 568 establishments with 25 or more persons engaged, including 373 large-scale and 195 medium-scale garment factories in Sri Lanka (Department of Census and Statistics, 2012). Nevertheless apparel manufacturing consumes huge amounts of materials and resources including water for their large employee population and energy for air conditioning, lighting and electrical machinery. This results in emission of significant amounts of pollutants and greenhouse gases. Furthermore, when building garment factories large areas of land are disturbed threatening the surrounding natural flora and fauna.

Two decades ago, sustainability was not a driving factor in the apparel industry. But as the world moves on and when people feel more and more responsible for sustainability, initiatives have been taken to make sure that the apparel sector also abides by the ethics and laws of environmental conservation. Many apparel companies are beginning to recognize the impacts of their activities on the environment and are trying to make significant changes to mitigate their negative environmental impacts. One measure is building Green Factories (GF) in a resource efficient manner using ecologically based principles, which could provide a healthy facility for people to work (Kibert, 2007). Another measure is compliance with various assessment programs[1] developed worldwide on social, economic and environmental impacts of industries such as BREEAM, LEED, Green Global, and ISO 20121.

In the Sri Lankan apparel sector some of the top companies have taken initiatives to make their manufacturing processes sustainable through building GF and to be compliant with environmental certifications (e.g. LEED) as a part of their ethical trading. The first three green factories are owned by the giant garment producers in Sri Lanka namely MAS Holdings, Brandix Lanka and Hidramani Group (Barrie, 2009). Further at the ground level of manufacturing, large organizations now have started using GF as a marketing strategy for their clients to go beyond their competitors to show the corporate social and environment responsibility they take. Nevertheless, except for a few organizations, still the degree and commitment of the ground level manufacturing factories vary

[1] The Building Research Establishment Environmental Assessment Method (BREEAM) in 1990 of the UK, Leadership in Environment and Energy Design (LEED) of the United States Green Building Council in 1998 (USGBC, 2011) and Green Globes of the Green Building Initiative (GBI) in 2005 of the US (Smith and Fischlein, 2006), ISO 14000 and newly released ISO 20121 standard for sustainable events management from the International Standards Organization, are some of the major standards on the certification and measurement of environment standards followed by the industries.

considerably and most apparel companies still do not see sustainability as an integral part of their core business values. Therefore, this study was carried out to identify the impact of a Green Factory (GF) on three pillars of sustainability; environment, employees (social) and economy – 3Es, in a leading apparel manufacturer and exporter in Sri Lanka.

2. Methodology

This study intends to investigate the effect of a GF on environmental benefits, employee perception and performance, and economical advantage to the company. The objective was achieved through comparing two factories of the selected export-oriented apparel manufacturing company (i.e. two different factories of the same company); first a GF, which is having the world's first LEED Platinum certification for initiation of environmental conservation and second a comparable Normal Factory (NF) which does not practice LEED. The GF is a 10,000m^2 building located in the intermediate climatic zone. It is designed for 1,300 people with lean-production standards, low energy consumption and having a comfortable atmosphere. The NF is a 17,000 m^2 building having normal production standards and is situated in the wet zone. In July 2012 there were 856 employees working in the GF while the number of employees in NF was 1687. Both factories produce ladies' intimate garments and export to the European markets.

Both quantitative and qualitative aspects of the GF were evaluated. In addition to the secondary data available, a survey was carried out to collect data from the employees. Thirty factory floor employees and ten factory floor staff members from each factory were selected through simple random sampling technique. Employee perceptions were obtained through a self-administered structured questionnaire, which consisted of employee performance, attributes of the indoor and outdoor environment and efficiency of resource utilization. In order to analyze data, descriptive statistical techniques were used through the Statistical Package for Social Science (SPSS) software. The results from the quantitative analysis were supported by the qualitative data obtained through interviews, discussions and observations.

3. Results and Discussion

3.1. Impact on Environment

Based on the information collected from the company, Appendix Table 1 compares and contrasts the technologies used in the GF and NF, which have an impact on the indoor and outdoor environment. The factory floor of GF is illuminated by T5 bulbs with electric balusters while NF uses T8 bulbs with magnetic balusters which are 40W florescent. The bulbs used in the GF give continuous lighting, which are highly efficient due to consumption of low energy for same output lux level. In the GF, LED lights are also provided to the needle points. The GF utilizes natural day light efficiently

through large plate transparent glasses made out of single glazed panels in both production and non-production areas instead of having concrete or cement walls like in the NF. In the production floor glasses are established as large windows in the GF, while in NF there are only small glass windows made out of double glazed panels which cannot be opened, as an air conditioning requirement. Although both factories are positioned along east-west axis, the GF plate glass windows are purposely placed in north and south sides along the walls to ensure higher natural light usage and reduce direct solar radiation coming into the building. Thus while only artificial light is available in the factory floor of the NF, the GF uses a combination of both artificial and natural light efficiently. In addition, the large glass windows provide scenic views of the surroundings, which is an effective stress control mechanism.

To reduce temperature passively in the GF; cool roofs (off white colour coated Zinc and Aluminium roofing sheet having a solar reflectivity index of 79% and infrared emission of 85%), photovoltaic roofs (solar panels) , and green roofs (a concrete roof with vegetation on top) are used. In the NF, roof is constructed with steel, asbestos sheets, and MC foil (underneath heat reflective layer). Eco bricks made of soil stabilized with 10% cement and compressed in a mould are used to make GF walls. This also reduces heat-gain in the building interiors and reflects solar radiation back. In the GF, indoor temperature and ventilation is controlled by an energy efficient Evaporating Cooling (EC) System. The 40 EC units intake outdoor air, filter it, and treat it with atomized water. The air is then distributed through ducts to the building. Exhausts fans help replace the air at a rate of about 40 air changes per hour. This reduces dry-bulb temperatures by up to 3°Celsius and increases humidity by about ten percent. The amount of water spray is based on the indoor relative humidity, while more water is used at midday, and little or none in the mornings and evenings when the outdoor humidity is high (Holcim, 2008). Whereas, NF has only normal (central) air conditioning system to reduce temperature, which is not sufficient to cool down the heat emitted from machines (cutting, moulding, sewing etc.). The technologies used in GF thus use energy 40% (Holcim, 2008) less than the NF.

Furthermore, the GF is powered by carbon-neutral sources; 10% by solar power and 90% by hydro power. It has 165 photovoltaic panels mounted on the roof top, the largest in Sri Lanka and it is connected to the main grid. Hydro power is produced in plant located 180 km away and transmitted to the factory through a power wheeling agreement and in non-working days the power generated is fed to the Ceylon Electricity Board using a reverse meter. The NF gets energy through the national grid and the diesel generators. The GF premise is a steel free zone. GF is almost a hazardous chemical free zone and conducts chemical usage training and awareness programs to update the employees. A spill kit comprised of saw dusts, sand, fabrics, mask, goggle glass, gloves is used in the GF as a precaution during chemical usage.

To save 50% of the potable water consumed by a comparable NF, GF uses push taps, low flow plumbing fixtures etc... Rain water harvesting tanks with a total capacity pushy of $120m^3$ are constructed on top of toilets, which send water down for flushing under gravity flow. They are filled through roof gutters and excess water is collected to a large pond which is used for irrigation. The GF is established on concrete bars (45cm height) without changing the natural environment (pile construction) while NF is established on a flat ground. The footprint of the two-story GF covers only about 15% of the site. The green factory has planted over 300 native trees for purification of air,

reduce soil erosion and conserve water. Shading of the building and grounds will keep the building an estimated 1^{o} to 2° Celsius cooler. For the reduction of soil erosion, GF has used a cascade system in accordance with existing contour lines in the garden which increases infiltration. The runoff is channeled to the retention pond. The cement-stabilized porous surface pavements reduce runoff and help to recharge the ground water (Holcim, 2008). Unlike in the NF, there is no separate treatment plant for waste water treatment at the GF, thus waste water is pumped to a centralized plant. In the GF, food wastes are fed to pigs, fabric wastes are sold to local buyers, polythene and cardboards are returned to their suppliers, E-wastes are sold to electronic companies, while stationary and thread cones are reused. Thus the GF helps keep the natural environment and ecosystems healthy for humans, animals, and plants by reducing waste and greenhouse gas emissions, controlling pollution, and treating land, air, and water as precious resources.

3.2. Impact on Employees

In the sample survey, the total respondent count was 80 having 60 factory floor employees and 20 factory floor staff members; half from GF and other from NF. Most of the floor employees were Machine Operators MO (about 77%) in both factories while others were Checkers and Packers. Floor staff was mainly belongs to production department (55%) while the rest belongs to quality control department (45%). The average age of respondents were 25 yrs and 26.5 yrs in GF and NF respectively, while majority of them were at the age category of 21 to 30 years. In both factories more than 80% of the employees were females while 70% of staff members were males. Education qualifications of floor employees were similar in the two factories as two thirds of them had education up to GCE O/L. The rest of the employees and the factory floor staff members had better education. The average work experiences of the respondents at GF and NF were 28 months and 41 months respectively.

Awareness and Perception about the Green Practices

The awareness levels on green practices was noted to be significantly different among the employees and staff of the two factories ($\chi 2 = 30.961$; $p = 0.000$). The awareness of green practices among the majority of employees and staff in GF was good (57.5%), where there were percentages having very good (20%) and moderate (22.5%) awareness levels. In the NF, none of the employees had very good awareness, while 27.5%, 40%, and 32.5% had good, moderate, and poor awareness levels respectively. There are awareness notice boards about the green and sustainability displayed everywhere in the GF, and employees have awareness programs about environment and eco-friendly practices. The GF has an ‘environmental week’ and essay and poetry competitions are being conducted.

Perception on Indoor and Outdoor Environment

The mean scores (MS) of satisfaction levels of the indoor environment were compared between GF and NF respondents (Table 1). Perceptions were taken with regard to illumination, including natural light and task lighting, attractiveness of the environment and outdoor views, thermal comfort, and air quality in the factory floors. Employees in both factories are satisfied with quality and brightness of the light inside the workplace (MS $\geq$ 3.5). However, due to the arrangement of lighting fixtures and T5 and LED lighting system, provide better satisfaction to the employees in the GF. Both factory employees believe that they do not use natural day light sufficiently for their work. A significantly superior scenic view to the respondents is provided in the GF compared to that of the NF. A natural, beautiful and stimulating environment is provided in the outside and courtyards in the GF. The production floors are free from columns and other hindrances. Large windows in the GF are a key part of the design, bringing the green outdoors into the factory floor. These helped them to reduce their perceived work related stress.

Table 1: Perception on the Indoor Environment

Indoor Green Practice	*Mean score*		*Mann-Whitney U value*	*P value*
	GF	*NF*		
Quality of the day light	*4.15*	*3.80*	*561.5*	*0.015*
Adequacy of day light brightness	*3.78*	*3.55*	*689.0*	*0.235*
Natural light usage efficiency	*2.95*	*2.55*	*660.5*	*0.161*
Scenic view through glasses	*4.53*	*2.05*	*58.0*	*0.000*
Stress reducing effect of scenery through glasses	*4.35*	*2.18*	*77.5*	*0.000*
Ventilation	*3.90*	*3.85*	*768.0*	*0.741*
Comfort of breathing	*4.23*	*4.08*	*697.5*	*0.258*
Quality of air	*4.18*	*3.45*	*403.0*	*0.000*
Acceptability of odour	*4.05*	*3.83*	*644.5*	*0.143*
Comfort with cooling system	*2.87*	*1.95*	*502.5*	*0.004*
Temperature	*2.95*	*2.25*	*465.0*	*0.001*
Employee density	*4.00*	*3.75*	*648.0*	*0.163*

Note: Score 5 – Highly satisfactory to 1 – Highly dissatisfactory

Ventilation inside the building and the comfort of breathing within the building were not significantly different between the factories although two different technologies are used. However, the quality of air was significantly better in GF than the NF. The NF uses a mechanical-compression/vapor-absorption air-conditioning systems system while the GF uses water evaporating cooling system[2].

[2] Water evaporating system called Evaporative cooling system (no electricity usage for cooling the air, natural air feed to the system and it is flown through a wet panel, at this stage the water in the wet panel absorb heat from natural air to vaporize making the relative humidity of the natural air higher, this causes the natural air to cool down and air is moved by fans, output removed by exhausted fans, by that, gas levels maintain inside the building (CO2, O2), which function as a controllable system (Holcim, 2008).

Although employees wear T-shirts and are allowed to work barefoot, they do not seem to have comfort with the cooling system and factory floor temperature in both factories as indicated by the mean scores of below three. Nevertheless, both these aspects were significantly better in GF compared to NF. The maximum temperature noted in the factory floor of GF was 27° Celsius. The GF maintains its indoor environment within the extended comfort zone specified by the ASHRAE[3] standard. When the day time outdoor temperature is too high, even the evaporating cooling system could not to maintain the required temperature inside the factory floor. According to the test results data of the factories, there was no difference in the chemical compounds and other particles in the air, thus the odour inside the building which was acceptable, was not significantly different. Perception on employee density in the GF was slightly better, but mean values did not show a significant difference between the factories. In general, GF seems to offer a comfortable, healthy, and attractive indoor environment perception for factory floor staff and employees.

Table 2: Perception on Outdoor Environment and Resources Utilization

Outdoor environment and Resources use efficiency	*Mean score*		*Mann-Whitney U value*	*P value*
	GF	*NF*		
Potable water use efficiency	*4.08*	*3.40*	*507.0*	*0.004*
Waste water recycling system	*3.85*	*2.60*	*426.0*	*0.000*
Rain water harvesting system	*4.10*	*1.25*	*100.5*	*0.000*
Solid waste management	*3.63*	*1.65*	*278.0*	*0.000*
Alterations to natural environment	*4.23*	*2.87*	*267.0*	*0.000*
Landscaping	*4.43*	*3.88*	*503.0*	*0.002*
Gas emission	*3.56*	*1.93*	*294.0*	*0.000*
Reduction of chemicals and toxins usage	*3.65*	*2.08*	*361.5*	*0.000*
Energy use efficiency	*3.93*	*1.95*	*253.0*	*0.000*
Solar power usage	*4.25*	*1.50*	*122.0*	*0.000*

Note: Score 5 – Highly satisfactory to 1 – Highly dissatisfactory

The assessment of the perceptions on outdoor environment and resources utilization practices of the two factories are given in Table 2. Accordingly, all outdoor and resource use practices are far more superior in the GF compared to the NF. Furthermore, while employees in the GF are satisfied with the above practices (MS $\geq$ 3.5), except for landscaping, employees in the NF are rather dissatisfied with those practices adopted by the factory. Employees are highly satisfied with the potable water use efficiency (e.g. use of push taps), and waste water recycling system in the GF. Rain water harvesting (tanks, infiltration, runoff collection, etc.) is practiced only at the GF thus its employees are highly satisfied with the system. Similar satisfaction could be seen with solid waste management (feeding, selling, and reusing) among the GF employees.

[3] American Society of Heating, Refrigerating, and Air conditioning Engineers

Both factories have made certain alterations to the natural environment as well as landscaping. GF factory has done minimum changes to the natural environment through pile construction technology, two story building, etc. Harmonizing with the site, the outdoor spaces in the GF are woven into greener parks. By landscaping, both factories have made their outdoor environment look more beautiful, thus the employees have a satisfactory attitude towards them. Environmental conservative actions such as reduction of gas emission, chemicals and toxins, and electricity and use of solar power have been given more emphasis in GF and the employees also are aware of the steps taken to mitigate environmental pollution and energy usage.

3.3. Impact on Economy

The GF has cost 2.66 million dollars, about 25% more than a NF (Holcim, 2008). The question is whether it provides sufficient economic return to the company in addition to the benefits it provides to the environment and employees. Both factories are designed for lean manufacturing, just-in-time manufacturing processes and efficient internal layouts that minimize transportation. In addition to these, the workers at the GF enjoy an exceptional indoor and outdoor working environment. Table 3 compares and contrast some of the perceived impacts of GF on employee welfare and productivity which ultimately determine the profits to the company.

Poor indoor environment negatively affects employees' physical health (e.g. asthma exacerbation and respiratory allergies) through poor air quality, extreme temperatures, excess humidity and insufficient ventilation and psychological health (e.g. depression and stress) through inadequate lighting, acoustics and ergonomic design (Singh, 2010). Green buildings can mean healthier people while non-green buildings could cause 'sick building syndrome' that cause significant stress to occupants (Kopel-Bailey and Josephson, 2008). Employees in the two factories are satisfied with the measures taken to reduce work related health issues and injuries ($MS \geq 4$). It was observed that both factories have implemented programs to reduce health issues and injuries in the workplace. Both factory employees believe that the products produced in their factories are good in quality and there is reduction in the errors made by themselves. The employees have attributed these positive developments to their experience, constant supervision and strict quality assurance practices maintained in both factories.

However, employee perceptions on efficiency and quality of work in the GF are significantly better than the NF. While employees believe that physical and psychological stresses are reduced due to the green workplace environment ($MS \geq 3.5$), those stresses are perceived quite high in the NF ($MS \leq 3$). The employees have identified proper internal factory layout, comfort zone within the factory, eco-friendly indoor and outdoor environment, and scenic views as factors contributing to more relaxed work. The employees in the GF also believe that their understanding about the green practices and environmental conservation improved after joining the factory, which was not the case among employees in the NF.

Table 3: Perceptions on Outcomes of Green Practices

Outcomes of Indoor and Outdoor Factory Environment	*Mean score*		*Mann-witney U value*	*P value*
	GF	*NF*		
Decline of work related health issues	*4.35*	*3.98*	*604.0*	*0.039*
Decline of work related injuries	*4.43*	*4.08*	*598.0*	*0.030*
Work efficiency	*4.38*	*3.80*	*450.5*	*0.000*
Quality of work	*4.48*	*3.80*	*402.5*	*0.000*
Quality of the product	*4.33*	*4.15*	*655.0*	*0.115*
Decline of errors	*4.20*	*4.03*	*710.0*	*0.318*
Decline of absenteeism rate	*4.30*	*3.73*	*512.0*	*0.003*
Retention in the job	*4.25*	*3.13*	*336.5*	*0.000*
Reduction of physical stress	*3.80*	*2.73*	*316.0*	*0.000*
Reduction of psychological stress	*3.85*	*2.53*	*239.0*	*0.000*
Allowances and salary increments	*2.75*	*2.75*	*798.0*	*0.984*
Understanding of green practices and environmental conservation	*4.35*	*2.18*	*72.0*	*0.000*

Note: Score 5 – Highly satisfactory to 1 – Highly dissatisfactory

These attributes of the GF have helped the employees to reduce their absenteeism rate and remain in the factory. According to the Company, the average absenteeism rates were 3.07% and 4.38% during the last four year period for GF and NF respectively. Similarly average turnover rates were 3.23% and 4.59% during the same period for GF and NF respectively. The factors contributing to the Key Performance Indicator (KPI) including average production efficiency, average quality level, absenteeism rate, labour turnover rate, first three days production efficiency, standard hours, additional material cost and errors made by employees per line and average temperature inside the factory showed better performance in the GF. Average on time delivery and order fulfilment showed similar performance levels in the two factories. These performance levels in the GF have helped it to reach KPI of 52% compared to 38% in the NF. Therefore, it seems that employee productivity in the GF has improved particularly through improving efficiency and quality of work while reducing their physical and psychological stress, absenteeism, and turnover. Since a similar remuneration package is used in both factories, perceived allowances and salary increments were similar in the two factories. The GF has not benefited its employees financially. An analysis was carried out to measure the overall job satisfaction of the employees, which is the main variable that indicates the volume and quality of the work. It was revealed that the GF employees were more satisfied with their job (MS = 3.9) compared to the employees in the NF (MS = 3.1) and it was statistically significant ($\chi 2 = 33.037$; $p = 0.001$).

In addition to the economic gains from the employee productivity improvement, the company also receives economic benefits from GF through reducing resource utilization. The number of electricity units consumed per standard hour in the GF and NF were 1.23kWh and 3.17kWh respectively. The average electricity cost of the GF and NF were Rs.19.00 and Rs. 33.27 per standard hour respectively in the last four year period. The GF has reduced its energy demand through using energy saving

technologies and solar power. The amounts of water used in the GF and NF were 1822 m^3 and 2725 m^3per month respectively. The average water bills of the GF and NF in the last four year period were Rs.118,109 and Rs. 215,851 per month respectively. The amount and cost of water are reduced in the GF through the use of water saving technologies and rain water harvesting systems. The GF also gets economic advantage through recycling and reusing wastes.

Furthermore, GF enhances the brand equity of the manufacturing company, and its overseas retailer. The GF is an ethical response to consumers who called for stronger environmental stewardship. This provides a competitive advantage over the less "sustainability-minded" manufacturers and retailers in the garment industry, thus bring in more loyal customers and profits (Holcim, 2008). Greening of the garment industry is expected to sustain and grow business and consumers in the West, who are increasingly demanding environmentally friendly goods (Sunday Times, 27th April 2008). Green workplace environment gains economic benefits through increasing resource use efficiency and improving the employee productivity in quantitative and qualitative terms. Because of the efficient operation and high brand equity, the payback period for the added costs of making a GF is only five years according to the company.

4. Conclusion

Building GF has a tremendous interest nowadays and gradually becoming a part of mainstream construction industry. There are many benefits of having green workplace environment for all the stakeholders. The results of this research could be summarized into a model presented in Figure 1, with three main areas sustainability Environment, Employees, and Economy (3E's). It has resulted in many environmental outcomes through reducing resource utilization and saving energy and water. The GF achieves environment sustainability through optimizing energy performance, reducing emissions, reducing waste, encouraging recycling, and reducing sediment contamination and soil erosion. Seventy five percent of the factory's land area is left to nature, covered with greenery or water, and managed as a habitat for plants and animals.

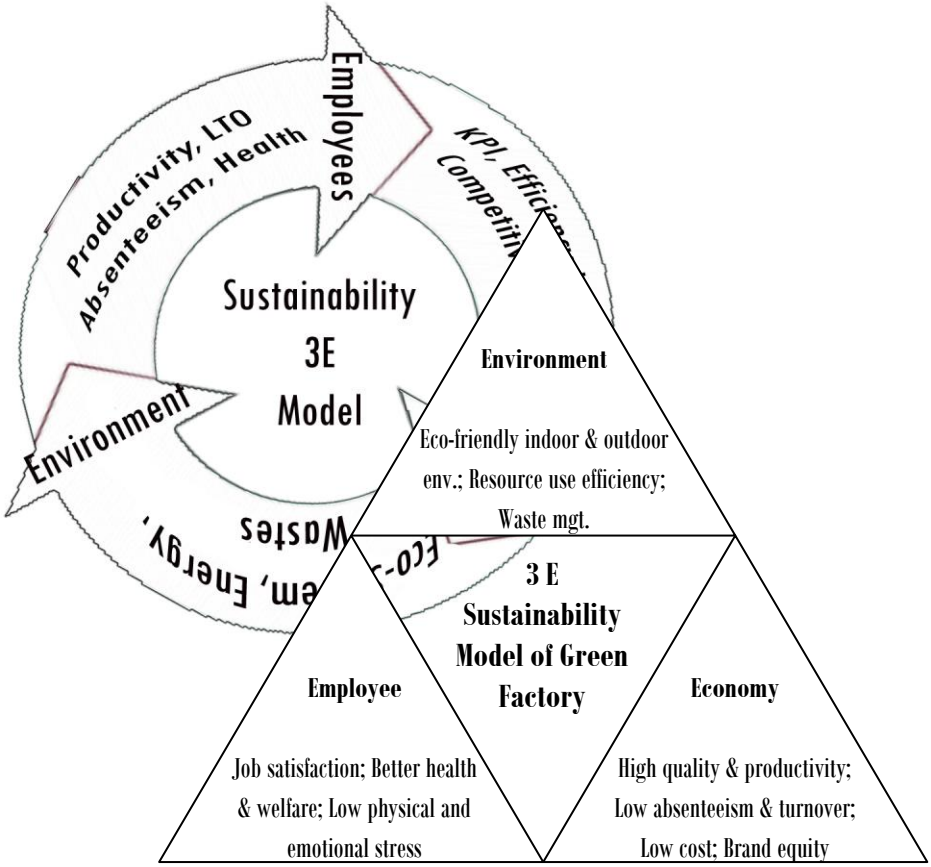

Figure 1: 3E Sustainability Model of Green Factories

The green work place environment has a significant impact on improving employee health, wellbeing and productivity. In the GF, every employee enjoys fresh air, natural light, comfortable surroundings, and beautiful outdoor views of intact nature. The manufacturing organization benefits economically from reducing long-term recurring cost and improving employee productivity and quality of work. Low cost of production and employee absenteeism rate and turnover are economic benefits of GFs. The brand equity gain from GF provides growth and stability to the manufacturer and retailers.

The results of this research thus reveal that GF has direct and indirect positive impact on environment, employees, and economy of a company. In the GF everyone including manufacturer, retailer, employees, surrounding communities and the government seems to be a winner. Since, everyone is benefitted by a GF, governments can promote such sustainable investments by providing various incentives; for instance better tax holidays, grants, etc. GF, thus clearly shows that a company can indeed do well by doing good.

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Appendix Table 1: Comparison of the technologies of GF and NF

Technology	*Green Factory - GF*	*Normal Factory - NF*
Indoor Illumination	*T5 bulbs with electric balusters* *LED lights to the needle points* *Large plate, single glaze glass windows, large openings* *Courtyards* *CFL and sensor(motion) lights in all non-production areas*	*T8 bulbs (40W fluorescent lights) with magnetic balusters* *Smaller size (60cm*50cm), Double glaze glass, Windows cannot be opened*
Ventilation and air conditioning	*Evaporative cooling system* *Exhaust fans* *Courtyards* *Large windows*	*Normal A/C system(Central A/C system by chillers)* *Exhaust fans*
Passive thermal control	*Cool roofs, photovoltaic roofs, and green roofs* *Vegetation cover (roof gardening)* *Furniture by indigenous material(Bamboo)* *Eco bricks* *Heat-absorbent paving* *Shaded courtyards*	*Asbestos roofing with MC foil* *Concrete blocks*
Potable water use efficiency & quality	*Push taps* *Water fountains/ filters (carbon and UV filters)*	*Normal taps*
Rain water harvesting	*4 Tanks of total 120m^3* *Storm water directed to pond* *Porous paving* *Cascade system*	*None*
Solid waste Management	*Food (200kg/day) – fed to pigs* *Fabrics (733 kg/day)-sold* *Polythene (8.3kg/day) -reusing* *Cardboards (50kg/day)-sold* *e-wastes(electronic wastes)-sold* *Packaging, thread cones, stationery-reusing*	*Food (370kg/day)-land filling* *Fabrics (1500 kg/day-reusing* *polythene (38 kg/day),* *Cardboards (1050 kg/day)-open air burnings*
Waste water treatment	*Sent to centralized plant*	*Treatment plant - filtering by coal*
Alterations to natural environment and Landscaping	*Minimal alterations.* *No excavation and top soil removal* *Pile construction (45cm above)* *Over 300 native trees planted*	*Constructed on the ground level* *Artificial garden*
Energy use and gas emission	*10% solar and 90% hydro power(100% renewable power)* *165 Photovoltaic panels on roof* *one standby mobile diesel generator*	*Hydro or thermal* *3 diesel generators and 40 feet chimney*