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DEVELOPMENT OF A SUSTAINABILITY INDEX FRAMEWORK FOR THE MAURITIAN TEXTILE INDUSTRY

Final Report

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Development of a Sustainability Index Framework for the Mauritian Textile Industry

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ABSTRACT

Textile companies contribute to a great extent to environmental degradation in Mauritius. Seeking sustainability is one of the key methodologies to strengthen society. Sustainability in the Mauritian textile industry has lately received a mounting amount of consideration. A survey has shown that the majority of textile companies in Mauritius are on the path of sustainable development. All the companies affirmed that they fully include all the aspects of sustainability namely environmental, economic and social into their operations. Novel approaches of manufacturing are essential to influence development in such a manner that long-term sustainability goals are met. The hunt for more sustainable development strategies obviously requires to a large extent more than just challenging evaluation and innovative theorizing. It demands creative ideas, based on triumphant experience, that are practically and cost-effectively implementable. In the recent years, several innovative technologies have appeared in the textile industry. Examples of innovative waterless dyeing technologies are the DyeCoo waterless dyeing technology using supercritical CO_2 and the waterless AirDye technology. Moreover, advanced effluent treatment technologies like ultrafiltration, microfiltration and nanofiltration lessen the environmental impacts of textile companies and enable companies to reach a higher level of sustainability. The Mauritian textile industry is in need of an innovative sustainability framework that comprises of all the highly innovative, advanced and latest manufacturing technologies and approaches. In order to provide guidance to sustainability, an innovative sustainability index framework has been developed using 174 environmental, 15 economic and 30 social indicators. It is in the form of an interactive questionnaire capable of generating a sustainability index based on the environmental, economic and social data of textile companies. The framework has been developed on Microsoft Excel 2010. The framework has been tested in 5 textile companies in Mauritius and it has generated the scores of 75%, 61%, 67%, 73% and 70% for company A, B, C, D and E respectively. This innovative sustainability index framework will give the Mauritian textile companies an insight as to where they are situated in the level of sustainability. A low score in sustainability index indicates areas that need improvement. This innovative sustainability framework will enable textile companies to truly evaluate their level of sustainability. This will have an overall benefit not only on the textile companies but on Mauritius Island as a whole.

NOMENCLATURE

^0C	Degrees celcius
CDP	Carbon disclosure project
CDSB	Climate Disclosure Standards Board
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon dioxide
DJSI	Dow Jones Sustainability Indexes
ESG	Environmental, Social, and Corporate Governance
ESI	Environmental Sustainability Index
GHG	Greenhouse gas
GRI	Global Reporting Initiaitve
HFO	Heavy Fuel Oil
IEA	International Energy Agency
IPPs	Independent Power Producers
kg	kilogram
KW	kilowatt
L	Litres
LPG	liquefied petroleum gas
m^3/d	metre cube per day

MID	Maurice Ile Durable
Mtoe	Million tonne oil equivalent
MW	Megawatt
N_2O	Nitrous Oxide
NO_x	Oxides of nitrogen
OECD	Organizations for Economic Cooperation and Development
OM	Organic matter
ppm	Parts per million
PSI	Product Sustainability Index
SDGS	Sustainable Development Goals
SIDS	Small island developing states
SMEs	Small and medium enterprises
SO_x	Oxides of sulphur
tCO_2e	Tonnes of CO_2 équivalent
UN	United Nations
V	Value
WPI	Workplace innovation

CHAPTER 1

INTRODUCTION

1.0 Challenges of the 21th century

Planet Earth has experienced recurring alterations of its climate all the way through time like the melting of arctic glaciers and periods of intense warmth owing to global warming [123, 221]. Global warming is the increase in world temperatures attributable to greenhouse gasses (GHGs) like carbon dioxide ($C0_2$) and methane (CH_4) that entrap heat into the earth [62, 222]. When fossils like coal, heavy fuel oil (HFO), diesel and liquefied petroleum gas (LPG) are burnt, carbon found inside the fuels is let loosed into the atmosphere and this causes atmospheric CO_2 to climb [109, 228]. Methane emissions are caused by uncontrolled anaerobic degradation of organic matter (OM) for instance organic constituents of municipal and industrial wastes. The global warming potential of methane is known to be 21 times higher that of CO_2 [223]. Ever since the start of industrialization, there has been a swift increment in GHG levels [224]. 65 percent of GHG emissions are engendered by fossil fuel combustion. Coal is accountable for 45 percent, oil for 35 percent and gas for 20 percent [225]. The foremost GHG that causes global warming is $C0_2$.

The concentration of CO_2 in the atmosphere throughout the past 2000 years has been in the region of 280 ppm. Since the past 150 years, CO_2 and CH_4 concentrations have increased and their concentrations are the highest for preceding 800,000 years [221]. From year 1860 to year 2000, $C0_2$ concentration experienced an increment from 280 ppm to 360 ppm. At the same time, average surface temperature has amplified from 0.5°C to 0.7°C [222]. The biodiversity of our planet earth is worse than it has ever been. If no key CO_2 emission reduction programs are set in motion, CO_2 might increase to 750 ppm by year 2100 [226]. Climate change is among the most crucial concerns of the early 21st century [62]. It corresponds to a noteworthy peril to ecology worldwide, the world financial system and to the human population [62]. Technical proof is showing that human actions are altering the world's climate. Devoid of a clean, safe and adequate furnish of energy, we would not be able to operate as a modern civilization. Climate change will have extreme outcomes not only for a precise state but for all of the states of the globe. Rising scientific agreements point to the requirement for pressing actions to trim down CO_2 emanations [62]. In December 2015, at the Paris climate conference (COP21), the earth unified to fight climate change and have set the aim of restricting global warming underneath 2°C above preindustrial levels [229]. The best approaches to lessen GHG emissions are to diminish utilization of fossils and avert uncontrolled degradation of organic matter [225].

With a present population of 7.5 billion people, the world has witnessed a global energy consumption of 13 147.3 Mtoe in year 2015 [252]. The consumption of oil, gas and coal were 4331.3, 3135.2 and 3839.9 Mtoe correspondingly [252]. Fossil fuels accounted for 86% of the global consumptions [252]. A sufficient energy furnish has been recognized to be among the key requirements for economic, ecological and social growth in complex societies [92]. Nevertheless, the situation is extremely distressing for the reason that the world energy demand is constantly escalating but there is an enormous exhaustion of our natural resources. The International Energy Agency (IEA) forecasts that primary energy demand globally will reach 15,359 Mtoe in 2020 and 17,387 Mtoe by 2035 [253]. Fuel production in the upcoming future will turn out to be extremely costly as a reduced amount of reachable reserves are exploited. The world population is expected to reach 8.5 billion in 2050 and with this a superior energy demand will be expected .The quantity of fossil fuels required to power the world will keep on escalating if no substitutes are found [224].

This boost in world consumption is also producing colossal quantities of wastes that can be recycled in a useful approach. Nevertheless, till now, several developing countries are not having any sophisticated recycling facilities. Consequently, resulting wastes which are not properly managed are resulting in the degradation of the environment [5]. Humanity is being faced with declining ecosystem quality and mounting danger of putting the biosphere into a condition where it would be complex or impracticable to sustain human life [35]. Environmental stewardship is lagging behind social and economic development. Excessive energy consumption, increase in world population and economic development will continue to exert tremendous pressures on the world's ecosystem if no viable solutions are sought [4, 72, 85, 145].

1.1 The necessity of a sustainable world

Humanity is living extremely ahead of the planet's capacity, consuming the Earth's non-renewable energy assets as if we had one additional planet to draw upon [74]. Planet earth is our sole home. Unless humans are able to shift to another planet which is most likely impossible, we need to develop strategies to prevent environmental disasters and an energy crisis. Many queries come up like who is going to maintain our world for the upcoming generations and who is going to compensate for the appropriate safeguarding of our blue planet? [87]. One of the foremost

universal goals would be to work towards creating a sustainable planet [145]. Sustainable development is defined as a development which reflects on the requirements of the present without compromising the needs of the upcoming future [46, 85]. Sustainable development also means ameliorating the quality of human life and at the same time living inside the carrying power of sustaining ecology [46, 51, 85]. The notion of sustainable development has been depicted by the three viewpoints specifically environmental, social and economic [17, 45, 110, 111]. Apprehensions about the planet's sustainability have increased following the United Nation's Conference in year 1972 which launched the idea of sustainable development as a solution for ameliorating the quality of life for upcoming generations [1]. There are mounting amounts of undertakings internationally to shift towards a more sustainable society [14]. This is shown, for example, in the increasing endeavors in the world community to fight climate change [15].

There is an interesting link between sustainable growth and climate alteration [62]. On one side, climate change affects core innate and human habitat and in that way conjointly the ground for social and economic expansion; at the same time, the world priorities on sustainable expansion have an effect on the GHG emanations. The twofold correlation between sustainable development and climate change calls for the need for the examination of policies that mutually tackle sustainable development and climate change. Sustainable development objectives for transition economies are firmly coupled with climate change mitigation. Consequently, the sustainable development goals for these countries also consist of GHG mitigation challenges [63, 62]. In addition, the recently adopted Sustainable Development Goals (SDGS) launched by the UN General Assembly emphasize the international support for a dedication towards a wide sustainability plan [16].

1.2 Mauritius: geography and environmental issues

The Republic of Mauritius is a very small island situated in the Indian Ocean (20.3484° S, 57.5522° E). Mauritius otherwise called the paradise island is found east of Madagascar and south-east of the African drift. Its nearest neighbor is the Reunion Island. The area of Mauritius is approximately 1865 km^2 and it has an Exclusive Economic Zone that covers an area of 1.9

million km^2 [66, 77]. Mauritius is more or less entirely enclosed by coral reefs, lagoons and beaches. Mountains having rocky crests rise from the luxuriant plains. The rivers run swiftly all the way through deep ravines, with numerous waterfalls [8]. The island has around 1.3 million people based on year 2015 consensus [65]. Be that as it may, this heaven island has an exceptionally delicate biological community [30]. Environmental degradation has been a major concern in Mauritius since many years. Industrial activities and fossil fuel consumption have been the major causes of loss in the biodiversity of this small island. Since many years, textile companies have greatly contributed to the degradation of this island.

1.3 Sustainability in the Mauritian textile industry

Textile companies contribute to a great extent to environmental degradation in Mauritius. Fossil fuels like coal and heavy fuel oils (HFO) are burned in boilers to generate high temperature steam for dye houses and dryers. These fossils generate gases like CO, CO_2, NO_x and SO_x. Huge volumes of effluent from dye houses are discharged on a daily basis into rivers and streams. Poorly treated wastewaters can cause eutrophication, acidification, photo-oxidant formation and great misbalance in the flora and fauna. The mainstream of textile companies are seeking to attain sustainable growth in green concepts [2]. Sustainability reporting is the act of evaluating, revealing, and being answerable to internal and external stakeholders for company performance towards the aim of sustainable growth [29]. For companies to function sustainably, they have to be financially, environmentally feasible and publicly suitable [32]. Companies will be able to lower their carbon footprint and decrease their overall environmental impacts. In the recent years, it has become a requirement from clients to reduce their environmental impacts and work towards sustainable development. For instance, companies like PUMA requires all its textile companies to work towards lowering their carbon footprint and adopt cleaner production technologies. Sustainable expansion will enable companies to ameliorate their competitive edge, monetary performance, communal commitment and the public awareness's of the company in the market [32].

1.4 Lack of a proper sustainability index framework for the Mauritian textile industry

So far, Mauritius is trying its best to improve its level of sustainability in all aspects. Seeking sustainability is one of the key methodologies to fortify society, particularly where parts of social and monetary value and a healthy surround are considered [62]. Sustainability reporting has ended up being essential in figuring out the degree of sustainability of companies. Mauritius has demonstrated its want in supporting sustainable development by consenting to an arrangement with the United Nations and building up the Mauritius and United Nations agreement for sustainable development. A national policy for a sustainable Mauritius known as Maurice Ile Durable has turned into an all-encompassing activity for a change towards a sustainable future [30]. A sustainability index framework will give the Mauritian textile companies an insight as to where they are situated in the level of sustainability. However, there is the inadequacy of a proper sustainability index framework for the textile industry in Mauritius. This study addresses the scarcity of data in the literature review with this respect.

1.5 Aims and objectives of this study

Much has been composed about research that is centered on sustainable development [64]. Relatively little writing, in any case, can be found that spotlights on the sustainability of textile companies in Mauritius. The swiftness of transformation in the modern world demands for continuous attainment of knowledge and its propagation [88]. This study intends to fill in the knowledge gap and expand the literature review by developing a sustainability index framework for the Mauritian textile industry.

The specific objectives are:

1. Assessing the current level of sustainability of the Mauritian textile industry.
2. Studying and assessing existing sustainability frameworks.
3. Identifying and developing a set of economic, social and environmental indicators relevant to the Mauritian textile industry.
4. Developing and testing an appropriate framework for sustainability assessment of textile companies in Mauritius.

CHAPTER 2

LITERATURE REVIEW

2.0 Sustainable development for a better world

Our civilization is at the present time faced with several unrelenting dilemmas in areas such as energy, transport, cultivation, and environment [69]. The planet's innate assets have been utilized in approaches that are financially ineffective and extravagant, devoid of adequate reckoning of the proper risks of reserve exhaustion. The combustion of fossils has encouraged swift expansion for decades but has caused perilous consequences, with climate alteration menacing to turn over decades of progress [31, 109]. The unrelenting nature of these dilemmas is intimately related to the reality that the predicaments happen from processes that are intensely implanted in and privileged by the state and market [69]. These dilemmas call for shifts or innovations, where social progress breaks away from past lines of growth [69]. Novel approaches of manufacturing are essential to influence development in such a manner that in the long-standing sustainability goals are met [69]. Sustainable development has been recognized as a very vital area of focus for business leaders and governments [138].

The concept of sustainability has attained immense amounts of consideration from the time of the publication of "Our Common Future" in year 1987 [149, 152]. Sustainable development affirms that development must be equally inclusive and ecologically sound to trim down poverty and erect shared prosperity for today's civilization and to keep on meeting the requirements of upcoming generations [46]. Sustainable development lays focus on the present and upcoming generation requirements with human health and ecological protection as a base line of the growth [45, 143. 145, 152]. It is well-organized with resources and cautiously planned to bring both instant and long-term benefits for planet [31]. Sustainable development is the finest use of resources in all aspects [45, 46].

The notions of sustainability are steadily integrating the majority of science and engineering disciplines [108, 112]. Science and engineering mutually generate technologies in the present world, while sustainability offers confronts and opportunities to the conception of a green economy [108]. Scientists from various arenas like physical, biological, and social scientists together with engineers have to bring scientific facts, tools, and approaches to aid society in developing elucidations for important sustainability challenges and at the same time help societies to go forward [139]. As per [39], the benefits of sustainable development are fit people,

safer work environment, diminished number of accidents, controlled environment, improved workplace and reduction in pollution.

2.1 Pillars of sustainability

Sustainability is a very versatile idea [124]. Sustainable growth is not thought in a box devoid of development pillars. Preceding researchers have identified these pillars as economy, social and environment. By ameliorating these three pillars, sustainable growth becomes reliable [39, 13, 36, 42, 43, 47, 52, 73, 110, 111, 62, 10]. Ever since two decades, sustainable growth has been conceptualized by focusing on the economic and social expansion through science and technology with no unfavorable impact the ecological balance of the world [125]. For that reason, stakeholders need to adopt principles of environmental, economic and social sustainability for sustained success [156].

2.1.1 Environmental

The ecosystem is an aspect that has been driving the sustainability dialogue to a huge degree [125]. Innate resource scarcities and distributive inequities frequently cause ecological deterioration and aggressive human conflicts, particularly in developing countries. It warns about the likelihood of worsening ecological conditions and increasing violence in upcoming decades, and advises increased global cooperation to afford for sustainable development [126]. Environmental sustainability also helps by stabilizing and decreasing the environmental burdens [127]. These environmental burdens can be aspects like global warming, exhaustion of stratospheric ozone layer, pollution of water bodies, noise pollution, acid rain and desertification [128]. At the present, it requires societies to deal with issues related to environmental deterioration in order to build up a sustainable vision [129,136].

2.1.2 Economic

The notion of economic development is seen as one of the three pillars of sustainable growth [143]. Sustaining economic growth is a vital and globally accepted idea for the broad public.

[153]. The significance of economic sustainability is currently increasingly recognized even by highest political delegates [153]. Economic sustainability comprises of factors like the degree of economic returns, the insecurity of returns, and in monetary economies, the related financial needs and the accessibility of finance [151].

2.1.3 Social

The approaches to the social aspect of sustainable growth are as miscellaneous as the approaches to the economic aspect [155]. Social sustainability calls for the need that the unity of society and its capability to labor towards universal goals be sustained. People needs, such as those of wellbeing, nourishment, housing, schooling and cultural expression should be met [155]. Social sustainability can also be defined as the degree to which communal values, identities, connections and institutions can continue into the upcoming future [154, 11]. The expansion of sustainable occupational health and safety surroundings is of paramount importance for social sustainability [42]. Health and safety is slowly becoming an important aspect in social sustainability. In many researches, proper running of occupational safety and health have been found to play a fundamental part in running a triumphant business [41]. Frail Occupational Safety and Health (OSH) regulatory system is an invitation for mishap [40, 42, 44, 51].

2.2 International conferences on sustainable development

International collaboration plays a role of paramount importance in promoting sustainable growth in our world [93]. As shown in Table 1, there has been a perceptible increment in global debates and amount of discussions regarding research on sustainable development over recent years [62].

Table 1: International conferences on sustainable development

Conference	Country and Year	Conference details	Source
United Nations Conference on Sustainable Development Rio+20 conference	Rio 2012	This conference has encouraged research and innovation for universal sustainability. Explicitly, the conference encouraged partnership among the scholarly and scientific society, chiefly in developing countries in order to reduce the technological bridge amidst developing and developed states and promote international research teamwork on sustainable development.	[94, 144]
Paris climate conference (COP21)	Paris 2015	In this conference, 195 countries have signed first-ever global climate agreement. The climate deal sets out a universal action plan to shun perilous climate change by restricting global warming to below 2°C.	[164]
ECO summit (5th Ecosummit London **)**	London 2017	Ecosummit speeds up green startups, energy corporates, transport and cities. The conferences boost commerce growth, co-investing, novelty and business venturing.	[165]
United Nations Sustainable Development Summit	New York 2015	The conference witnessed the creation of The 2030 Agenda for Sustainable Development. The agenda is an action plan for the well fare of the planet and its inhabitants. This conference has recognized that annihilating poverty is the highest world confront and that it is a crucial prerequisite for sustainable growth.	[157, 158]
South East European Conference on Sustainable	Croatia 2002 to 2013	The conferences focused on the propagation of knowledge on techniques and technologies for sustainable growth. The attendees have presented their notion of sustainable growth and strategies	[108, 109]

Development of Energy, Water and Environment Systems (SDEWES)		for measuring sustainability with respect to energy, environment and production systems.	
International Conference REGSA	Ireland 2014	This conference encouraged the production of renewable electricity in South America and at the same time ameliorating ecological conditions and energy security and reducing poverty locally. Tertiary institutions were encouraged to create pilot projects to augment renewable energy production at regional level.	[95]
International Conference LINKS	Brazil 2015	This conference focused on policies for sustainable growth and confronts in the utilization of energy and water resources There has been also the promotion of facts, ideas and experience obtained from victorious schemes related to technological modifications in the energy sector and their impacts on water and greenhouse gas emanations.	[96]
United Nations conference on the environment and development	Rio de Janeiro 1992	The conference marked the termination of several months of consultations between Member States and UN experts who reviewed great quantities of data and shared a wide range of experiences in ecological protection, civil rights, woman empowerment, employment, health and urban development. Each conference has established conformities on global issues.	[162]
Rheims International Conference on Sustainability Studies	Rheims Annual	This conference brought experts from different parts of the globe, whose work focuses on numerous facets of sustainability.	[142]
United Nations Conference on the Human Environment	Stockholm 1972	This conference focused on international ecological problems and marked a turning point in the creation of international ecological politics.	[163]
Third International	Apia, Samoa 2014	It centered the world's focus on countries that are a special case for sustainable growth with respect	[159]

Conference on Small Island Developing States		to their unique and particular vulnerabilities.	
World Summit on Sustainable Development (WSSD)	Johannesburg 2002	This conference has centered the world's focus on meeting world challenges, including ameliorating people's lives and protecting our natural assets in a world that is increasing in population, with ever-rising demands for food, water, proper sanitation, energy and health.	[160]
BPoA+5 (1999) Five-year review of the Barbados Programme of Action	Barbados 1999	This conference has identified six predicaments that require pressing attention namely energy, freshwater resources, tourism, climate change, climate variability, natural and environmental disasters.	[161]
United Nations Climate Change Conference	Copenhagen 2009	The Copenhagen summit lifted up the climate alteration policy to the uppermost political level. Approximately 115 global leaders participated in the high-level summit, causing it to be of the chief gatherings of global leaders ever. The Copenhagen Accord consisted of numerous key factors but the most important one was the long-standing target of limiting the utmost global average temperature increment to no more than 2°C above pre-industrial levels.	[173]

2.3 United Nations sustainable development goals

In year 2015, the Sustainable Development Goals (SDGs) were published and approved by the United Nations (UN). These goals are significant components of Agenda 2030 which is an accord by the UN to ameliorate international sustainability by year 2030 [7, 32]. The SDGs comprises of 17 goals that covers all facets of sustainable development (Figure 1). These goals are a grand march toward actionable targets for sustainable growth that covers all the facets of sustainability [7].

Figure 1: United Nations sustainable development goals [167]

These SDGs are structured around the goal of attaining 'The Future We Want' [34]. They are grand step towards sustainable growth, taking a much wider vision of sustainability than ever achieved before. Nevertheless, there are realistic challenges like how to put into practice change and innovation [56]. The wideness and interconnectedness of these goals make it obvious that experts from multiple disciplines must labor together to realize the goals. Complicated matters like climate alteration, poverty and civil rights need knowledge and abilities from dissimilar disciplines in an incorporated manner. This will enhance the aptitude to comprehend intricate problems and tackle them, aligned to the anticipated results from education for sustainable growth [141]

2.4 Kyoto protocol

The Kyoto Protocol is known to be as one the most noteworthy global endeavor ever made to trim down the effects of global warming and climate alteration. It is of immense significance for determining the commitments to lessen greenhouse gas emanations and the applicable mechanisms [169, 168, 170]. The Kyoto Protocol started taking effect in year 2005, 8 years after its outset in year 1997. This is due to the fact that the Protocol had to be approved by 55 countries worldwide [169, 177]**.** The Kyoto Protocol has defined driving factors of carbon dioxide emanation, which has the uppermost rate in the midst of other greenhouse gas emanations, in five subdivisions as follows: population size, carbon density, gross domestic product per capita (GDP), energy density and deforestation. These five factors have to be addressed thoughtfully for the purpose of decreasing carbon dioxide emanations. This is extremely imperative for the Protocol to be triumphant [169, 177].

2.5 Paris Agreement COP 21

In year 2015, the world has witnessed the happening of Paris Conference of the Parties (COP21). It has been one of the highly triumphant climate change conferences ever by creating the Paris Agreement [174]. The Paris Agreement agglomerates all nations worldwide into a universal cause to embark on ambitious endeavors to fight climate alteration and become accustomed to its effects, with improved support to aid developing states to do so. As such, it draws a novel course in the global climate endeavors [178]. The agreement sets the goal to maintain the utmost global average temperature rise as near as possible to 1.5 °C [175, 172, 176]. In order to accomplish this goal, suitable monetary flows and an improved capacity building framework will be developed [171]. This will provide a supporting hand by developing the highly susceptible countries, with respect to their national targets. This agreement also allows for improved precision of action by providing a more dynamic framework [171,178].

2.6 Commitment of countries for sustainable development across the globe

All states around the world should reflect on sustaining its assets to upcoming generations through respecting sustainable development goals that consist of communal advancement, poverty diminution, equity, improved resilience, economic expansion and ecological sustainability [54]. All states in the globe are inter-reliant that is to say they are unswerving to the "tragedy of the commons" against their will [54]. Multiple world partnerships have been launched to support sustainable development [34]. World partnerships are win-win occasions for addressing climate change at reduced cost and at the same time pushing developing countries on a minor-carbon route, as carbon emanations, capture and storage are highly geographically independent [34]. Renewable energy is fundamental to a shift to a sustainable world [57, 86]. As shown in Table 2, many countries have started boosting their renewable energy capacity [57].

Table 2: Sustainable development programs in different countries around the world

Country	Sustainable development programs	Source
Nigeria	Increment in the quantity of renewable energy resources in electricity generation.	[59]
Qatar	Making the cost of electricity production from the wind turbine favorable to that from fossil fuels.	[60]
Russia	Realization of multiple structural and market modifications to ease investment in renewable energy.	[61]
Polish	Teacher training on the importance and principles of sustainable growth in the world.	[86]
Azerbaijan	Generation of electricity and heat using solar energy.	[87]
India	Utilization of wind turbine and refurbishment of tropical dry evergreen forest (TDEF).	[34]
Africa	Renewable energy utilization.	[146]
China	Adoption of ecological protection, pollution control and moving from end-of-pipe treatment to source control.	[148]
Mauritius	Generation of electricity from renewable energy. Development of sustainable tourism and eco efficiency.	[156]
Europe	Installation of solar photovoltaic power and wind turbines throughout the country.	[171]

2.7 Sustainability frameworks in the world

Sustainability frameworks have the purpose of proposing a systematic approach to sustainable growth [136]. It is a great challenge to incorporate sustainability principles in areas like research, and company management. Above the description of sustainability, it is essential to set up the basic conditions with respect to objectives and metrics. The notion of sustainability assessment is as essential as complex. However, it has been improved quantitatively and qualitatively. The quantity of tools is rising and at the same time several frameworks have enlarged their preliminary proposal to incorporate support tools like application guidelines and case study experiences [131]. As shown in Table 3, sustainability frameworks can be classified into five categories [132,133].

Table 3: Framework categories

Number	Categories	Description
1	Self-assessment	Voluntary standards that set guidelines to provide facts of the present situation to prepare for upcoming actions. These frameworks may comprise of a list of best-practices which can enable benchmarking.
2	Footprints	Framework that enables the conversion of the concept of sustainability in a quantitative approach. These frameworks have become trendy with organizations and the public as they are simple to comprehend, apply and communicate.
3	Protocol	Methodological proposals that enables monitoring and evaluation of sustainability. They consist of a highly strong methodological proposal compared to self-assessment frameworks.
4	Guide	Systematization of a series of guidelines, sustainability indicators, and best practices that behave as ideas for working with the theme. These guides act as reference material which can enable for self-assessment.
5	Certifications or Labels	Auditable standards that prove conformity to established methods. They are based on guidelines, protocols and assessments.

A number of frameworks have been developed to provide sustainability solutions to the world problems. They are enumerated below.

2.7.1 Climate Change Reporting Framework (climate disclosure standard board)

The Climate Disclosure Standards Board (CDSB) is a global association of companies and ecological nongovernmental organizations [235]. The CDSB focuses on improving and aligning the universal conventional corporate reporting model to associate natural assets with financial assets. CDSB functions on the basis that shareholders and financial bodies can make improved and informed choices if organizations are open, transparent and examine the dangers and opportunities linked with climate change-associated information. CDSB behaves as a medium for alliance on how existing standards and practices can be utilized to connect economic and climate change-linked information using the Climate Change Reporting Framework [235].

The Climate Change Reporting Framework gives precise guidance for preparing concise revelations on climate change-related information in conventional reports. It centers on the perils and opportunities that climate change presents to a company's policy and economic performance. Initiated in year 2010, the Climate Change Reporting Framework depends on pertinent existing standards like the Greenhouse Gas Protocol and International Financial Reporting Standards. The uniqueness of the framework is that it references existing standards rather than inventing a new one. The Framework also takes up significant principles and objectives of economic reporting to balance conventional financial reporting models [235]. It focuses on how climate change impinges on an organization's economic performance and value creation. Information obtained with respect to the Climate Change Reporting Framework allows investors to formulate informed and robust choices. These are dependent on lucidity, assurance and faith in climate-change associated opportunities and risks revealed by an organization [235].

Organizations can utilize the Climate Change Reporting Framework to include climate change-associated information in their reports [235]. The contents of the framework aid organizations in attaining a holistic vision of how climate change can impinge on their performance and the required actions they could take to tackle the risks and opportunities. Governments can profit from a standard ready framework that can be instantly utilized or referenced as an approach of compliance in regulation. Investors will be capable of making knowledgeable decisions based on lucidity, self-assurance and conviction. Analysts will be better prepared to use climate change-associated information in predicting impacts on upcoming cash flow [235].

There are four steps in providing significant climate change disclosure reports and they are enumerated below:

1) Determination

Evaluation of what needs to be included in the report by considering the following factors:

• The requirements of the investors with respect to climate change

• The opinion of board of executives

• An assessment of the present business model concerning climate change and the meticulous perils, opportunities and governance challenges it presents

• The availability of adequate data to allow readers to assess precedent performance and anticipate upcoming outlook

• Regulatory and conformity requirements

2) Preparation

Setting of a lucid base as you build up the content and considering factors like:

• Lucidity on the reporting age and reporting limitations

• Recognition of applicable standards, protocols and policies

• A study of the material concerns created by climate change

• Clarity in the disclosure contents

• The times scales covered by disclosures so that precedent results and upcoming prospects are understandable

3) Presentation

Ensuring that the disclosure is helpful to investors by considering the following factors:

• Usage of very straightforward language and at the same time going in depth on context and assumptions

• Thorough argument of the connection between climate risk and organization prospects

• Proper presentation of information to enable easy yearly comparisons

• Sectioning important information so that investors can center their focus on specific areas

• Usage of climate change measures that illustrate improvement versus targets

4) Review

Checking that the disclosure is precise, comprehensive, trustworthy and appropriate by considering the following factors:

• Checking whether the contents of the report are aligned with the expectations of steps 1, 2, and 3

• Ensuring that the final drafted report consist of a meticulous internal review and sign-off

• Sharing of the final drafted report with chosen external stakeholders to request their viewpoints

The indicators of the Climate Change Reporting Framework are presented in Table 5.

2.7.2 Global Reporting Initiative (GRI) framework

GRI reporting is among the most common strategies for company sustainability reporting [24, 29]. The aim of the GRI is to allow the transmission of sustainability records. Its intention is to make available procedures to show a clearer image of the human and environmental impacts of a company. Moreover, one of the GRI's foremost purposes is to allow investors and stakeholders to craft well-planned decisions concerning outlays and the purchasing of goods and services from the corporation. Moreover, the GRI framework allows the comparison of data and allows a proper benchmarking between different organizations. The GRI focuses greatly on environmental issues. Environmental issues are connected to further social responsibility issues

that are elemental in enhancing the progress of a sustainable society. Due to this basic relationship, the GRI provides a channel to integrate sustainability using environmental performance indicators [18]. The GRI has established 79 indicators: 9 for financial performance, 30 for ecological performance and 40 for communal performance. Communal performance is then split into 14 indicators of employment practices, 9 for individual rights, 8 for communal facets and 9 for corporation product accountability [20].

The five guidelines of the GRI for data compilation are namely:

i) Trends reporting, to reflect on past, present and futures objectives,

ii) Protocols usage, to offer fundamental direction for interpreting and compiling data,

iii) Data presentation, to demonstrate normalized data,

iv) Data aggregation, to decide on the suitable aggregation of data,

v) Metrics to utilize.

The GRI is, subsequent to the ISO 14001 standard, the next highest dominant standard for social responsibility. Consequently the GRI and ISO 14001 may perhaps pursue parallel diffusion trends [19, 27, 23]. The GRI is a very important communication strategy for lowering data asymmetry amid a firm and its shareholders and stakeholders [28]. The indicators of the framework are presented in Table 5.

2.7.3 Environmental, Social, and Corporate Governance (ESG) Disclosure Framework

In the precedent 20 years, there have been mounting requirements for enhanced corporate reporting, and fascinatingly the spotlight is principally on supporting organizations to make available additional non-financial data [180]. The rising interest paid to concerns of sustainability has caused a great increment in firms' data revelation on ecological, communal and governance (ESG) practices [179]. ESG disclosure, as a chief component of non-financial data, aids to offer a higher comprehension of firms' businesses [179].

The whole ecological regulatory paradigm is erected around the notion that companies must be compelled to carry out ecological enhancements, since they would otherwise find them expensive or unbeneficial, and consequently not embark on them on their own [186]. ESG practice includes manufacturing technology, the utilization of raw materials and the relations with regulations and society. It has an effect on the company in the long run, and consequently requires finely designed strategies. ESG revelation makes available significant additional facets over and above financial data [179].

With the enhanced accessibility of ESG data disclosure, the asymmetric information between companies and associated parties can be trimmed down. The affiliations with significant stakeholders can be reinforced, leading to improved operating performance all the way through consumption, capital investment, positive employment conduct, and as a result superior firm value. Stakeholders say that a firm with proper ESG practices should be capable of performing well when competing in the regional and global market [185]. Therefore, the stakeholders will recompense such good quality management through higher investment, superior consumption, and higher productivity. For instance, if the society considers a firm to be operating properly based on their ESG disclosure, the former may desire to purchase more items from it, consequently causing a rise in profitability [185].

A superior degree of ecological risk may lessen a firm's likelihood of being chosen relative to its peers by its prospective customers, which once more influences fiscal performance [179]. ESG disclosure also ameliorates transparency and visibility in industries' communal and ecological factors and governance [181]. Superior ESG disclosure is linked with higher stakeholder involvement, decreasing the probability of myopic decisions [179]. Ecologically or socially motivated actions can enhance the management team's abilities and the companies’ aptitude to draw qualified employees. Furthermore, such actions can improve the companies' status [187].

Many studies scrutinize on the correlation between ESG information disclosure and company value by centering on explicit ecological, communal and ethical events. Investors respond less unhelpfully to firms with higher ecological information disclosed than those with lower data provided [182]. [183] gave proof that higher ESG disclosure amid a sample of EU and North American firms caused an increment in company value by lessening information risk. [184] have

utilized a sample of Canadian, German and French firms and have found proof of a positive relationship.

The United Kingdom is among the chief countries when it comes to promoting ESG disclosure. It necessitates ESG disclosure in a company's Business Review, as mentioned in the Companies Act (2006). Such disclosure involves revelation on the weight of the firm's business on the ecosystem, data about the firm's employees and policies applied by the firm with respect to these issues and the efficiency of those policies [179]. This ESG Disclosure Framework caters for altering and varied beliefs for the revelation of ESG information. The Framework has the aim of offering direction on the rationale behind ESG-linked queries and eases an informed debate between general partners and their limited partner investors. The indicators of the framework are presented in Table 5.

2.7.4 IPIECA Climate Change Reporting Framework

The quantifying and reporting of greenhouse gas emanations is becoming frequent in companies and states as society endeavors to trim down GHG emissions. Approaches to quantify and report greenhouse gases must be tackled with intricacy, ambiguity and conflicting options for assessment and aggregation [236]. Reporting on climate alteration is more and more expected to go further than GHGs to cover numerous other facets of an organization's climate-related positions and actions. In the latest years, stakeholders have been greatly interested in the oil and gas industry's opinions on risks related to climate change and the actions taken to address these risks [236].

IPIECA is the international oil and gas industry organization for ecological and communal issues. It builds up shares and encourages best practices and facts to aid the industry in ameliorating its ecological and societal performance [236]. IPIECA assists the company tackle these reporting matters by offering guidance and reporting standards. The oil and gas industry has adopted different procedures to report greenhouse gas emanations, developing the initial sector guidance in year 2004. IPIECA behaves as a channel to bring experts to work collectively on dilemmas like greenhouse gas emanations, energy efficiency and trimming down the impact of fuel emanations [236]. By doing this, IPIECA aids the oil and gas industry deal with its

ecological impact and tackle climate risks while it labors to meet the rising demands for energy. In addition, companies can also report information to third parties. Over the last 10 years, several of these third-party businesses have developed an array of tools and formats for oil and gas industries to bring into play in describing their positions related to climate alteration risks and in publicly revealing greenhouse gas emanations-associated performance data. In several cases, these tools have changed, increasing in degree, detail and intricacy [236].

IPIECA has crafted a reporting framework specific for the oil and gas companies for public disclosure of information in a very easy, clear-cut and transparent manner that allows for a wide coverage of the concerns and provides a reliable reporting methodology [236]. A big quantity of IPIECA members are currently moving further than just GHG emanations reporting and piloting the climate change reporting framework [236]. The indicators of the framework are presented in Table 5.

2.7.5 Environmental Sustainability Index (ESI)

The Environmental Sustainability Index (ESI) measures the general advancement towards ecological sustainability [237]. The index offers a complex profile of countrywide ecological stewardship based on a compilation of numerous indicators obtained from fundamental datasets. The ESI provides a method for establishing "peer groups" of states for benchmarking ecological performance [237]. The cluster analysis offers a set of seven groupings that connects states depending on their ecological traits. The clusters smooth the progress of comparative analysis that aids to highlight leaders on an issue-by-issue basis and allows states to measure relative performance and spot best practices [237].

The ESI benchmarks the aptitude of states to safeguard their ecosystem over the upcoming decades. It achieves so by incorporating 76 data sets - tracking innate resource endowments, precedent and current pollution intensities, ecological management endeavors, and a civilization's ability to enhance its ecological performance [237]. These indicators allow for contrast among the five basic constituents of sustainability: ecological systems, ecological stresses, human being susceptibility to ecological stresses, communal ability to act in response to ecological challenges and global stewardship. The topics revealed in the indicators were

identified through a far-reaching review of the ecological literature, appraisal of accessible data, meticulous analysis and international discussion with policymakers, researchers and indicator specialists [237].

The ESI makes available a precious tool for the benchmarking of ecological stewardship and allows for comparative policy analysis. However, the scarcity of trustworthy data for performance measurement of several issues across several states hampers endeavors to shift towards better data-driven and empirical decision making [237]. Ecological stewardship requires the consideration of an extensive range of pollution control and resource management concerns. Several states are faced with dissimilar ecological challenges like excessive pollution due to industrialization and the stresses of poverty and incapacity. Ecological stewardship not only relies on policy efforts but also on the communal, political, and financial systems of a society [237]. Even if it appears that no state is on a completely sustainable route, a few states are dealing with their ecological challenges much better than others. Measures of governance, the strictness of regulations and the level of international cooperation are directly related to overall ecological accomplishment [237]. The indicators of the ESI framework are presented in Table 5.

2.7.6 The Joint World Bank-IMF Debt Sustainability Framework for Low-Income Countries

Low-income countries are faced with great challenges in order to achieve their sustainable development goals and in order to ensure that their external debt stays sustainable. In year 2005, the Executive Boards of the Bank and the IMF developed a framework for debt sustainability assessments in low-income countries and named it the Joint World Bank-IMF Debt Sustainability Framework for Low-Income Countries. They then carry out an assessment of a country's repayment capacity over time by making use of debt ratios and conducting stress tests. This framework is a valuable tool for monitoring macroeconomic imbalances and to comprehend monetary risks. The framework aids states to maintain a balance in their development objectives with debt sustainability concerns. Countries that have obtained benefits from debt relief can utilize the framework in determining the proper pace of future indebtedness in order to prevent a recurrence of debt distress [270]. The indicators of the Joint World Bank-IMF Debt Sustainability Framework are presented in Table 5.

2.7.7 IFC Sustainability Framework

IFC's Sustainability Framework communicates the corporation's tactical pledge to sustainable development, and is an essential component of IFC's strategy to risk management and reduction. The framework consists of IFC's strategy and performance standards on ecological and communal sustainability [238]. The policy on ecological and communal sustainability depicts IFC's pledges, roles, and responsibilities associated with ecological and communal sustainability. IFC's Access to Information Policy depicts IFC's pledge to transparency and good governance, and summarizes the firm's institutional revelation commitments with respect its capital outlay and advisory services [238]. The performance standards are centered towards clients, giving assistance on how to recognize risks and impacts, and are developed to prevent, reduce, and handle risks and impacts as an approach of doing business in a sustainable manner [238]. This also includes stakeholder participation and revelation obligations of the client with respect to project-level activities. With respect to its direct investment, IFC obliges its customers to utilize the performance standards to deal with ecological and communal risks and impacts so that development opportunities are improved. IFC utilizes the framework together with several other tactics and policies to manage the activities of the company with the aim of achieving its overall development goals [238]. The indicators of the framework are presented in Table 5.

2.7.8 Organizations for Economic Cooperation and Development (OECD)

Several enterprises have begun their path towards green growth by making sure that their development is financially and ecologically sustainable. Their pioneering experiences greatly prove that ecological improvements go together with profit-making and improved competitiveness [233]. Nevertheless, several small and medium-sized businesses (SMEs), that comprises around 99% of all businesses across the OECD have not yet seized these great opportunities [233].

The OECD Sustainable Manufacturing Toolkit helps by providing a practical starting point for enterprises around the globe to ameliorate the efficiency of their processes. This enables them to contribute in a positive way to sustainable development. The Toolkit comprises of an internationally applicable set of indicators that aid businesses in measuring their ecological performance at the level of the facility [233]. It gives advice on 18 of the highly important and

commonly utilized quantitative indicators for ecological performance that will aid in driving performance in industries [234]. These indicators will assist internal management and decision-making and can be utilized for all categories of manufacturing. The indicators of the framework are presented in Table 5.

2.7.9 Dow Jones Sustainability Indexes (DJSI)

Businesses are faced with increasing pressures from both internal and external stakeholders to take into consideration the ecological and communal impacts of their operations. Several organizations have implemented a number of sustainability schemes. Details on these schemes are openly shared in corporate sustainability. Nevertheless, stakeholders have to struggle to comprehend the information which is reported. To aid in highlighting corporations with a model sustainability performance, a quantity of ratings, awards, and indices have been developed [188, 189]. One of them is the Dow Jones Sustainability Index [189].

Investors are more and more seeing sustainability as an important aspect in the overall enterprise success and there are mounting pressures to invest in businesses that set industry-wide best practices with respect to sustainability [190]. Corporate sustainability performance performs a measurement of the degree to which a company includes financial, ecological, communal, and governance factors into its operations, and finally the impacts they have on the company and society [191]. However, there is no globally accepted methodology of measuring corporate sustainability, but it is evident that businesses must measure sustainability performance [192, 189].To give investors with supplementary insight into corporate sustainability, a quantity of sustainability indices have also been developed [189,193,189]. It has been said that the DJSI is among the best sustainability indices in the world and that it utilizes a best-in-practice assessment procedure [189]. The DJSI monitors the performance of firms that lead in corporate sustainability in their corresponding sectors. The indices operate as benchmarks for investors who include sustainability aspects into their portfolios [196]. The indicators of the framework are presented in Table 5.

2.7.10 Ford Product Sustainability Index (PSI)

Ford Product Sustainability Index (PSI) is one of the highly comprehensive approaches in determining how the ecological, social and financial impacts of vehicles can be tackled as from the earliest stages of their development [232]. The PSI allows for a basis for permanent evaluation and enhanced sustainability performance for new generations of vehicles. As a result, the all-new Ford Mondeo, S-MAX and Galaxy models show enhanced product sustainability performance when compared with their predecessors [232]. For example, more recycled and renewable materials have been utilized in the making of these three models. Furthermore, the safety performance of these models has been enhanced and there has been a reduction in the life-cycle air emissions and life cycle cost of ownership [232].The indicators of the framework are presented in Table 5.

2.7.11 Carbon disclosure project (CDP)

The Carbon Disclosure Project is among a company's voluntary ecological disclosure channels that allow for the examination of disclosure decisions. The CDP forwards questionnaires to companies around the world to collect data on GHG emanations and interlinked problems such as emission reduction schemes and endeavors [230]. Managers are faced with two sequential decisions [230,231]. Initially, they have to decide whether to collect the data requested, fill in the questionnaire, and send it back it to the CDP Second, they have to choose if their response will be made publicly available or not [230,231].The CDP questionnaire is chiefly suited for a cross-country study as it allows for an internationally reliable disclosure standard. Besides, GHG emanations have a widely alike impact almost anywhere in the globe and therefore allow the use of similar accounting mechanisms [230,231]. The indicators of the framework are presented in Table 5.

2.7.12 CSD framework

The United Nations Division for Sustainable Development has developed a set of indicators known as the CSD indicators. These indicators can be utilized as a reference for states to develop or revise nationwide indicators of sustainable development [239]. The preceding two editions of

the CSD indicators were released worldwide in year 1996 and 2001. They have been greatly tested and utilized by several countries around the globe [239]. All states have to take into consideration the new CSD core indicators when performing a revision on existing national indicators of sustainable development or during the development of new indicators. These core indicators cover problems that are specific for sustainable development in the majority of countries. They make available important information not available from other indicators. CSD indicators can be utilized by international organizations for their capacity-building activities with respect to indicators of sustainable development. Incessant work on the CSD indicators will give an idea of a country's experiences made in adopting the new set of indicators [239]. The indicators of the framework are presented in Table 5.

2.7.13 A framework for advancing environmental and social sustainability in the United Nations system

The ecological and communal sustainability framework of the United Nations plays an important role in promoting and protecting the well-being of humans in accordance with globally recognized declarations, conventions and standards [240]. The Framework holds a very holistic interpretation of the company's work starting from policy conception to the internal management of the operations and this allows for smart decision-making [240]. United Nations organizations have embraced numerous ways of considering communal and ecological impacts [240]. The framework consists of all the individual actions to be adopted by each United Nations entity to incorporate ecological and communal sustainability measures. At the same time, it comprises of collective practices for the organizations to adopt like support and knowledge-sharing function and a centralized reporting structure. The main advantages of a common sustainability framework are mainly higher integrity, reduced risks, higher opportunities, simplification and increased transparency [240]. The indicators of the framework are presented in Table 5.

2.7.14 Global Framework for Climate Risk Disclosure

A cluster of investors from around the globe have announced the implementation of a Global Framework for Climate Risk Disclosure [241]. The investors necessitate this info so as to

scrutinize an organization's business risks that result from climate change and also a company's endeavors to mitigate those risks [241]. The Framework inspires standardized climate risk disclosure to render it easier for investors to analyze and compare organizations [241]. The indicators of the framework are presented in Table 5.

2.7.15 Higg Index

The Higg Index is a set of tools that allows companies of all sizes at each stage in their sustainability journey to precisely determine and score their company's sustainability performance. It offers a holistic approach that empowers companies to make significant ameliorations that protect the interests of employees the society and the ecosystem. The Higg Index allows brands and manufacturers to achieve transparency by making clear, comparable, and meaningful sustainability scores become public. By using one common language to share sustainability scores, consumers will be able to make informed purchasing decisions [251]. The indicators of the framework are presented in Table 5.

2.7.16 Comparative matrix of the frameworks

A comparative matrix of the indicators present in all the frameworks is presented in Table 5.

Table 4: List of frameworks

Framework number	Name of framework
1	CDSB Climate Change Reporting Framework
2	Global Reporting Initiative (GRI) framework
3	Carbon disclosure project (CDP)
4	Ford Product Sustainability Index (PSI)
5	Dow Jones Sustainability indexes(DJSI)
6	A framework for advancing environmental and social sustainability in the United Nations system
7	IPIECA Climate Change Reporting Framework
8	Environmental Sustainability Index (ESI)
9	Organizations for Economic Cooperation and Development (OECD)
10	Environmental, Social, and Corporate Governance (ESG) Disclosure Framework
11	Global Framework for Climate Risk Disclosure
12	IFC Sustainability Framework
13	The Joint World Bank-IMF Debt Sustainability Framework for Low-Income Countries
14	CSD framework
15	Higg Index

Table 5: Comparative matrix of frameworks

FRAMEWORKS COMPARATIVE MATRIX																
ENVIRONMENTAL INDICATORS			**FRAMEWORK NUMBER**													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Material	Total materials use other than water	Tonnes, kilograms or volume		✔												✔	
	Percentage of materials used that are wastes (processed or unprocessed) from sources external to the reporting organization	Tonnes, kilograms, or volume		✔													
	Fossil fuels consumption	Tonnes or kilograms	✔	✔				✔	✔	✔	✔						
	Non-renewable materials intensity	Tonnes/normalisation factor		✔							✔						
	Weight of non-renewable resources consumed	Tonnes						✔			✔						
	Weight of restricted substances consumed	Tonnes									✔						
	Normalisation factor	Nb									✔						
	Residuals intensity	Tonnes/normalisation factor									✔						
	Recyclability	%		✔						✔	✔						
	Weight per unit of materials consumed	Tonnes,kilograms									✔						
	Proportion of non-renewable content	%		✔				✔			✔						
	Non-renewable materials intensity over product lifetime	Tonnes/year									✔						
	Expected lifetime of product	Year									✔						
	Renewable materials content of products	%									✔						
	Proportion of restricted substances contained	%									✔						
	Proportion of reused content	%		✔						✔	✔						
	Fertilizer consumption per hectare of arable land	L/ha								✔							
	Pesticide use per hectare of crop land	L/ha								✔							
	Coal consumption per populated land area	Tonnes/ha								✔							
	Restricted substances intensity	Tonnes/normalisation factor									✔						
	Weight of restricted substances consumed	Tonnes									✔						
	Recycled and natural materials related to all polymers	NA				✔											
	Vehicle allergy-tested interior	NA				✔											
	Undertaking of materiality analysis to identify the most important material issues	NA					✔										
	Public disclosure details of the materiality analysis	NA					✔										

Water	Total water use	m^3		✔			✔	✔			✔						✔
	Water intensity	m^3/normalisation factor									✔						
	Units of water consumed in production process	m^3									✔						
	Units of water consumed in overhead	m^3									✔						
	Total recycling and reuse of water	%		✔													
	Total volume of water recycled and reused as a percentage of the total water withdrawal	%		✔													
	Water sources and related ecosystems/ habitats significantly affected by use of water.	NA		✔													
	Annual withdrawals of ground and surface water as a percent of annual renewable quantity of water available from the sources	%		✔				✔								✔	
	Freshwater withdrawal (excluding once-through cooling water)	m^3		✔													
	Total volume of water withdrawn from surface water, including water from wetlands, rivers, lakes and oceans	m^3		✔				✔									
	Total volume of water withdrawn from ground water	m^3		✔				✔									
	Total volume of water withdrawn from rainwater collected directly and stored by the organization	m^3		✔				✔									
	Total volume of water withdrawn from waste water from another organization	m^3		✔				✔									
	Total volume of water withdrawn from municipal water supplies or other water utilities	m^3		✔				✔									
	Freshwater availability per capita	m^3/ capita								✔							
	Internal groundwater availability per capita	m^3/ capita								✔							
	BOD in water bodies	mg/l														✔	
	Dissolved oxygen content	mg/l								✔							
	Suspended solids content	mg/l								✔							
	Electrical conductivity	Siemens per meter (S/m)								✔							
	Phosphorus concentration	mg/l								✔							
	Surface water availability	m^3								✔							
	Groundwater availability	m^3								✔							
	Percentage of country under severe water stress	%								✔							
	Concentration of Faecal Coliform in Freshwater	mg/l														✔	
	Water stress	NA								✔							
	Turbidity	FTU								✔							
	Availability of surface freshwater	m^3								✔							
	Availability of ground water	m^3								✔							
	Surface and groundwater withdrawals in comparison to their recharge rates	NA								✔							

	Internal renewable water per capita	m^3/ capita								✔							
	Water inflow from other countries per capita	m^3/ capita								✔							
	Is your facility location rated “high” or “very high” for overall water risk?	NA															✔
	Does your facility track water use from this source?	NA															✔
	What was the frequency of water measurement?	NA															✔
	Does your facility know what facility processes or operations use the most water?	NA															✔
	Has your facility set targets for reducing water use?	NA															✔
	Does your facility have an implementation plan to improve water use?	NA															✔
	Has your facility implemented a water balance or another analysis to evaluate the traceability of water intake vs. usage ?	NA															✔
Biodiversity	Location and size of land owned, leased, or managed in biodiversity-rich habitats	Ha		✔				✔		✔	✔					✔	
	Subsurface and underground land that may be owned, leased, or managed by the organization	NA		✔													
	Position in relation to the protected area (in the area, adjacent to, or containing portions of the protected area) or the high biodiversity value area outside protected areas	NA		✔				✔									
	Type of operation (office, manufacturing or production, or extractive	NA		✔													
	Size and location of all habitat protected areas or restored areas, and whether the success of the restoration measure was or is approved by independent external professionals	Ha		✔													
	Partnerships with third parties to protect or restore habitat areas distinct from where the organization has overseen and implemented restoration or protection measures	NA		✔													
	Status of each area based on its condition at the close of the reporting period	NA		✔													
	Percentage of country's territory in threatened ecoregions	%						✔		✔							
	Threatened bird species as percentage of known breeding bird species in each country	%								✔							
	Threatened amphibian species as percentage of known amphibian species in each country	%								✔							
	Description of the major impacts on biodiversity associated with activities and/or products and services in terrestrial, freshwater, and marine environments	NA		✔													
	Amount of impermeable surface as a percentage of land purchased or leased	%		✔													
	Impacts of activities and operations on protected and sensitive areas	NA		✔													

	Changes to natural habitats resulting from activities and operations and percentage of habitat protected or restored	%		✔				✔									
	National Biodiversity Index	Nb								✔							
	Acidification exceedance from anthropogenic sulfur deposition	Nb								✔							
	Percentage of mammals threatened	%								✔							
	Productivity overfishing	NA								✔							
	Acidification	NA								✔							
	Eutrophication	NA								✔							
	Objectives, programmes, and targets for protecting and restoring native ecosystems and species in degraded areas.	NA		✔				✔									
	Number of IUCN Red List species with habitats in areas affected by operations	Nb		✔													
	Business units currently operating or planning operations in or around protected or sensitive areas	Nb		✔													
	Water sources and related ecosystems/habitats significantly affected by discharges of water and runoff	NA		✔													
	Use of Fertilizers	L														✔	
	Use of Agricultural Pesticides	L														✔	
	Severity of human induced soil degradation	NA								✔							
	Land area affected by human activities as a percentage of total land area	%								✔							
	Percent of land area having very low anthropogenic impact	%								✔							
	Percent of land area having high anthropogenic impact	%								✔							
	Ecological footprint per capita	Gha								✔							
	Weight of releases into land from production process	Tonnes									✔						
	Weight of releases into land from overhead	Tonnes									✔						
	Size of water body and related habitat that are significantly affected by water discharges	ha		✔													
	Biodiversity value	Nb		✔						✔							
	Annual average forest cover change rate from 1990 to 2000	ha/year								✔							
	Salinized area due to irrigation as percentage of total arable land	%								✔							
	Percentage of total forest area that is certified for sustainable management	%								✔						✔	
	Environmental Hazard Exposure Index	Nb								✔							
	Percentage of total land area under protected status	%						✔		✔						✔	
	Natural cover area as a percentage of total land area	%									✔						
	Natural cover area	Ha									✔						
	Total land area	Ha						✔			✔						

	Wood Harvesting Intensity	Nb														✔	
	Area of Urban Formal and Informal Settlements	Ha														✔	
	Algae Concentration in Coastal Waters	mg/l														✔	
	Annual Catch by Major Species	Nb														✔	
	Area of Selected Key Ecosystems	Ha														✔	
	Abundance of Selected Key Species	NA														✔	
	Practices to protect and conserve biodiversity	NA												✔			
	Practices to maintain the benefits from ecosystem services	NA												✔			
	Practices to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities	NA												✔			
	Has your facility identified the significant environmental impacts associated with current operations within the factory premises?	NA															✔
	Does your facility maintain a documented system to identify, monitor and periodically verify all laws, regulations, standards, codes and other legislative and regulatory requirements for your significant environmental impacts?	NA															✔
	Does your facility engage in environmental improvement in your local context?	NA															✔
Gaseous emissions	Gross absolute greenhouse gas emissions (CO_2, CH_4, N_20, HFCs) Report separate subtotals for each gas in tonnes and in tonnes of CO_2 equivalent for the following: • direct emissions from sources owned or controlled by the reporting entity • indirect emissions from imported electricity heat or steam	tCO_2e	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔			✔	✔
	Estimated future direct and indirect emissions of greenhouse gases from their operations, purchased electricity, and products/services	tCO_2e						✔					✔				
	Life Cycle Air Quality	NA				✔											
	GHG emissions intensity ratio	tCO_2e/normalization factor		✔							✔						
	GHGs released in energy consumption for overhead	tCO_2e									✔						
	GHGs released by transport used for business travel	tCO_2e									✔						
	Amount of GHG emissions reductions achieved as a direct result of initiatives to reduce emissions	tCO_2e		✔													✔
	Carbon Intensity	tCO_2e/ USD										✔					
	Product emission intensity	tCO_2e/ product										✔					

	Service intensity	tCO_2e/ service										✔					
	Sales intensity	tCO_2e/ per sales										✔					
	Strategies to reduce project-related GHG emissions	NA												✔			✔
	CO_2 emissions per capita	tCO_2e/ per capita						✔		✔							
	GHGs released per unit of material during its production	tCO_2e/ per unit									✔						
	Emissions associated with the value chain, use and disposal of finished products	tCO_2e	✔					✔									
	Source of the emission factors used and the global warming potential (GWP) rates used	NA		✔													
	Weight of additional GHG emissions released from production process	tCO_2e									✔						
	Weight of additional GHG emissions released from overhead	tCO_2e									✔						
	Use and emissions of ozone-depleting substances (CFCs)	Tonnes of CFC-11 equivalents		✔				✔		✔	✔					✔	
	NO_x, SO_x, and other significant air emissions by type	Ppm		✔	✔			✔		✔	✔						✔
	Indoor air quality	NA								✔							
	VOC emissions	Ppm								✔							✔
	Participation in GHG trading schemes	Nb	✔										✔				
	Intensity of pollutant releases to air	tonnes/normalisation factor									✔						
	Weight of releases [from production processes and, if available, overhead]	Tonnes									✔						
	Climate change policy	NA						✔					✔				
	Description of actions the company is taking to reduce, offset, or limit greenhouse gas emissions.	NA											✔				
	Emissions management strategies	NA											✔				
	Climate Change Statement	NA						✔					✔				
	Anthropogenic NOx emissions per populated land area	ppm/ha								✔							
	Anthropogenic SO_2 emissions per populated land area	ppm/ha								✔							
	Anthropogenic VOC emissions per populated land area	ppm/ha								✔							
	Urban population weighted NO_2 concentration	ppm/capita								✔							
	Urban population weighted SO_2 concentration	ppm/capita								✔							
	Does your facility have control devices or abatement processes for on-site emissions to air?	NA															✔
	Does your facility have control devices or abatement processes for indoor air quality issues from production processes?	NA															✔
	Has your facility gone beyond permit requirements to achieve a higher level of air performance in Nitrogen Oxides (NOx), Sulfur Oxides (SOx), and Particulate Matter (PM)?	NA															✔

	Do you have a process for implementing modernized equipment to reduce or eliminate air emissions and indoor air quality issues at your facility?	NA															✔
Waste	Total amount of waste by type and destination	Tonnes		✔			✔	✔		✔						✔	✔
	Hazardous waste treated offsite	Tonnes						✔		✔						✔	✔
	Total waste treated	Tonnes		✔													
	Percentage of waste sent to landfill	%						✔									✔
	Percentage of waste recycled and/or valorized	%		✔						✔						✔	✔
	Ecological Footprint	NA								✔							
	All production, transport, import, or export of any waste deemed “hazardous”	Tonnes		✔				✔									
	Ratio of solid waste properly disposed to total generated solid waste	NA								✔							
	Quantity of unsafe disposal of waste	Tonnes						✔		✔							
	Quantity of radioactive waste generated	Tonnes								✔						✔	
	Weight of releases into landfills from production process	Tonnes									✔						
	Weight of releases into landfills from overhead	Tonnes									✔						
	Weight of transfers into disposal from production process	Tonnes									✔						
	Weight of transfers to disposal from overhead	Tonnes									✔						
	Weight of transfers for treatment from production process	Tonnes									✔						
	Weight of transfers for treatment from overhead	Tonnes									✔						
	Weight of transfers to recycling from production process	Tonnes									✔						
	Weight of transfers to recycling from overhead	Tonnes									✔						
	Weight of transfers for energy recovery from production process	Tonnes									✔						
	Weight of transfers for energy recovery from overhead	Tonnes									✔						
	Weight of transfers to sewage from production process	Tonnes									✔						
	Weight of transfers to sewage from overhead	Tonnes									✔						
	Waste recycling rates	%								✔							
	Hazardous waste generation rate	%						✔		✔							✔
	Does your facility have well-marked, designated hazardous waste storage areas?	NA															✔
	Does your facility forbid open burning and dumping on-site?	NA															✔
	Does your site provide training to all employees whose work involves hazardous waste handling (such as maintenance and custodial staff)?	NA															✔
	Does your facility set formal targets to reduce waste quantity?	NA															✔
	Did you set a target for improving waste disposal methods for your facility's overall waste?	NA															✔

	Does your facility have an implementation plan to reduce waste quantity or improve type of treatment?	NA															✔
Effluent	Weight of releases into surface water from production process	Tonnes									✔						
	Weight of releases into surface water from overhead	Tonnes									✔						
	Total volume of planned and unplanned water discharges by destination	m^3		✔													✔
	Total volume of planned and unplanned water discharges by quality of the water including treatment method	m^3		✔													✔
	Intensity of pollutant releases to surface water	Tonnes/normalisation factor									✔						
	Industrial organic effluents	mg/l								✔							
	NH_3 in effluent	mg/l									✔						✔
	P in effluent	mg/l									✔						✔
	N in effluent	mg/l									✔						✔
	Industrial organic water pollutant (BOD) emissions	mg/l								✔							✔
	Does your facility have a back-up plan if there is an emergency situation related to wastewater?	NA															✔
	Is sludge disposed of properly?	NA															✔
	Has your facility requested wastewater quality test results from the offsite wastewater treatment plant?	NA															✔
	Ammonium-N	mg/l															✔
	Antimony	mg/l															✔
	Arsenic	mg/l															✔
	Cadmium	mg/l															✔
	Chromium (VI)	mg/l															✔
	Cobalt	mg/l															✔
	Copper	mg/l															✔
	Cyanide	mg/l															✔
	Mercury	mg/l															✔
	pH	mg/l															✔
	Phenol	mg/l															✔
	Sulfide	mg/l															✔
	Temperature [°C]	mg/l															✔
	TSS	mg/l															✔
	Zinc	mg/l															✔
Suppliers and supply chain	Performance of suppliers relative to environmental components of programmes and procedures described in response to Governance Structure and Management Systems section	NA		✔													

	Percentage of new suppliers that were screened using environmental criteria	%		✔														
	Number of suppliers subject to environmental impact assessments	Nb		✔														
	Number of suppliers identified as having significant actual and potential negative environmental impacts	Nb		✔														
	Significant actual and potential negative environmental impacts identified in the supply chain	NA		✔														
	Percentage of suppliers identified as having significant actual and potential negative environmental impacts with which improvements were agreed upon as a result of assessment	%		✔														
	Percentage of suppliers identified as having significant actual and potential negative environmental impacts with which relationships were terminated as a result of assessment, and why	%		✔														
Products and services	Significant environmental impacts of principal products and services	NA		✔														
	Percentage of the weight of products sold that is reclaimable at the end of the products' useful life andpercentage that is actually reclaimed	%		✔														
	Import of polluting goods and raw materials as percentage of total imports of goods and services	%								✔								
	Extent to which environmental impacts of products and services have been mitigated during the reporting period	NA		✔														
	Percentage of reclaimed products and their packaging materials for each product category	%		✔														
Environmental compliance	Incidents of and fines for non-compliance with all applicable international declarations/conventions/treaties, and national, sub-national, regional, and local regulations associated with environmental issues.	NA		✔														
Transport	Significant environmental impacts of transportation used for logistical purposes	NA		✔														
	Actions to mitigate the environmental impacts of transporting products, members of the organization's workforce, and other goods and materials	NA		✔														
	Vehicles in use per populated land area	Nb								✔								
Certification	ISO 14001 certified sites	Nb		✔						✔								
	Number of ISO 14001 certified companies per billion dollars GDP (PPP)	Nb								✔								
Accidental spills	Oil Spills	m^3		✔														
	Chemical spills	m^3		✔														

	Fuel spills	m^3		✔														
	Number of sites whose risk analysis identified at least one scenario of major accidental pollution to surface water	Nb		✔														
	Proportion of those sites with an operational oil spill contingency plan	%		✔														
	Proportion of those sites having performed at least one anti-pollution exercise during the year	%		✔														
	Location of spill	NA		✔														
	Material of spill	NA																
Environmental expenditure	Total environmental expenditures by type	$		✔														
Reducing transboundary environmental Pollution	CFC consumption	Kilograms								✔								
	Total marine fish catch	Tonnes								✔								
	Seafood consumption per capita	Tonnes/capita								✔								
Environmental grievance mechanisms	Total number of grievances about environmental impacts filed through formal grievance mechanisms during the reporting period	Nb		✔														
	Number of grievances resolved during the reporting period	Nb		✔														
	Total number of grievances about environmental impacts filed prior to the reporting period that were resolved during the reporting period	Nb		✔														
Noise	Drive-by-Exterior Noise	dB(A)				✔												
Environmental policy	Is your company's environmental management policy publicly available?	NA					✔											
Energy	Direct energy use segmented by primary source	KJ		✔			✔		✔	✔	✔	✔				✔	✔	
	Indirect energy use	KJ		✔			✔				✔	✔						
	Primary Energy Source	NA										✔						
	Energy intensity ratio	KJ/normalisation factor		✔							✔							
	Energy consumed in overhead	KJ									✔							
	Average annual energy consumption per product	KJ/product									✔					✔		
	Initiatives to use renewable energy sources and to increase energy efficiency	NA		✔						✔								
	Energy consumption footprint of major products.	KJ		✔														
	Other indirect (upstream/downstream) energy use and implications, such as organizational travel, product lifecycle management, and use of energy-intensive materials	KJ		✔														
	Energy used in generating electricity and services purchased from external source (optional)	KJ	✔															

	Renewable energy share in energy and electricity	%		✔							✔					✔	
	Transport energy intensities (Overall average fuel consumption for all modes per passenger-km or tonne-km)	tonnes of oil equivalent (toe) per tonne-km Travel: toe per passenger-km										✔					
	Energy use/GDP	KJ/GDP								✔							
	Electricity sold	KJ or KW		✔								✔					
	Heating sold	KJ or KW		✔								✔					
	Cooling sold	KJ or KW		✔								✔					
	Steam sold	KJ or KW		✔								✔					
	Energy consumed outside of the organization	KJ		✔													
	Does your facility know what facility processes or operations use the most energy?	NA															✔
	Has your facility set targets for improving energy use?	NA															✔
	Does your facility have an implementation plan to improve energy use?	NA															✔
	Amount of reductions in energy consumption achieved as a direct result of conservation and efficiency initiatives	KJ		✔													
	Energy efficiency	%								✔							
	Reductions in the energy requirements of sold products and services achieved	KJ		✔													
	Hydropower and renewable energy production as a percentage of total energy consumption	%					✔			✔	✔						
Assessment and management of environmental risks and impacts	Identification and evaluation of environmental risks and impacts of the project	NA												✔			
	Promotion of improved environmental performance through the effective use of management systems	NA												✔			
ECONOMIC INDICATORS			**FRAMEWORK NUMBER**														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Monetary flow indicator	Net sales	$		✔													
	GDP per Capita	$/capita														✔	
	Investment Share in GDP	$														✔	
	Balance of Trade in Goods and Services	NA														✔	
	Debt to GNP Ratio	NA														✔	
	Expenditure on Research and Development as a Percent of GDP	%														✔	
	Employee Turnover Rate	%					✔										
	Geographic breakdown of markets	NA		✔													
	Cost of all goods, materials, and services purchased	$		✔													
	Percentage of contracts that were paid in accordance with	%		✔													

	agreed terms, excluding agreed penalty arrangements. Terms may include conditions such as scheduling of payments, form of payment, or other conditions																
	Total payroll and benefits (including wages, pension, other benefits, and redundancy payments) broken down by country or region	$		✔													
	Distributions to providers of capital broken down by interest on debt and borrowings, and dividends on all classes of shares, with any arrears of preferred dividends	$		✔													
	Increase/decrease in retained earnings at end of period	$		✔													
	Gross domestic product at market prices	$									✔						
	Gross capital formation	$									✔						
	Goods and services exports	$									✔						
	Goods and services imports	$									✔						
	PV debt/ exports	%													✔		
	PV debt /GDP	%													✔		
	PV debt/ budget revenue	%													✔		
	Debt service/ exports	%													✔		
	Life Cycle Cost (Sum of vehicle price and 3 years service (fuel cost, maintenance cost, taxation) minus residual value	$				✔											
	Debt service/budget revenue	%													✔		
	Operating costs	$		✔													
	Employee wages and benefit	$		✔													
	Payments to providers of capital	$		✔													
	Payments to government (by country)	$		✔													
	Community investments	$		✔													
Financial implications and other risks and opportunities for the organization's activities due to climate change	A description of the risk or opportunity and its classification as either physical, regulatory, or other	NA		✔													
	A description of the impact associated with the risk or opportunity	NA		✔													
	The financial implications of the risk or opportunity before action is taken	NA		✔													
	The methods used to manage the risk or opportunity	NA		✔													
	The costs of actions taken to manage the risk or opportunity	$		✔													
	The extent to which the scheme's liabilities are estimated to be covered by the assets that have been set aside to meet them	NA		✔													
	Percentage of salary contributed by employee or employer.	%		✔													
	The level of participation in retirement plans (such as participation in mandatory or voluntary schemes, regional or country-based schemes, or those with financial impact	Nb		✔													

Financial assistance received from government	Tax relief and tax credits	$		✔													
	Subsidies	$		✔						✔							
	Investment grants, research and development grants, and other relevant types of grants	$		✔													
	Awards	Nb		✔													
	Financial assistance from Export Credit Agencies (ECAs)	$		✔													
	Financial incentives	$		✔								✔					
	Other financial benefits received or receivable from any government for any operation	$		✔													
Ratios of standard entry level wage by gender compared to local minimum wage at significant locations of operation	Ratio of the entry level wage by gender at significant locations of operation to the minimum wage	Nb		✔													
	Whether a local minimum wage is absent or variable at significant locations of operation, by gender	NA		✔													
Proportion of spending on local suppliers at significant locations of operation	Percentage of the procurement budget used for significant locations of operation spent on suppliers local to that operation (such as percentage of products and services purchased locally).	%		✔													

SOCIAL INDICATORS			**FRAMEWORK NUMBER**													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Employment	Breakdown of workforce, where possible, by region/country, status (employee/non-employee), employment type (full time/part time), and by employment contract (indefinite or permanent/fixed term or temporary)	NA		✔													
	Net employment creation segmented by region/country	NA		✔													
	Employee benefits beyond those legally mandated (e.g., contributions to health care, disability, maternity, education, and retirement).	NA		✔													
	Total number and rate of new employee hires during the reporting period, by age group, gender and region.	%		✔													
	Total number and rate of employee turnover during the reporting period, by age group, gender and region.	%		✔													
	Benefits which are standard for full-time employees of the organization but are not provided to temporary or part-time employees, by significant locations of operation	NA		✔													
	Total number of employees that were entitled to parental leave,	Nb		✔													

	by gender.																
	Total number of employees who returned to work after parental leave ended, by gender	Nb		✔													
	Total number of employees who returned to work after parental leave ended who were still employed twelve months after their return to work, by gender	Nb		✔													
	The return to work and retention rates of employees who took parental leave, by gender.	%		✔													
Basic human sustenance	Proportion of undernourished in total population	%								✔							
	Percentage of population with access to improved drinking-water supply	%								✔							
Labor/ management relations	Percentage of employees represented by independent trade union organizations or other bona fide employee representatives broken down geographically	%		✔													
	Policy and procedures involving information, consultation, and negotiation with employees over changes in the reporting organization's operations (e.g., restructuring)	NA		✔													
	Provision for formal worker representation in decision making or management, including corporate governance	NA		✔													
	Minimum number of weeks' notice typically provided to employees and their elected representatives prior to the implementation of significant operational changes that could substantially affect them	Nb		✔													
Health and safety	Practices on recording and notification of occupational accidents and diseases, and how they relate to the ILO Code of Practice on Recording and Notification of Occupational Accidents and Diseases.	NA		✔													
	Description of formal joint health and safety committees comprising management and worker representatives and proportion of workforce covered by any such committees	NA		✔			✔							✔			
	Standard injury, lost day, and absentee rates and number of work-related fatalities (including subcontracted workers).	Nb		✔ ✔													
	Description of policies or programmes (for the workplace and beyond) on HIV/AIDS	NA		✔													
	Evidence of substantial compliance with the ILO Guidelines for Occupational Health Management System	NA		✔													
	Description of formal agreements with trade unions or other bona fide employee representatives covering health and safety at work and proportion of the workforce covered by any such agreements	NA		✔													
	Percent of population with adequate sewage disposal facilities	%														✔	

	Percent of population with access to primary health care facilities	%														✔	
	Immunization against infectious childhood diseases	NA														✔	
	Contraceptive Prevalence Rate	%														✔	
	Safe drinking water supply	NA								✔							
	Level at which each formal joint management-worker health and safety committee typically operates within the organization	NA		✔													
	Percentage of the total workforce represented in formal joint management-worker health and safety committees	%		✔			✔										
	Extent, as a percentage, to which various health and safety topics are covered by these agreements	%		✔													
	Anticipation and avoiding adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances	NA												✔			
	Ensuring that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks	NA												✔			
	Incentives for a healthy lifestyle	$					✔										
Training and Education	Average hours of training per year per employee by category of employee (e.g., senior management, middle management, professional, technical, administrative, production, and maintenance).	Hours/per year		✔			✔										
	Description of programmes to support the continued employability of employees and to manage career endings.	NA		✔			✔										
	Specific policies and programmes for skills management or for lifelong learning	NA		✔													
	Transition assistance programs provided to facilitate continued employability and the management of career endings resulting from retirement or termination of employment	NA		✔													
	Percentage of total employees by gender and by employee category who received a regular performance and career development review	%		✔													
	Secondary or Primary School Completion Ratio	Nb														✔	
	Adult Literacy Rate	%														✔	
Diversity and opportunity	Description of equal opportunity policies or programmes, as well as monitoring systems to ensure compliance and results of monitoring.	NA		✔													
	Composition of senior management and corporate governance bodies (including the board of directors), including female/male ratio and other indicators of diversity	NA		✔													

	Percentage of individuals within the organization's governance bodies in each of the following diversity categories: gender, age group and minority groups	NA		✔			✔										
	Board diversity (ratio or percentage of women and non-employee directors in the company boardroom, relative to their male/non-independent colleagues)	%					✔					✔					
Equal remuneration for women and men	Ratio of the basic salary and remuneration of women to men for each employee category, by significant locations of operation	Nb		✔			✔							✔		✔	
Strategy and management	Description of policies, guidelines, corporate structure, and procedures to deal with all aspects of human rights relevant to operations, including monitoring mechanisms and results	NA		✔													
	Evidence of consideration of human rights impacts as part of investment and procurement decisions, including selection of suppliers/contractors	NA		✔													
	Description of policies and procedures to evaluate and address human rights performance within the supply chain and contractors, including monitoring systems and results of monitoring	NA		✔													
	Employee training on policies and practices concerning all aspects of human rights relevant to operations	NA		✔													
Human rights	Total number and percentage of significant investment agreements and contracts that include human rights clauses or that underwent human rights screening	%		✔			✔										
	Total number of hours in the reporting period devoted to training on human rights policies or procedures concerning aspects of human rights that are relevant to operations	Hrs		✔													
	Percentage of employees in the reporting period trained in human rights policies or procedures concerning aspects of human rights that are relevant to operations	%		✔													
	Human Rights Policy	NA								✔		✔					
	Number of grievances about human rights impacts filed, addressed, or resolved	Nb										✔					
	Has your company developed a due diligence process to proactively identify and assess potential impacts and risks relating to respecting human rights?	NA					✔										
	Has your company conducted an assessment of potential human rights issues across your business activities in the past three years?	NA					✔										
	Does your company publicly disclose its commitments and the status of its human rights assessment?	NA															
Supplier assessment for	Percentage of new suppliers that were screened using criteria for impacts on society	%		✔													

impacts on society	Number of suppliers subject to assessments for impacts on society	Nb		✔														
	Number of suppliers identified as having significant actual and potential negative impacts on society	Nb		✔														
	Significant actual and potential negative impacts on society identified in the supply chain	NA		✔														
	Percentage of suppliers identified as having significant actual and potential negative impacts on society with which improvements were agreed upon as a result of assessment	%		✔														
	Percentage of suppliers identified as having significant actual and potential negative impacts on society with which relationships were terminated as a result of assessment, and why	%		✔														
Human rights grievance mechanisms	Total number of grievances about human rights impacts filed through formal grievance mechanisms	Nb		✔														
	Of the identified grievances, report how many were resolved during the reporting period	Nb		✔														
	Total number of grievances about human rights impacts filed prior to the reporting period that were resolved during the reporting period	Nb		✔														
Non-discrimination	Description of global policy and procedures/programmes preventing all forms of discrimination in operations, including monitoring systems and results of monitoring.	NA		✔										✔				
	Total number of incidents of discrimination during the reporting period	Nb		✔														
Freedom of association and collective bargaining	Description of freedom of association policy and extent to which this policy is universally applied independent of local laws, as well as description of procedures/programmes to address this issue	NA		✔														
	Measures taken by the organization in the reporting period intended to support rights to exercise freedom of association and collective bargaining.	NA		✔														
Supplier assessment for labor practices	Percentage of new suppliers that were screened using labor practices criteria	%		✔														
	Number of suppliers subject to impact assessments for labor practices	Nb		✔														
	Number of suppliers identified as having significant actual and potential negative impacts for labor practices	Nb		✔														
	Significant actual and potential negative impacts for labor practices identified in the supply chain	NA		✔														
	Percentage of suppliers identified as having significant actual and potential negative impacts for labor practices with which improvements were agreed upon as a result of assessment	%		✔														

	Percentage of suppliers identified as having significant actual and potential negative impacts for labor practices with which relationships were terminated as a result of assessment, and why	%		✔													
	Supplier Code of Conduct	NA										✔					
Labor practices grievance mechanisms	Total number of grievances about labor practices filed through formal grievance mechanisms during the reporting period	Nb		✔													
	Of the identified grievances, how many were resolved during the reporting period	Nb		✔													
	Total number of grievances about labor practices filed prior to the reporting period that were resolved during the reporting period	Nb		✔													
Child labor	Description of policy excluding child labor as defined by the ILO Convention 138 and extent to which this policy is visibly stated and applied, as well as description of procedures/ programmes to address this issue, including monitoring systems and results of monitoring	NA		✔								✔		✔			
	Operations and suppliers considered to have significant risk for incidents of child labor and young workers exposed to hazardous work	NA		✔													
	Operations and suppliers considered to have significant risk for incidents of child labor in terms of type of operation (such as manufacturing plant) and supplier	NA		✔													
	Measures taken by the organization in the reporting period intended to contribute to the effective abolition of child labor	NA		✔													
Forced and compulsory labor	Description of policy to prevent forced and compulsory labor and extent to which this policy is visibly stated	NA		✔										✔			
	Operations and suppliers considered to have significant risk for incidents of forced or compulsory labor either in terms of type of operation (such as manufacturing plant) and supplier	NA		✔													
	Measures taken by the organization in the reporting period intended to contribute to the elimination of all forms of forced or compulsory labor	NA		✔													
Disciplinary practices	Description of appeal practices to human rights issues	NA		✔													
	Describe the representation and appeals process	NA										✔					
Security practices	Human rights training for security personnel (Include type of training, number of persons trained, and average training duration)	NA		✔													
	Percentage of security personnel who have received formal training in the organization’s human rights policies or specific procedures and their application to security	%		✔													
Indigenous rights	Description of policies, guidelines, and procedures to address the needs of indigenous people. This includes indigenous	NA															

	people in the workforce and in communities where the organization currently operates or intends to operate			✔													
	Total number of identified incidents of violations involving the rights of indigenous peoples during the reporting period	Nb		✔													
	Ensuring that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of indigenous peoples	Nb											✔				
	Anticipation and avoiding adverse impacts of projects on communities of indigenous peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts	NA											✔				
	Promoting sustainable development benefits and opportunities for indigenous peoples in a culturally appropriate manner	NA											✔				
	Establishment and maintaining of an ongoing relationship based on Informed Consultation and Participation (ICP) with the indigenous people affected by a project throughout the project's life-cycle.	NA											✔				
	Preserving the culture, knowledge, and practices of indigenous peoples	NA											✔				
Supplier human rights assessment	Percentage of new suppliers that were screened using human rights criteria	NA		✔													
	Number of suppliers subject to human rights impact assessments	NA		✔													
	Number of suppliers identified as having significant actual and potential negative human rights impacts	NA		✔													
	Significant actual and potential negative human rights impacts identified in the supply chain	NA		✔													
Community	Description of policies to manage impacts on communities in areas affected by activities, as well as description of procedures/ programmes to address this issue, including monitoring systems and results of monitoring	NA		✔													
	Awards received relevant to social, ethical, and environmental performance	NA		✔													
	Percentage of operations with implemented local community engagement, impact assessments, and development programs	NA		✔													
	Operations with significant actual and potential negative impacts on local communities	NA		✔													
Bribery and corruption	Description of the policy, procedures/management systems, and compliance mechanisms for organizations and employees addressing bribery and corruption	NA		✔								✔					
	Total number and percentage of operations assessed for risks related to corruption	%		✔													
	Significant risks related to corruption identified through the risk assessment	NA		✔													

	Total number and percentage of employees that the organization's anti-corruption policies and procedures have been communicated to, broken down by employee category and region	%		✔													
	Total number and percentage of business partners that the organization's anti-corruption policies and procedures have been communicated to, broken down by type of business partner and region	%		✔													
	Total number and percentage of governance body members that have received training on anticorruption, broken down by region	%		✔													
	Total number and percentage of employees that have received training on anti-corruption, broken down by employee category and region	%		✔													
	Total number and nature of confirmed incidents of corruption	Nb		✔													
	Total number of confirmed incidents in which employees were dismissed or disciplined for corruption.	Nb		✔													
	Total number of confirmed incidents when contracts with business partners were terminated or not renewed due to violations related to corruption	Nb		✔													
	Public legal cases regarding corruption brought against the organization or its employees during the reporting period and the outcomes of such cases	Nb		✔													
	Number of confirmed cases of corruption and bribery in the last four fiscal years as well as the number of ongoing investigations	Nb					✔										
	Does your company publicly report on breaches (e.g. number of breaches, cases etc.) against your codes of conduct/ethics?	NA					✔										
Anti-competitive behavior	Total number of legal actions pending or completed during the reporting period regarding anticompetitive behavior and violations of anti-trust and monopoly legislation in which the organization has been identified as a participant	Nb		✔													
	Main outcomes of completed legal actions, including any decisions or judgments	NA		✔													
Political contributions	Description of policy, procedures/management systems, and compliance mechanisms for managing political lobbying and contributions	NA		✔													
	Amount of money paid to political parties and institutions whose prime function is to fund political parties or their candidates	$		✔													
Competition and pricing	Court decisions regarding cases pertaining to anti-trust and monopoly regulations	NA		✔													

	Description of policy, procedures/management systems, and compliance mechanisms for preventing anti-competitive behavior	NA		✔														
Customer health and safety	Description of policy for preserving customer health and safety during use of products and services, and extent to which this policy is visibly stated and applied, as well as description of procedures/programmes to address this issue	NA		✔														
	Number and type of instances of non-compliance with regulations concerning customer health and safety, including the penalties and fines assessed for these breaches	Nb		✔														
	Number of complaints upheld by regulatory or similar official bodies to oversee or regulate the health and safety of products and services	Nb		✔														
	Percentage of significant product and service categories for which health and safety impacts are assessed for improvement	%		✔														
	Total number of incidents of non-compliance with regulations and voluntary codes concerning the health and safety impacts of products and services within the reporting period	Nb		✔														
Products and services	Description of policy, procedures/management systems, and compliance mechanisms related to product information and labeling	NA		✔														
	Number and type of instances of non-compliance with regulations concerning product information and labelling, including any penalties or fines assessed for these breaches	Nb		✔														
	Description of policy, procedures/management systems, and compliance mechanisms related to customer satisfaction, including results of surveys measuring customer satisfaction	NA		✔														
	Percentage of significant product or service categories covered by and assessed for compliance with such procedures	%		✔														
	Total number of incidents of non-compliance with regulations and voluntary codes concerning product and service information and labeling	Nb		✔														
Marketing communications	Whether the organization sells products that are banned in certain markets	NA		✔														
	How the organization has responded to questions or concerns regarding these products	NA		✔														
	Total number of incidents of non-compliance with regulations and voluntary codes concerning marketing communications, including advertising, promotion, and sponsorship	Nb		✔														
Advertising	Description of policies, procedures/management systems, and compliance mechanisms for adherence to standards and voluntary codes related to advertising	NA		✔														
	Number and types of breaches of advertising and marketing	Nb		✔														

	regulations																
Respect for privacy	Description of policy, procedures/management systems, and compliance mechanisms for consumer privacy	NA		✔													
	Number of substantiated complaints regarding breaches of consumer privacy	Nb		✔													
Customer privacy	Total number of substantiated complaints received concerning breaches of customer privacy	Nb		✔													
	Total number of identified leaks, thefts, or losses of customer data	Nb		✔													
Departures	Number of deaths (overall)	Nb		✔													
	Number of resignations	Nb								✔							
	Number of termination / negotiated departures	Nb								✔							
	Number of contract termination by mutual agreement	Nb															
	Deaths from waterborne diseases	Nb								✔							
	Deaths from respiratory infections	Nb								✔							
	Morbidity and mortality stemming from toxins and mutagens	Nb								✔							
	Children under five mortality rate per 1,000 live births	%								✔						✔	
	Death rate from intestinal infectious diseases	%								✔							
	Child death rate from respiratory diseases	%								✔							
	Average number of deaths per million inhabitants from floods, tropical cyclones, and droughts	Nb								✔							
	Life Expectancy at Birth	Years														✔	
Poverty	Percent of Population Living below Poverty Line	%														✔	
	Gini Index of Income Inequality	Nb														✔	
	Unemployment Rate	%														✔	
Absenteeism rate	Sickness absenteeism rate	%		✔			✔										
Science/Tech	Technology achievement index	Nb								✔							
	Innovation index	Nb								✔							
	Digital Access Index	Nb								✔							
Travel and logistics	Distance travelled by all employees for business purposes	Km									✔						
	Distance of transporting input materials from suppliers to the facility	Km									✔						
	Distance of transporting products from the facility to the purchaser	Km									✔						
	Distance travelled by all employees for commuting	Km									✔						
	GHG emissions (CO_2e) per distance	CO_2e / km									✔						
Institutional capacity	University enrollments	NA								✔							
	Research scientists	NA								✔							
	Innovation capacity	NA								✔							

	Number of researchers per million inhabitants	Nb								✔							
	Knowledge creation in environmental science, technology, and policy	NA								✔							
	National Sustainable Development Strategy	NA														✔	
	Implementation of Ratified Global Agreements	NA														✔	
Global stewardship	Intergovernmental environmental activities	NA								✔							
	World Economic Forum Survey on private sector environmental innovation	NA								✔							
	Contribution to international and bilateral funding of environmental projects and development aid	NA								✔							
	Role in international environmental aid	NA								✔							
	Participation in international environmental agreements	NA								✔							
Cultural heritage	Protection of cultural heritage from the adverse impacts of project activities and support its preservation	NA												✔			
	Promotion of the equitable sharing of benefits from the use of cultural heritage	NA												✔			
Corporate governance	Number of executive and non-executive directors on the board of directors/supervisory board of your company	Nb					✔										
	Is the board of directors/supervisory board headed by a non-executive and independent chairman and/or an independent lead director ?	NA					✔										
	Does your board nomination policy include diversity factors such as gender, race, ethnicity, country of origin or nationality?	NA					✔										
	Number of women on your company's board of directors/supervisory board	Nb					✔										
	How does your company ensure the effectiveness of your board of directors/supervisory board and the alignment with the (long-term) interests of shareholders ?	NA					✔										
	Number of board members with relevant work experience in your company's sector	Nb					✔										
	Company's pre-defined corporate indicators relevant for variable CEO compensation as well as guidelines on time vesting and performance period for variable CEO compensation	NA					✔										
	Annual compensation for the Chief Executive Officer and the median of the annual compensation of all other employees as well as the ratio between the two	Nb					✔										
Risk & crisis management	Number of people, departments and committees responsible and accountable for enterprise risk management in terms of risk appetite & tolerance as well as risk monitoring & reporting	Nb					✔										

	Do you perform a correlation analysis of the key risks identified?	NA					✔											
	Does your company perform sensitivity analysis and stress testing on a group level?	NA					✔											
	Two important long-term (3-5 years+) emerging risks that your company identifies as having the most significant impact on the business in the future, and indicate any mitigating actions that your company has taken in light of these risks	NA					✔											
	What strategies does your company pursue in order to promote and enhance an effective risk culture throughout the organization?	NA					✔											
Codes of business conduct	What mechanisms are in place to assure effective implementation of your company's codes of conduct (e.g. compliance system)?	NA					✔											
Customer relationship management	Does your company monitor and set quantitative targets to improve customer satisfaction and are targets and results communicated externally?	NA					✔											
Tax strategy	Does your company have a tax policy/principles/strategy in place which indicates your approach towards taxation?	NA					✔											
	Does your company publicly report on key business, financial and tax information for regions or countries in which it operates?	NA					✔											
Impact measurement & valuation	Do you carry out programs which address a clear social need in a way that they also provide financial benefits to the company?	NA					✔											
Information security &cyber security	Do you have an information security/cyber security strategy that is regularly reviewed and updated?	NA					✔											
	Is the board of directors engaged in the information security/cyber security strategy and review process?	NA					✔											
	Are information security/cyber security risks a formal component of the overall risk management framework?	NA					✔											
	Do you have a chief security officer in place?	NA					✔											
	Do you have a specific cyber-threat intelligence team in place?	NA					✔											
	Do you have business continuity plans and incident response procedures in place and how often do you test them ?	NA					✔											
	Has your company experienced breaches of information security or other cyber security incidents over the past three years?	NA					✔											
Privacy protection	Do you have a person formally responsible for data privacy?	NA					✔											
	What mechanisms are in place to ensure effective implementation of your company's privacy policy?	NA					✔											
	Does your company inform customers on the following	NA					✔											

	privacy protection issues?																
Social reporting	What type of external assurance your company has received in relation to your company's social reporting?	NA					✔										
	What extent your company reports on social Key Performance Indicators (KPIs) in the public domain and provide the targets linked to these indicators	NA					✔										
Corporate citizenship and philanthropy	Does your company have a group-wide strategy that provides guidance to your corporate citizenship/philanthropic activities?	NA					✔										
Stakeholder engagement	Do you have a policy or procedure to ensure that the corporate stakeholder engagement strategy is applied consistently across all operations?	NA					✔										
Land acquisition and involuntary resettlement	Minimizing of displacement by exploring alternative project designs	NA												✔			
	Avoiding forced eviction	NA												✔			
	Minimizing adverse social and economic impacts from land acquisition or restrictions on land use by: (i) providing compensation for loss of assets at replacement cost (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected	NA												✔			
	Improving, or restoring, the livelihoods and standards of living of displaced persons	NA												✔			

2.8 Mauritius Island

The Republic of Mauritius is a very small island located in the Indian Ocean (20.3484° S, 57.5522° E). Mauritius also known as called the paradise island is found east of Madagascar and south-east of the African drift. Its nearest neighbor is the French island of Reunion (Figure 2 and 3).

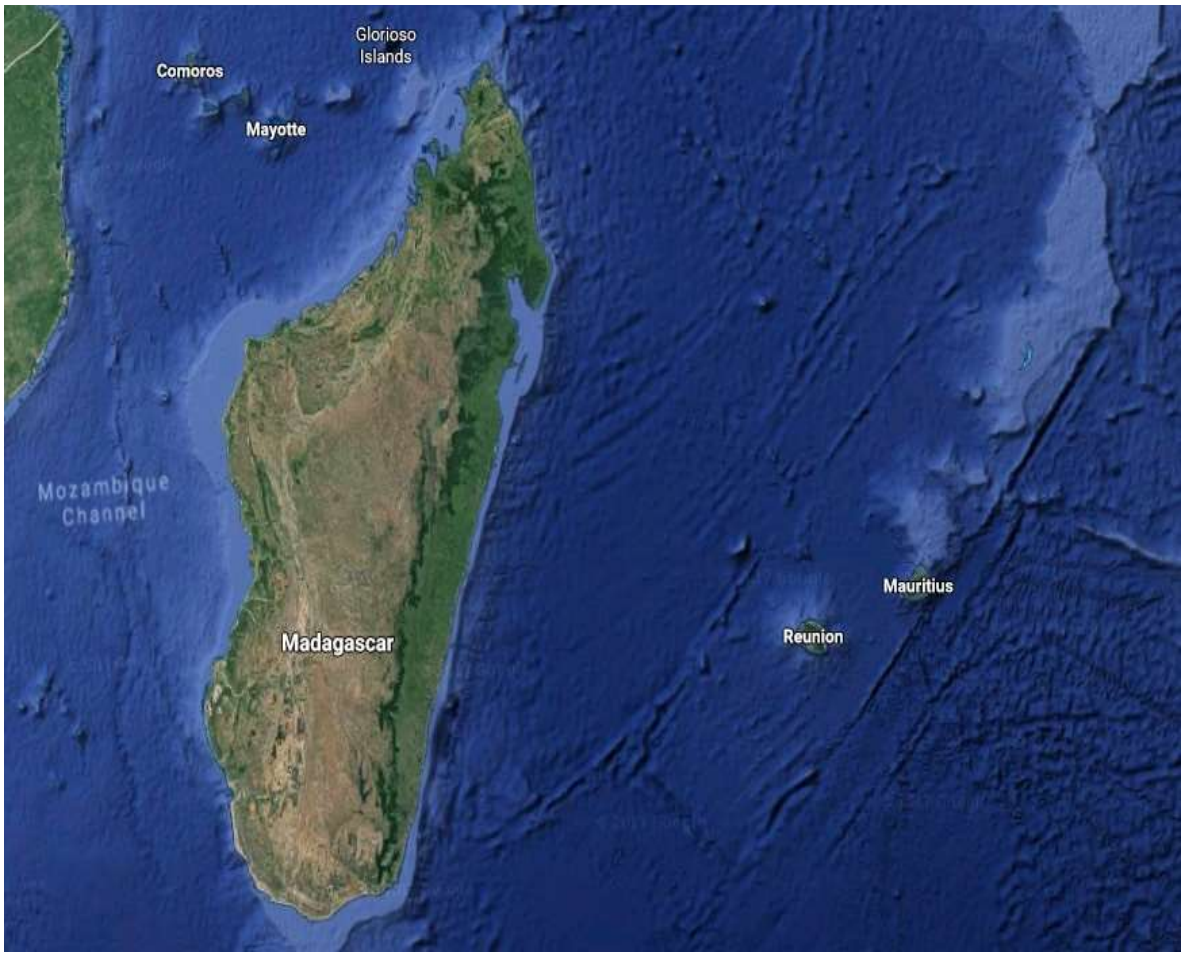

Figure 2: Google map satellite image showing location of Mauritius Island

Together with the island of Mauritius, the Republic also consists of Rodrigues, Agalega and Saint Brandon. In conjunction with Reunion Island, they form the Mascarene Islands of the Indian Ocean [92].

Figure 3: Google Map satellite image giving a closer view of Mauritius Island

By the 18th century, Mauritius was under the control of the French rule. A large number of slaves were brought to cultivate the land. Drawn for the most part from Madagascar, Africa and Southern India, the slaves and indentured laborers have contributed a great deal to the ethnically diversity of the island. It has people of different ethnics ranging from Indo-Mauritians (68%), creoles (27%), Sino-Mauritians (3%), and Franco-Mauritians (2%) [97]. Mauritius achieved independence in year 1968 and became a Republic in 1992 [98]. Port Louis is the capital and the largest city.

Mauritius has around 1.3 million inhabitants based on year 2015 survey [65]. Mauritius has a yearly growth rate of 5% which has caused a rise in life expectancy of 72.38 years and a reduction in infant deaths (15.03 deaths for every 1000 live births). The current birth rate is 15.06 for every 1000 population with a yearly growth rate of 0.84%, which ranks Mauritius as being amongst the lowest in the African continent. 0.30% of the Mauritian population is

aged between 0–14 years, 65% is aged from 15 to 64 years and 5.4% is aged above 65 years [99].

The beautiful island of Mauritius is volcanic in origin [98]. The island covers around 1865 km^2 and has an Exclusive Economic Zone (EEZ) that widens over an area of 1.9 million km^2 [66, 77]. 43% of land in Mauritius is filled by agriculture, 25% is consists of built-up areas, 25% is taken by dense forests and the rest comprises of deserted fields and reservoirs [80]. This volcanic island is more or less fully enclosed by coral reefs, lagoons and sandy beaches. High altitude mountains rise from the fertile plains. The rivers run through profound ravines and have recurrent waterfalls [8].

The island of Mauritius is well famous for being one of the most competitive economies in the sub-Saharan Africa. In year 2015, it had GDP growth of approximately 3.5%. The Mauritian economy is driven by many sectors like sugarcane, information and communication technology, tourism, manufacturing and financial services. It is situated among the uppermost per capita remuneration levels when compared to other African countries [81].With respect to atmospheric conditions, the island of Mauritius has two seasons namely summer and winter. The mean temperature in summer is around 24.7 °C and mean temperature in winter around is 20.4 °C [82].

2.8.1 Status of energy sector in Mauritius

Mauritius Island has already achieved a 100% electrification rate and electricity is supplied to the entire island from a combination of renewable and non-renewable energy resources [83]. Because of the fact that Mauritius has no natural fossil fuel reserves, it is highly reliant on imported fossil fuels and locally accessible renewable energy resources. Mauritius Island imports around 77.3% of its fuel [83]. The imported fuels are mainly petroleum products like coal, diesel, heavy fuel oil (HFO) and kerosene [83]. In year 2014, the majority of the petroleum products were imported from countries like India and South Africa. Coal, utilized mainly for power generation, was imported chiefly from South Africa and a minor amount from China. Mozambique and India are in addition recurrent suppliers of coal to Mauritius Island [83].

In Mauritius, electric power is produced by Central Electricity Board (CEB) and Independent Power Producers (IPPs). Both IPPs and the CEB have electricity production infrastructures.

However, only the CEB is accountable for power distribution on the island [84]. At present, the Mauritian energy mix is dominated by fossils. In year 2015, 83.6% of the Total Primary Energy Requirement (TPER) was met through coal and petroleum derivatives. The remaining 16.4% of the TPER was covered through renewable energy namely bagasse from sugarcane, fuel wood, photovoltaic, hydropower and landfill gas [77].

Petroleum derivatives like kerosene and heavy fuel oil and coal are burnt in boilers to produce electricity. Gasoline, diesel and aviation fuel are chiefly utilized in the transportation sector of the island. Liquefied petroleum gas (LPG) is extensively utilized in domestic houses as cooking gas. Apart from the transportation sector and the generation of electric power, the manufacturing sector as well consumes a huge quantity of energy in terms of coal, diesel, heavy fuel oil and liquefied petroleum gas [78].

Mauritius is destined to move towards renewable energy resources for its power requirements because of energy insecurity dilemmas imposed by heavy reliance on fossil energy [78]. Renewable energy resources that have been extensively developed in Mauritius comprise of hydropower and sugarcane bagasse. Solar photovoltaic energy and wind energy are now being developed on the island [78].

2.8.2 Environmental issues in Mauritius

Small island developing states (SIDS) are states that are distinguished by their little size, seclusion, likelihood to disaster and a delicate ecosystem [101]. Because of their great reliance on developed nations for fossil energy and deficiency in technologies for efficient waste management, SIDS like Mauritius island have to face severe sustainability issues [102].The degradation of the ecosystem has been a severe concern in Mauritius island since several years [199]. Environmental degradation is the decline in quality of the environment due to exhaustion of natural resources, annihilation of natural habitats and the extermination of wildlife [198].

The main culprit for degradation of the ecosystem is human activity. Excessive combustion of fossils and deforestation are the chief causes of this degradation. Besides, the highly noxious chemicals released by manufacturing and chemical industries contaminate the water bodies in Mauritius. These results in the pollution of water bodies [200]. Over the last

decades, an increase in industrialization has consequently resulted in a rise in the amount of industrial wastes and this has worsened the environmental issues on our island [102, 103].

2.8.3 Sustainable development in Mauritius

In year 2007, the notion of Maurice Ile Durable (MID) was developed by the Mauritian Government. At the center of the MID vision was the requirement to shift from fossil energy to renewable energy [197]. However, shifting to renewables under conditions of an overriding fossil industry is a very tough proposition. Furthermore, Mauritius has shown its desire in promoting sustainable development by agreeing to an arrangement with the United Nations and creating the Mauritius and United Nations agreement for sustainable development. The benefits acquired by Mauritius with sustainable development are lower carbon footprint, environmental stewardship, ecological restoration, cleaner environment, world recognition, enhancement in the quality of life and happier people [197].

Demands for sustainable development have amplified considerably in current years [104]. Organizational sustainability is found at the center of the sustainable growth of the state and the globe as it was the institutionalization and organizational expansion that has caused the birth of large amounts of wealth and success in the last 200 years [68, 74]. Organizations have to demonstrate not only financial but also ecological and social sustainable achievements [105, 106, 107]. In the last decade, multiple companies in Mauritius have made plentiful attempts to incorporate sustainability into their management systems. These include manufacturing companies , food and beverages companies, Coca Cola, Air Mauritius, IBL - fondation Joseph Lagesse, Omnicane, Terragen, Lux Resorts and textile companies. These endeavors have only partially been capable to deal with sustainability because these were focused to tackle precise requirements of diverse type of companies [67].

Increasingly more businesses are in agreement that sustainability-associated approaches are vital to be competitive nowadays and even more so in the upcoming future. They say that gains of dealing with sustainability benefit not only to the ecosystem and to humanity, but also to the organizations themselves through concrete profits. These gains are in the form of decreased expenditures and risks of doing business and through intangible advantages in the form of amplified brand reputation, augmented attractiveness to talent and better competitiveness [75]. In the initial stage of a building up the notion of business sustainability, organizations are faced with communal and environmental dilemmas from outside their

markets which pressurize them to act [74]. Business sustainability is frequently defined as handling the triple bottom line – a method by which companies run their fiscal, communal and ecological risks, commitments and opportunities [74, 254]. For organizations to contribute to sustainable development, innovation plays a key function [76]. Since recent years, the mainstreams of textile companies in Mauritius are working towards sustainable growth [2]. This has been demonstrated by increasing endeavors to reduce energy and water consumption, waste generation and GHG emissions.

2.9 The Mauritian textile industry

Textiles have been one of mankind's biggest inventions from materials that were developed to maintain our body warm and shield us from the elements to fabrics that have the capacity eliminate the sweat from our bodies [210]. These discoveries have advanced over several thousands of years when humanity first came into being on this earth [210]. Textiles have proceeded from one progressive step to another. Proof of the initial textile materials can be traced back to the Stone Age [210]. In the present century, the textile industry is among the highly effervescent and active industries in the globe in terms of ingenuity and assortment of product offerings [115]. The progress of textiles has caused the development of an international billion dollar industry [210]. There are a number of textile companies that are operating since many years in Mauritius. The textile industry has a key role in the Mauritian economy both in employment creation and in the significance of industrial production. With the increasing demands for textile products, textile production has risen swiftly in the latest years [203]. The major textile companies operating in Mauritius are presented in Figure 4.

Figure 4: Major textile companies present in Mauritius

These textile companies are found at different locations in Mauritius. However, most of them are centered in the capital of the island (Port Louis) and in center.

2.9.1 Environmental impacts of textile companies

The textile industry plays a great role in the depletion of scarce natural resources and because of this it faces unprecedented confronts. Since many years, climate alteration, water stresses and swelling raw materials prices are threatening to destabilize the innovation aptitude of this industry. The textile industry has several impacts on the ecosystem. These are enumerated below.

2.9.1.1 Land pollution

Adverse outcomes that appear from the occurrence of waste materials on the ecosystem is a chief predicament worldwide and it calls for emphasis of the recycling and reuse processes [145]. The textile manufacturing process generates a noteworthy quantity of solid waste [212] Removal and management of textile wastes have caused global concerns to rise. Textile wastes comprise of wastes that are produced from the streams of fiber, textile production process, the biological and primary sludge retrieved from the wastewater treatment plant and wastes coming from commercial service and consumption [207, 212]. Due to the fact that post-consumer textile waste cannot be straightforwardly decomposed, buildup of these wastes can create infectious diseases, draw pests and spread noxious odors in the ecosystem [208]. In the present century, textile waste management comprises of reusing wastes as second-hand textiles and filling materials, landfilling, and incineration [211, 209]. Nevertheless, all of these activities have their own ecological impact and cause a loss in energy and raw materials.

2.9.1.2 Water pollution

Water pollution is a great ecological menace throughout the globe. Water is a vital resource for all living beings in this world. The textile industry is a noteworthy contributor to the pollution of water bodies and maybe second only to tanneries and pulp & paper industry [197]. Textile companies are a great consumer of chemicals, dyes and water for manufacturing of clothing [113].

Dye is said to be among the highly troublesome constituents in textile wastewater treatment due to its intricate chemical structure [114]. Dye is the chief element in textile coloring effluent. Various categories of dyes are utilized in the industry, depending on the features of the fiber. Throughout the fabric dyeing process, the majority of the dye is exhausted in the fabric material. However, the unfixed dye is released into the effluent and this generates a

colored effluent [119, 117, 118]. Release of dyes into the effluent streams comprises of a small concentration of dyes. However, it is extremely visible due to its staining properties [116,120]. Elimination of dye from the textile effluent is a significant ecological dilemma for the following reasons:

- The textile effluent is highly toxic and has carcinogenic and mutagenic properties which can cause various health disorders.
- The effluent has low biodegradability which has a great impact on photosynthesis.
- The textile effluent is extremely recalcitrant in nature [116, 120]

In order to guarantee sustainable ecological development, the release of dyes in effluents should be trimmed down to the utmost level [218]. Suspended solids are other classes of pollutants in textile effluents. Suspended solids are formed oil, grease, clay, silt and gritty are mixed together [121, 122]. The amount of total suspended solids in textile effluents has a significant impact on the aquatic environment. High amounts of suspended solids have the capacity of choking the breathing organ of aquatic fish and this can cause decreased growth in fish [121, 122].

2.9.1.3 Air pollution

GHG emissions from textile companies are a great source of air pollution. It is extremely essential to scrutinize the GHG emissions of textile companies and look for potential energy saving measures. With respect to GHG emission accounting, some large cloth production organizations such as Levi Strauss Co. and Continental Clothing Co. have undertaken an evaluation of the life cycle carbon footprint of shirts, T-shirts and other clothing's [204]. [205] conducted an analysis of the carbon footprint of the textile supply chain and affirmed that electricity and thermal energy (steam) consumption are the chief sources of GHG emanations [69]. It is therefore important to seek energy saving measures for electricity and steam consumption.

2.9.2 Economic impacts of textile industries

The notion of economic development is seen as one of the three pillars of sustainable growth [143]. Sustaining economic growth is a vital and globally accepted idea for the broad public. [153].The significance of economic sustainability is currently increasingly recognized even

by highest political delegates [153]. Economic sustainability comprises of factors like the degree of economic returns, the insecurity of returns, and in monetary economies, the related financial needs and the accessibility of finance [151]. The textile industry in Mauritius has a key role in the economy for creation of employment in the value of industrial manufacturing [213].

2.9.3 Social impacts of textile companies

Textile fabrics are in close contact with our skin every day. They are absolutely all over the place at any moment of our lives. They are present in the clothes we wear on our body, in our bed and linens, in our transportation systems and they are used to protect wounds. It is thus primordial that textile fabrics do not impair human health [215]. However, many chemicals utilized in household products have been found to have adverse effects on human health and the environment and this includes chemicals used in the textile industry. The human health impacts can range from mild allergies to toxic chemicals that can lead to birth defects.

Some dyes used in textiles have been shown to be extremely toxic to human health. For example, heavy metals like lead and cadmium present in dyes and pigments are highly prone to bioaccumulation in the human body. This can eventually have mutagenic and carcinogenic effects on the human body [216, 214] Studies have demonstrated that reproductive toxicity in human beings could be caused by exposure to textile materials that contain brominated flame retardants, highly fluorinated water and stain repellants, phthalates, and antibacterial agents. [217]. Serious attempts have been made in the current years to have a better control on the quantity of chemicals utilized in textile industries and trim down those that are the most toxic to humans [215].

2.9.4 Sustainability in the Mauritian textile industry

Because of an ever rising pressure from customers and markets, for financial or political grounds, sustainability is a factor that highly influences the textile industry [130]. It is a relative agreement that dealing with sustainability is an indispensable challenge that is enforced on all society's sectors [130]. Sustainability in the Mauritian textile industry has lately received a mounting amount of consideration. It is thought to be a successful solution for the incessant growth of the textile industry [194]. Integrating sustainability practices in business, as extensively reported, is not only beneficial for business; it is crucial if the industry wants to keep on expanding, innovating and creating employment in a world of

increasingly limited resources. Major progress in research and development has compelled the industry to offer high-performance products for the markets and this is a global occurrence [210].

2.9.5 Best practices to achieve sustainability in textile companies

The hunt for more sustainable development strategies obviously requires to a large extent more than just challenging evaluation and innovative theorizing. It demands creative ideas, based on triumphant experience, that are practically and cost-effectively implementable. [206]. There are several windows of opportunity to reinforce the role and visibility of sustainable development in textile companies by making use of best practices which are enumerated below [69].

2.9.5.1 Eco efficiency

Small and medium enterprises (SMEs) have to face severe troubles to compete in the world market, particularly in the textile sector, where clients ask for enhanced ecological performance as criteria for supply. Therefore, the textile industry has been developing sustainable actions by considering the principles of eco-efficiency. Eco-efficiency aims at adopting best environmental practices that also result in cost savings. This must show positively on the ecological and financial performance of the industry [201, 202, 3]. Moreover, eco-innovation is said to be the key to competitiveness because it stimulates the manufacturing sector to shift from strategies such as “end-of-pipe” to the “closed- loop”, with constructive outcomes on utilization of raw materials and energy [85,145]

2.9.5.2 Shifting from fossil energy to renewable energy

To uphold energy supply and keep atmospheric conditions inhabitable for upcoming generations, it is necessary to find substitute sources of energy. Low carbon dioxide emission technologies are extremely significant for sustainable energy growth and development [62]. In the latest years, renewable energy resources have become highly crucial due to the restricted quantity of petroleum-based fuels, which are constantly depleting [137]. Great emphasis is laid on renewable energy worldwide because of its capacity to contribute positively to sustainable development [53, 86, 57, 58, 62, 92].

Solar energy is the most abundant, effortlessly accessible and one of the safest form of the sustainable energy. Solar energy technologies can be classified into 3 categories. The first category, photovoltaic (PV) system, generates electricity by direct conversion of solar radiation [62].The second category, concentrating collectors, make use of concentrating solar power to heat up a receiver, which is localized on the focus point of the collector. Then, the heat energy is transformed into mechanical energy by making use of a turbine system and then electricity is generated [62]. The third category, solar heating systems, utilize solar thermal energy for the heating up of household water [62].

Biofuels are other forms of renewable energy. They have the capacity to substitute petroleum-based fuels and aid in the reduction of CO_2 emanations. They are deeply studied in developed countries for the creation of an enhanced ecosystem. However, it is necessary to acquire basic feedstocks for the development of biofuels in a lucrative way [137].

2.9.5.3 Workplace innovation (WPI)

Sustainable development is a great source of technological innovation. In the recent years, more and more industries have started allotting considerable amounts of funding to research and to develop new solutions [85]. Workplace innovation (WPI) has the capacity of bringing radical modifications in the workers' milieu and thus can improve the turnover of companies [48]. It refers to how workers are deployed in order to ameliorate overall performance and also to generate good quality job [49, 62]. Workplace innovation (WPI) is also the deployment of innovative interventions in the work planning and organization, human resource management and manufacturing technologies [50].

2.9.5.4 Operational innovation

Operational innovation refers to the utilization of approaches which can improve and maximize the operations of the company [62, 38, 108, 12]. Some of the approaches are mentioned below:

- Reducing energy usage by using energy efficient light bulbs, air conditioning and heating
- Adopting waste recycling practices
- Adopting water recycling practices for irrigation of cane fields

- Using non hazardous chemicals only
- Low temperature bleaching and dyeing
- Cold pigment dyeing
- Ozone washing
- Usage of eco-friendly enzymes instead of bleaching chemicals
- Using environmentally friendly products in the manufacturing process [6]

2.9.5.5 Sustainable chemistry

Sustainable chemistry is known to be a holistic approach where the whole lifecycle of chemicals and the associated actors, institutions and culture is also given consideration. This means that every stakeholder that is found along the life cycle chain of the chemicals have accountable roles [69, 71]. Moreover, other factors like human health, the ecosystem, communal conditions and financial aspects have to be reflected on [69, 71]. Besides, sustainable chemistry also covers system innovations which will create deep-seated transformations in both social and technical dimensions [69]. One of the main intents of sustainable chemistry is to make use of chemicals which are environmentally friendly. The chemicals must not have any untoward effect on both human beings and the ecosystem and their use in products ought to be sustainable [69, 71]. With respect to hazardous chemical, sustainable chemistry calls for the defensive principle. For some chemicals, the hazardous property of a substance is enough to activate the implementation of safety measures [69, 71].

2.9.5.6 Sustainability education

Education is a vital constituent and a basis to any nation's expansion; it motivates scientific undertaking, improves the life of people, and injects a skillful labor force into the job market. Without any doubt, it can be said that education strengthens a country [89]. To allow the world to develop cordially, it is indispensable to disseminate education on sustainable development [92, 69, 88]. It is thought that renewable energy education is going to play a key role in promoting sustainable growth. It is therefore essential that policy makers are knowledgeable of the most up-to-date progress in the sector of renewable energy [90].

2.9.6 Barriers of adopting innovation and sustainability initiatives

Shifting towards a more sustainable world is evidently an intricate attempt that requires far-reaching partnership across various disciplines and sectors [36, 70]. There are several restrictions linked with sustainable growth. These constraints are not only dependent on scientific and technological limitations but also on communal restraints [108, 38, 42]. Part of the dilemma is that the huge amounts of funding required are often seen as an obstacle [62]. Other barriers are issues like resistance to transformation, lack of dedication towards innovation and sustainability and lack of partnership [108,147]

2.10 The benefits of a sustainability index framework for the Mauritian textile industry

Sustainable textile manufacturing is said to be a chief footstep in moving forward towards a more sustainable world. In order to provide a practical approach for the comparison of sustainability across organizations, a quantitative scoring system or index is indispensable. The objective of developing such an index is to improve the decision-making ability for modifications in textile manufacturing processes [134].

A sustainability index should be developed in such a manner that it accurately mirrors the sustainability of the textile company [166]. A sustainability index can be developed using tools such as frameworks and indicators. These tools are methods to interpret reality. Furthermore, they are significant tools to communicate with stakeholders and to make pledges for incessant enhancement in sustainability performance [134,135].

A sustainability index framework will give the Mauritian textile companies an insight as to where they are situated in the level of sustainability. Each textile company will receive its corresponding sustainability score. A low score in sustainability index will indicate the areas that need improvement. This will enable the companies to further improve their level of sustainability by working on their process. This will have an overall benefit not only on the textile companies but on Mauritius Island as a whole.

CHAPTER 3

METHODOLOGY

3.0 Introduction

A sustainability index should be developed in such a manner that it can be applied to all the textile companies in Mauritius. The index should be selected properly so that it reflects beyond doubt the sustainability of the textile company concerned. The triumph and precision of a sustainability index relies on how correctly the given data sets bear resemblance to the actual occurrences [195]. To achieve the appropriate resemblance, the steps below are followed:

3.1 Assessing the current level of awareness of textile factories with regards to sustainability

As an initial phase of the project, we have assessed the awareness of textile companies in Mauritius on sustainability. The sample size was determined by identifying textile companies with high turnovers and having significant environmental impacts. The ecological issues are mainly due to the generation of polluting textile effluents, noxious emissions from boilers, solid wastes and hazardous materials use (Table 6).

A questionnaire has been developed to determine the level of awareness of textile companies with regards to sustainability drivers and practices. The questionnaire used in the study was carefully designed so as to take into account all the objectives of the study. It was developed by basing ourselves on existing literature on sustainability. It focuses on all the aspects of sustainability namely environmental, energy, economic and social.

Table 6: Textile companies in Mauritius chosen for survey

No	Textile company
1	Esquel Ltd
2	RT Knits
3	Wensum Ltd
4	Star Knitwear
5	Laguna Clothing
6	Ferney Spinning Mills
7	Tropic Knits Ltd
8	World Knits Ltd
9	FM Denim Ltd
10	Tara Knitwear/Rossana Textiles Ltd
11	Consolidated Fabrics Ltd

12	CDL limited
13	Firemount Ltd
14	DDI Ltd
15	Palmar Limitee
16	CompagnieMauricienne de Textile Ltée
17	Aquarelle clothing
18	Maxiwear Ltd

The respondents participating in the exercise were mainly the general managers, human resource managers, production managers, operations managers, dyehouse managers, finance directors, environmental engineers and sustainability engineers. Information was collected from mid November 2017 to February 2018.

The textile companies were informed about the second phase of the project which will consist of the developing of a sustainability index framework for the Mauritian textile industry. They were informed about the benefits of participating in the second phase of the project and their interests were noted.

3.2 Indicator selection

After a deep study of the Mauritian textile industry, a set of environmental, economic and social indicators have been identified for the framework. The main indicator categories used to assess the environmental sustainability of textile companies are mainly water, biodiversity, air emissions, solid waste, effluent, eco materials, hazardous materials management, supply chain and products, compliance, certifications, transport and energy. The number of indicators for each category is presented in Table 7.

Table 7: Number of indicators for each category

Category	Number of indicators
Environment	174
- Water	22
- Biodiversity	2
- Air Emissions	67
- Solid Waste	6
- Effluent	25
- Eco Materials	6
- Hazardous materials management	9

- Supply chain and products	2
- Compliance	2
- Certifications	10
- Transport	1
- Energy	22
Economic	15
Social	30
Total	219

3.3 Sustainable manufacturing framework

A sustainable manufacturing framework has been developed using the selected indicators. It encompasses all the different aspects of sustainability namely environmental, economic and social. The framework has been developed on Microsoft Excel 2010. It is in the form of an interactive questionnaire capable of generating a sustainability index based on the environmental, economic and social data of textile companies. The questionnaire consists of both qualitative and quantitative indicators. The uniqueness of the questionnaire is that it adjusts itself to the company. Some companies have unit operations which might not be present in other companies. The type of indicators and also the quantity of indicators present in the questionnaire vary depending on the company. Some companies will have indicators which will not be relevant to other companies. The interactive questionnaire is capable of adjusting itself to the companies and will generate a sustainability index upon insertion of environmental, economic and social data. The framework also calculates the GHG emissions of companies upon insertion of the mass of individual fossil fuels consumed.

3.4 Sustainability framework testing

Data collection was done in 5 textile factories that have shown their interest in taking part in the second phase of the project. Data was collected with respect to environmental, economic and social indicators and the sustainable manufacturing framework generated a sustainability index for the 5 companies.

CHAPTER 4

SURVEY RESULTS AND DISCUSSIONS

4.0 Survey response

This survey makes multiple novel contributions by providing to both academics and practitioners a greater perspective on the sustainability awareness of textile companies in Mauritius. We have obtained a response rate of 56% from the companies. The response of each company is presented in Table 8.

Table 8: Response obtained from textile companies for the survey

No	Textile company	Response
1	Esquel Ltd	✔
2	RT Knits	✖
3	Wensum Ltd	✔
4	Star Knitwear	✔
5	Laguna Clothing	✔
6	Ferney Spinning Mills	✔
7	Tropic Knits Ltd	✖
8	World Knits Ltd	✖
9	FM Denim Ltd	✔
10	Tara Knitwear/Rossana Textiles Ltd	✖
11	Consolidated Fabrics Ltd	✔
12	CDL limited	✖
13	Firemount Ltd	✔
14	DDI Ltd	✖
15	Palmar Limitee	✔
16	CompagnieMauricienne de Textile Ltée	✖
17	Aquarelle clothing	✔
18	Maxiwear Ltd	✖

✔: Positive response

✖: Negative response

The survey results obtained from the textile companies, which have given a positive response, have been compiled and are presented below.

4.1 Sustainability Awareness

100% of the companies interviewed affirmed that they are fully engaged in sustainable development. With respect to sustainability objectives, 100% of the companies have the objectives of decreasing energy and water consumption, waste generation and CO_2 emissions. One company has the objective of collecting used oil for recycling and also improve the combustion efficiency of the boiler. 40% companies have a sustainability report and the majority of them are internal reports.

4.2 Environment

4.2.1 Environmental Policies, Procedures and Awareness

All the companies affirmed that they track environmental performance metrics. The main metrics used are mainly water consumption, electricity consumption, paper and chemicals consumption per month, waste generation per month and gaseous emissions per month. 80% of the companies have an environmental policy statement endorsed by top management. 20% of the companies interviewed are certified ISO 14000. Other environmental certifications are mainly Oeko Tex, EU Eco label, Wrap, Reach, and fair trade. 40% of the companies have carried out an environmental impact assessment (EIA) to determine its environmental impacts (Figure 5).

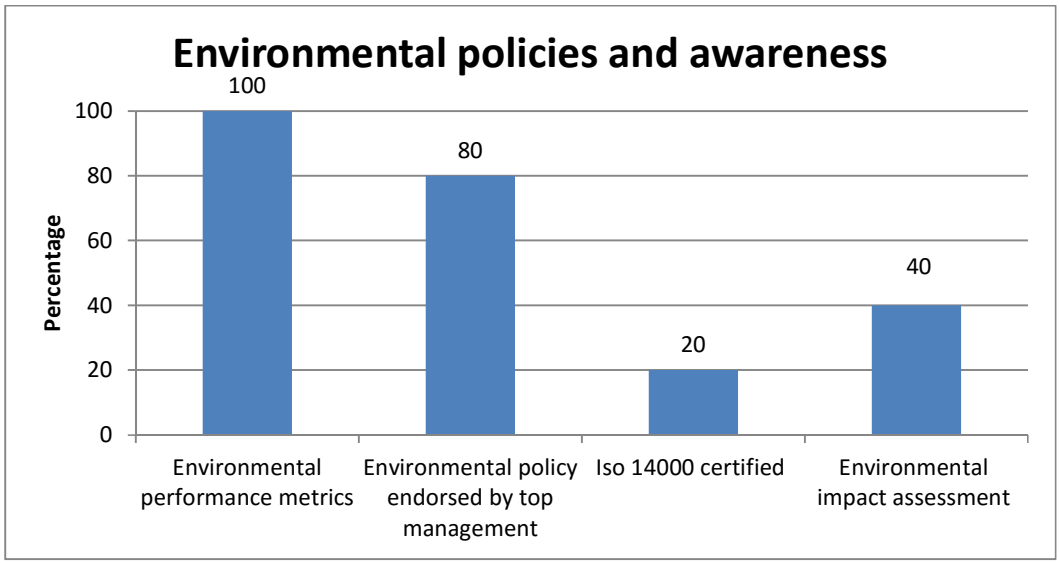

Figure 5: Environmental policies and awareness in textile companies

4.2.2 Solid Waste Generation

The textile manufacturing process generates a noteworthy quantity of solid wastes [212]. Removal and management of textile wastes have caused global concerns to rise. Textile waste comprises of waste that are produced from the streams of fiber, textile production process, the biological and primary sludge retrieved from the wastewater treatment plant and wastes coming from commercial service and consumption [207, 212]. Due to the fact that post-consumer textile waste cannot be straightforwardly decomposed, buildup these waste can create infectious diseases, draw pests and spread noxious odors in the ecosystem [208]. In the present century, textile waste management comprises of reusing wastes as second-hand textiles and filling materials, landfilling, and incineration [211, 209].

100 % of the companies interviewed track a normalized solid waste metric. The metrics used for solid waste measurement are mainly plastic wastes, paper wastes, fabric wastes each measured in kilograms on a monthly basis. The amount of solid waste generated was not disclosed by the companies. The solid waste generated is disposed by land filling and recycling. 90 % of the companies recycle scrap garment materials. The companies have a policy for recycling for the items presented Figure 6.

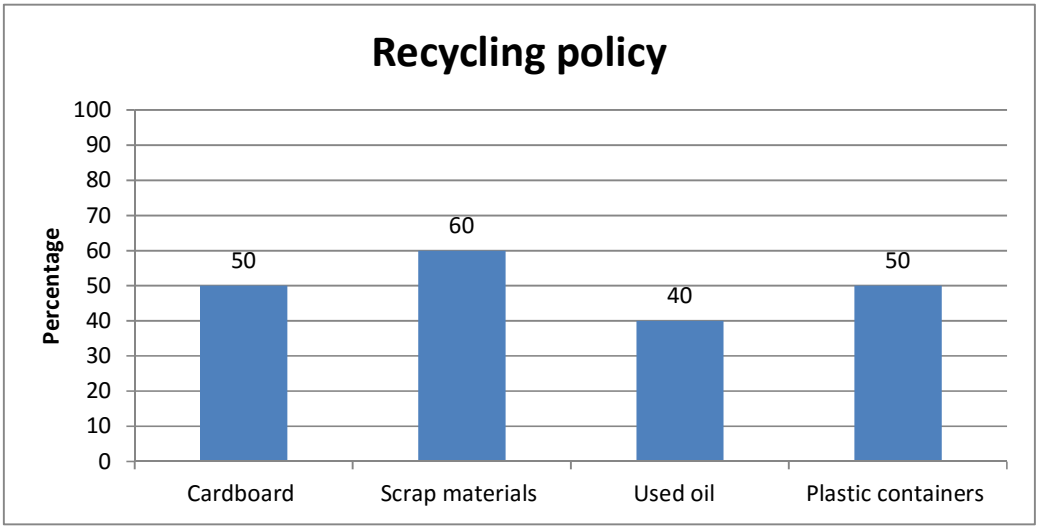

Figure 6: Recycling policy for materials in textile companies

4.2.3 Wastewater Generation

Water pollution is a great ecological menace throughout the globe. Water is a vital resource for all living beings in this world. The textile industry is a noteworthy contributor to the pollution of water bodies and maybe second only to tanneries and pulp & paper industry [197]. Textile companies are a great consumer of chemicals, dyes and water for manufacturing of clothing [113]. Great quantities of textile wastewater can modify the physical, chemical, and biological properties of the aquatic world and could be also detrimental to human health, livestock and other living organisms in the biodiversity [247,248]. 70 % of the companies interviewed produce and discharge industrial effluent and they possess a valid effluent discharge permit. 60 % of the companies track a normalized effluent metric. Waste water generation was mainly measured at monthly interval in m^3. The volume of effluent generated was not disclosed by the companies. 50 % of the companies have an effluent treatment plant and they carry out regular testing of the effluent (Figure 7).

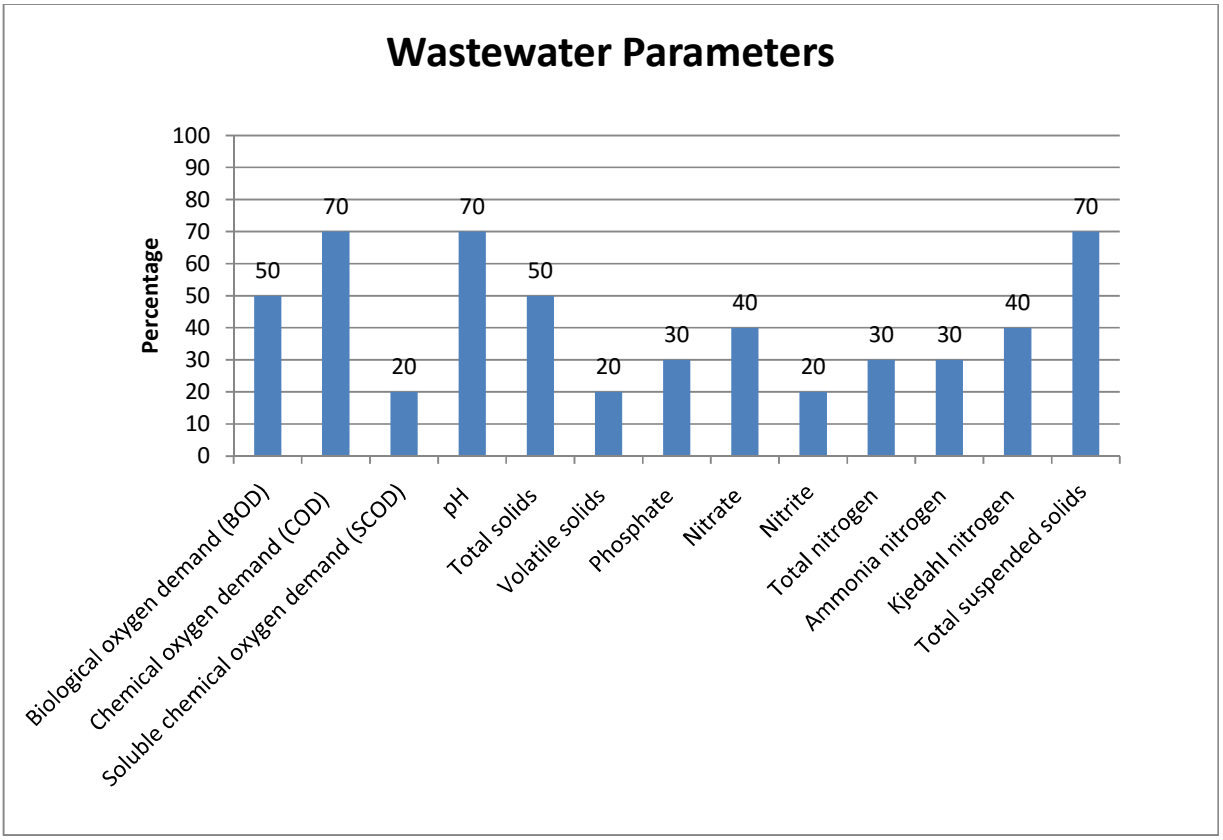

Figure 7: Wastewater parameters

As far as permissible limits are concerned, 100% of the companies respect all the permissible limits for effluent discharge specified in the environmental protection act (EPA) 2002.

4.2.4 Gaseous Emission from Boilers

Boilers are pressure vessels which are utilized in industries for the heating of water and turning it into high temperature steam [244]. 40% of the companies use water tube boilers and 80% of the companies use fire tube boilers. All the companies carry out regular maintenance of the boilers to prevent problems like scaling and fouling. The frequency of maintenance is mostly every 3 months. 80% of the companies carry out regular monitoring of stack emissions. 30% of the companies have air pollution control equipment. The installed equipment are mainly air filters, wet scrubber and built in grit collector. The parameters monitored are presented in Figure 8.

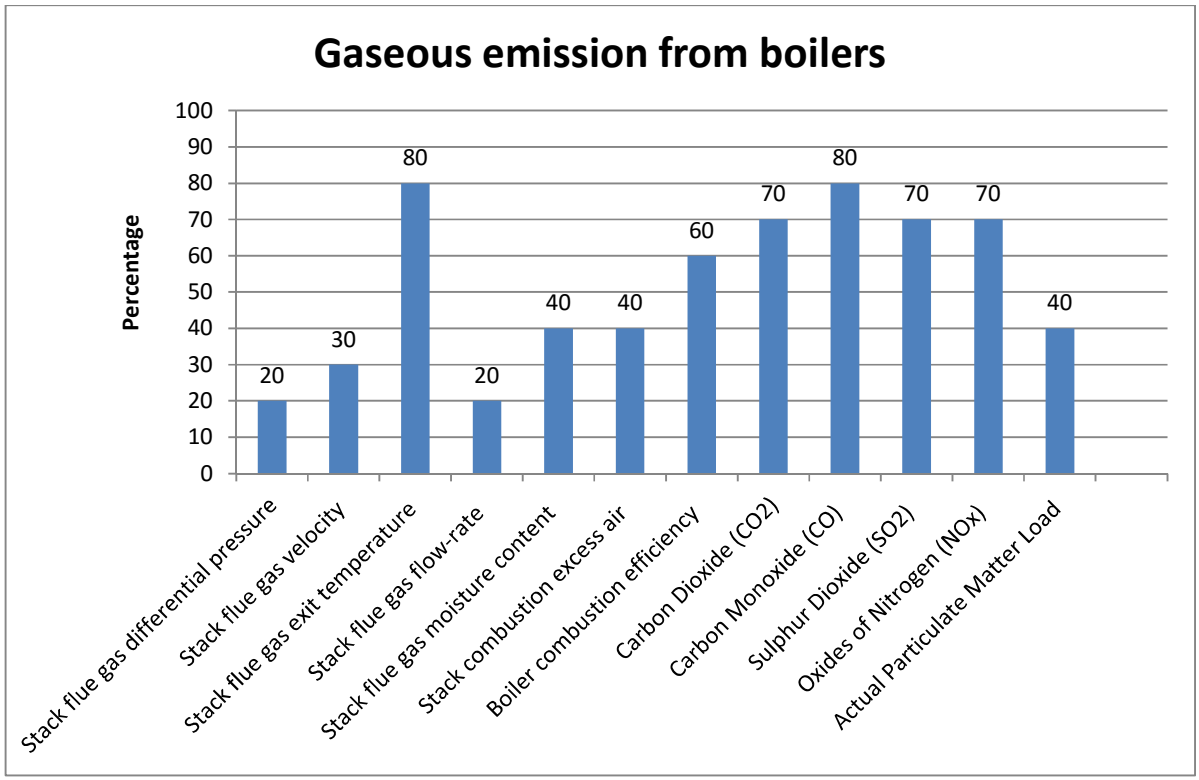

Figure 8: Air emission parameters

GHG emissions from textile industries are a great source of air pollution. It is extremely essential to scrutinize the GHG emissions of textile industries and look for potential energy saving measures.

4.2.5 Hazardous Chemical Use

Several chemical substances are known to possess hazardous properties. Several times, the property of a chemical is beneficial for certain application but at the same time it causes human health risks or environmental issues. Humans are clearly aware about the dangers of chemicals since more than hundreds years. However, there is the necessity for control and management of these hazardous chemicals to prevent environmental disasters and to ensure human security [245, 246]. 30 % of the companies interviewed use hazardous chemicals and they maintain an electronic inventory of all hazardous chemicals used on site.

4.2.6 Water Use

The textile industry is a great consumer of fresh water. All the organizations interviewed track a normalized water-use metric. 50% have a documented leak detection program. Textile companies have adopted water conservation technologies in toilets in order to minimize their water consumption. The water conservation technologies are presented in Figure 9.

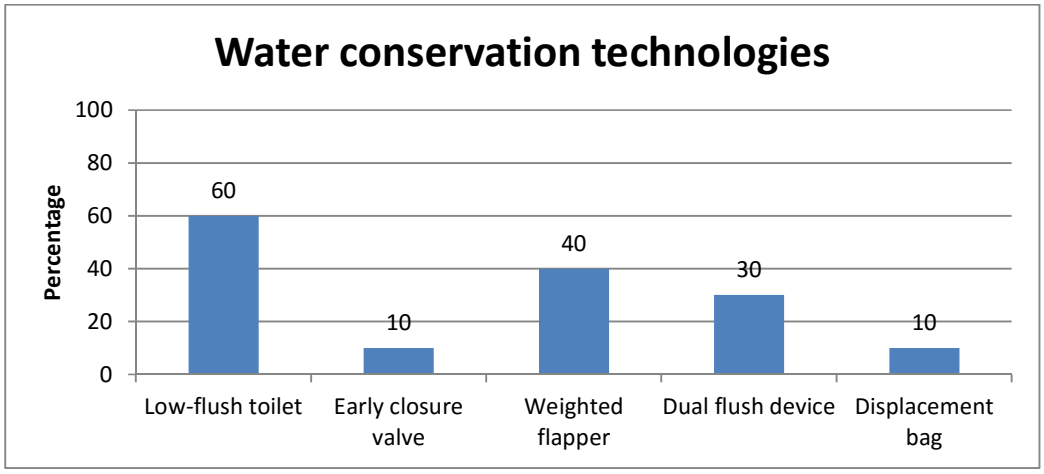

Figure 9: Water conservation technologies used in textile companies

4.2.7 Environmental Compliance

The degree of compliance with respect to environmental regulations differs greatly across firms in Mauritius. The fact is that several companies do just enough to respect regulatory standards, some do much more and others do less [249]. Only two of the companies interviewed previously had incidents associated with non-compliance with environmental laws and regulations. These incidents were mainly the propagation of fly-ash from the facility onto neighboring houses.

4.2.8 Energy Use

The textile industry is a great consumer of energy in terms of electricity, steam and fossil fuels. Energy is among the key cost factors in the textile industry [250]. In Mauritius, all the companies interviewed track a normalized energy-use metric. The main metrics used are mainly electricity, steam and fossil fuel use. 20% of the companies interviewed affirmed using coal in boilers for steam generation. This high temperature steam is then fed into the dye house and dyers. At certain times, textile dyeing demands high temperatures of above 100 °C. 70% of companies use heavy fuel oil in boilers. 60% use liquefied petroleum gas. 40% of the companies use diesel and 100% use petrol. As far as renewable energy is concerned, it is present in the form of photovoltaic panels in 20% of the companies (Figure 10).

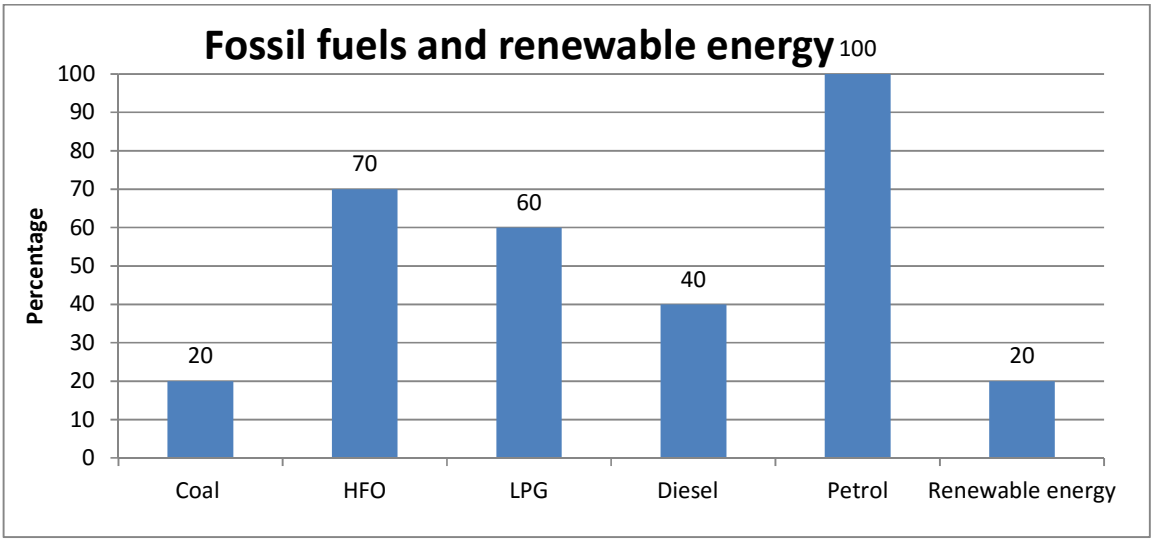

Figure 10**:** Fossil fuels and renewable energy used in textile companies

Improving the energy-efficiency of the process should be a main concern for textile companies. There are several cost effective energy-saving opportunities that exist in every textile industry [250]. With respect to Mauritian textile industries, 70 % of the companies interviewed have performed a formal energy audit and have identified energy efficiency opportunities. The optimization strategies for lighting are presented in Figure 11.

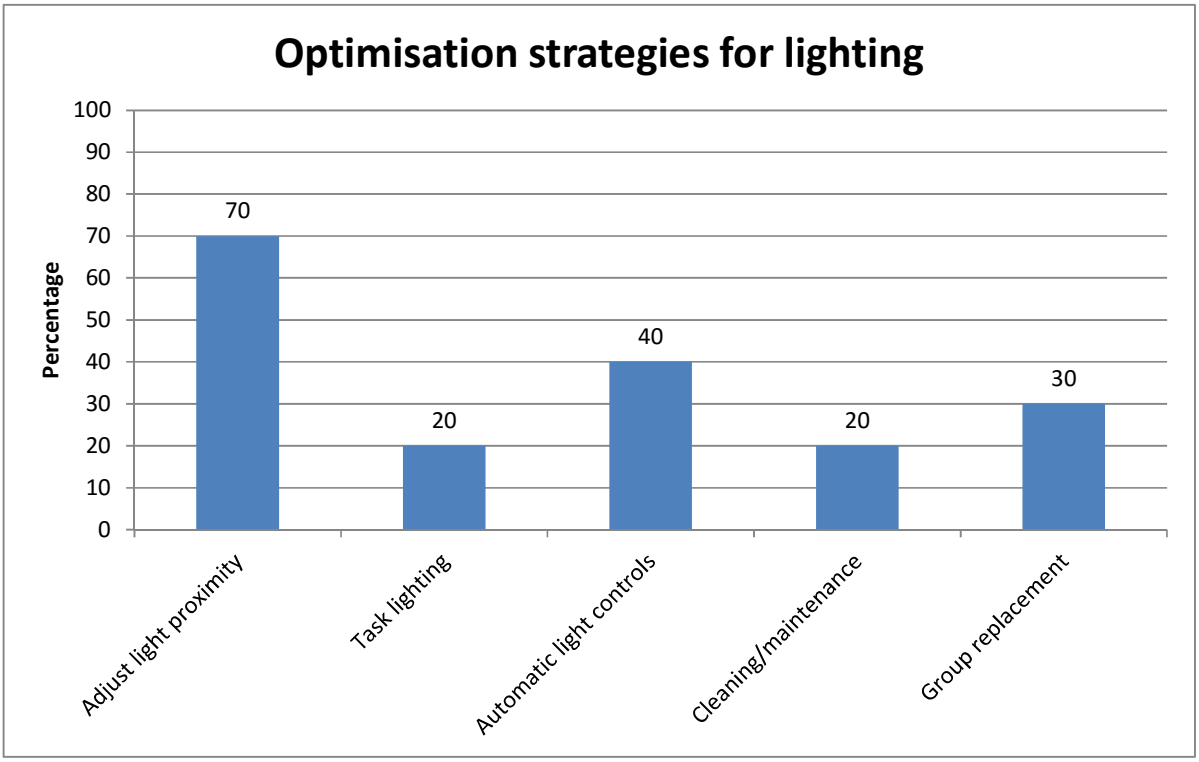

Figure 11: Optimization strategies for lighting

The majority of textile companies have adjusted light proximity and have used automatic light controls as techniques for optimization. Furthermore, companies have utilized energy efficient technologies such as electronic ballasts, hybrid ballasts and T8 or T5 lamps etc. The percentage of companies using each one of them is presented in Figure 12. The survey has shown that the majority of textile companies use LED exit signs, electronic ballasts, T5 and T8 lamps as energy efficient technologies.

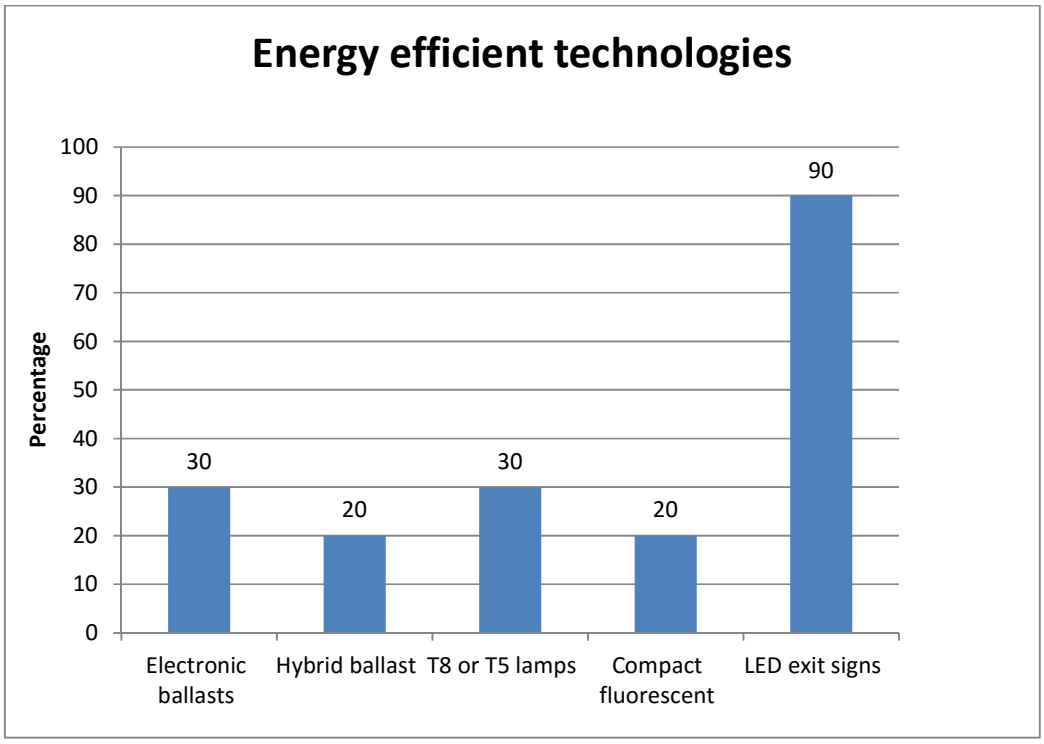

Figure 12: Energy efficient technologies utilized in textile companies

Furthermore, 70% of the companies interviewed have conducted a formal study to determine the appropriate lighting levels for each task and process. 80% have installed energy efficient air conditioning systems. This will help reduce the energy consumption of the company.

4.3 Economic

The notion of economic development is seen as one of the three pillars of sustainable growth [143]. Sustaining economic growth is a vital and globally accepted idea for the broad public. [153].The significance of economic sustainability is currently increasingly recognized even by highest political delegates [153]. Economic sustainability comprises of factors like the degree of economic returns, the insecurity of returns, and in monetary economies, the related financial needs and the accessibility of finance [151]. The textile industry in Mauritius has a key role in the economy for creation of employment in the value of industrial manufacturing [213]. The survey has shown that 30% of the companies have turnovers less than Rs 100 million. 10% have turnovers between Rs 150 million to Rs 250 million and 60% have turnovers above Rs 500 million (Figure 13).

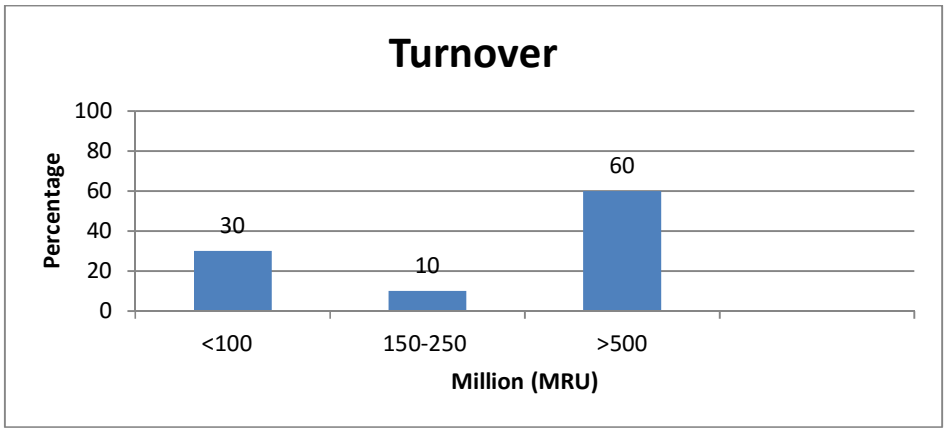

Figure 13: Turnovers of textile companies

4.4 Social

The approaches to the social aspect of sustainability are as miscellaneous as the approaches to the economic aspect [155]. Social sustainability calls for the need that the unity of society and its capability to labor towards universal sustainability goals. The survey has shown that 75% of the companies interviewed have already informed their staff about the importance of sustainability in business (Figure 14). A great majority of the companies (80%) have implemented CSR programs. These programs include donations to vulnerable families, grants to the National Empowerment Fund (NEF), study materials to students and donations to Cancer Foundations.

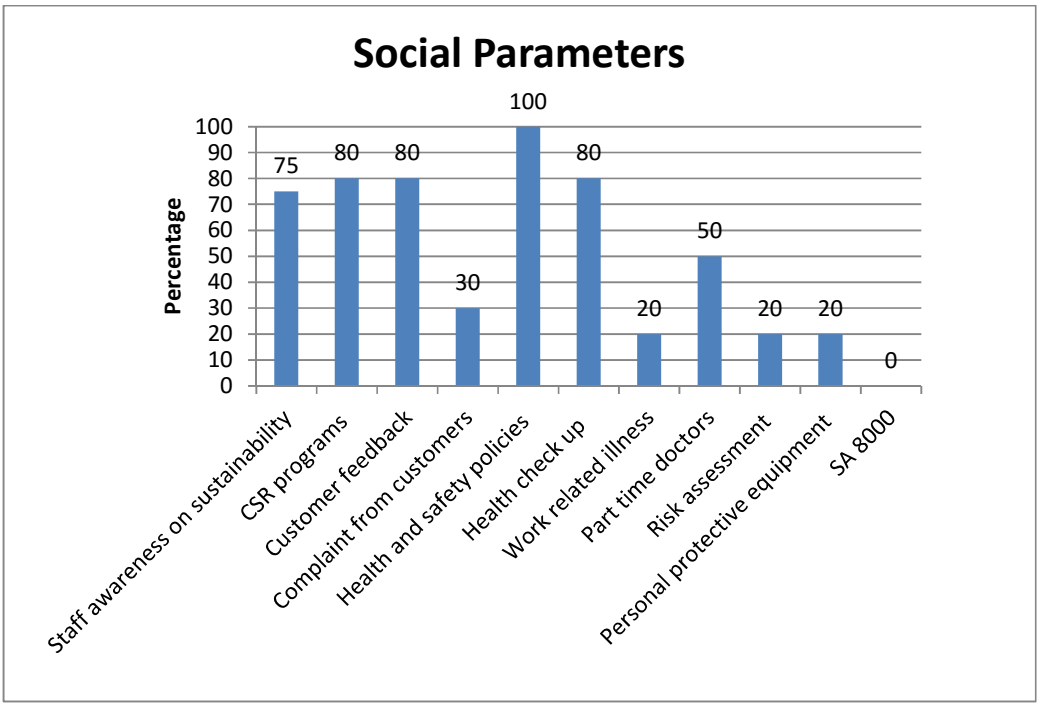

Figure 14: Social parameters

80% of the companies use customer feedback to monitor complaints related to sustainability from customers. All the companies interviewed have health and safety policies. A sustainable occupational health and safety surroundings is of paramount importance for social sustainability [42]. Health and safety is slowly becoming the main subjects of universal fears. In many researches, proper running of occupational safety and health have been found to play a fundamental part in running a triumphant business [41]. Frail Occupational Safety and Health (OSH) regulatory system is an invitation for mishap [40, 42, 44, 51]. 80% of the companies carry out regular health checkup of their employees and 20% have recorded work related illnesses. 50% of the companies have employed part time doctors to cater for the health of the employees. Many companies (20%) have performed risk assessments in their facility to reduce the number of risks to which the workers are exposed. Also, personal protective equipment (PPE) has been given to all of them.

4.5 Conclusion for survey

As a whole, it can be said that the majority of textile companies in Mauritius are on the path of sustainable development. All the companies interviewed affirmed that they are fully include all the aspects of sustainability namely environment, economic and social into their business. In the long run, this will lead to a more sustainable textile industry in Mauritius. This will be beneficial to the island and its inhabitants. Together, we can work towards creating a more sustainable Mauritius.

4.6 Participation in the second phase of the project

The majority of textile factories gave a positive response for the second phase of the project (Table 9). 9 textile factories gave a positive response and 9 gave a negative response.

Table 9: Response for second phase of project

No	Textile company	Response for second phase of project
1	Esquel Ltd	✔
2	RT Knits	✖
3	Wensum Ltd	✔
4	Star Knitwear	✖
5	Laguna Clothing	✔
6	Ferney Spinning Mills	✔
7	Tropic Knits Ltd	✖
8	World Knits Ltd	✖
9	FM Denim Ltd	✔
10	Tara Knitwear/Rossana Textiles Ltd	✖
11	Consolidated Fabrics Ltd	✔
12	CDL limited	✖
13	Firemount Ltd	✔
14	DDI Ltd	✖
15	Palmar Limitee	✔
16	CMT Ltée	✖
17	Aquarelle clothing	✔
18	Maxiwear Ltd	✖

✔: Positive response

✖: Negative response

The remaining of the project is continued with the textile companies that have accepted to participate in the second part of the project.

CHAPTER 5

SUSTAINABILITY INDEX FRAMEWORK

5.0 Sustainability index framework

5.1 Indicator selection

The concept of sustainable development has been portrayed by the three viewpoints namely environmental, economic and social. After a deep study of the Mauritian textile industry, a set of environmental, economic and social indicators have been identified for the framework. The main indicator categories used to assess the environmental sustainability of textile companies are mainly water, biodiversity, air emissions, solid waste, effluent, eco materials, hazardous materials management, supply chain and products, compliance, certifications, transport and energy. The number of indicators for each category is presented in Table 10.

Table 10: Number of indicators for each category

Category	Number of indicators
Environment	174
- Water	22
- Biodiversity	2
- Air Emissions	67
- Solid Waste	6
- Effluent	25
- Eco Materials	6
- Hazardous materials management	9
- Supply chain and products	2
- Compliance	2
- Certifications	10
- Transport	1
- Energy	22
Economic	15
Social	30
Total	219

5.2 Sustainable manufacturing framework

A sustainable manufacturing framework has been developed using the selected indicators. It encompasses all the different aspects of sustainability namely environmental, economic and social. The framework has been developed on Microsoft Excel 2010. It is in the form of an interactive questionnaire capable of generating a sustainability index based on the environmental, economic and social data of textile companies. The questionnaire consists of

both qualitative and quantitative indicators. The uniqueness of the questionnaire is that it adjusts itself to the company. Some companies have unit operations which might not be present in other companies. The type of indicators and also the quantity of indicators present in the questionnaire vary depending on the company. Some companies will have indicators which will not be relevant to other companies. The interactive questionnaire is capable of adjusting itself to the companies and will generate a sustainability index upon insertion of environmental, economic and social data. The framework also calculates the GHG emissions of companies upon insertion of the mass of individual fossil fuels consumed.

5.3 Credit scoring system

A credit scoring system has been used to calculate the scores and sustainability index. The individual scores and sustainability index has been calculated using the following formula:

$$\sum_{i=1}^{n} \frac{x_i z_i}{y_i z_i} x100 = \frac{x_1 z_1 + x_2 z_2 + x_3 z_3 + x_4 z_4 + \ldots\ldots + x_n z_n}{y_1 z_1 + y_2 z_2 + y_3 z_3 + y_4 z_4 + \ldots\ldots + y_n z_n} x100$$

Where,

x_i = Score obtained for each indicator

y_i = Maximum achievable score for each indicator

z_i = Number of credits for each indicator

The scoring system has been designed with three possible scores for each indicator namely 0, 1 and 2. The maximum achievable score for each indicator is 2. Each indicator has a specific scoring criteria. As for the credits, three possible credit values for each indicator namely 3, 5 and 7 have been used for the design. Indicators have been assigned credit values based on their degree of importance.

5.4 GHG emissions and offsets calculations

Direct GHG emission from individual fuel consumption at source has been calculated using the following formulae:

$$tCO_2e = [Usage(t)\,x\,CO_2\ Emission\ Factor\ (\frac{kgCO_2}{t})\,x\,\frac{1t}{1000kg}]+$$
$$[Usage(t)\,x\,N_2O\ Emission\ Factor\ (\frac{kgN_2O}{t})\,x\,\frac{1t}{1000kg}\,x\,265\,GWP]+$$
$$[Usage(t)\,x\,CH_4\ Emission\ Factor\ (\frac{kgCH_4}{t})\,x\,\frac{1t}{1000kg}\,x\,28\,GWP]$$

The global warming potential (GWP) values for N_2O and CH_4 are 265 and 28 respectively [269]. The emission factor of each individual fuel is presented in Table 11.

Table 11: Emission factors of fuels [269]

Fuel	Emission factors (kg/ ton fuel)		
	CO_2	N_2O	CH_4
Bituminous coal	2440.68	0.0387	0.258
Sub bituminous coal	1816.29	0.02835	0.189
Lignite coal	1201.9	0.01785	0.119
Anthracite coal	2624.61	0.04005	0.267
Heavy fuel oil (HFO)	3126.96	0.02424	0.404
Liquefied petroleum gas (LPG)	2984.63	0.00473	0.2365
Diesel oil	3186.3	0.0258	0.43
Gasoline	3069.99	0.02658	0.443

Indirect GHG emissions from electricity consumption and GHG offsets from electricity generated from renewable energy have been calculated using the following equation:

$$tCO_2e = [Usage(KWh)\,x\,CO_2\ Emission\ Factor_{grid}\ (\frac{kgCO_2}{KWh})\,x\,\frac{1t}{1000kg}]+$$
$$[Usage(KWh)\,x\,N_2O\ Emission\ Factor_{grid}\ (\frac{kgCO_2e}{KWh})\,x\,\frac{1t}{1000kg}]+$$
$$[Usage(KWh)\,x\,CH_4\ Emission\ Factor_{grid}\ (\frac{kgCO_2e}{KWh})\,x\,\frac{1t}{1000kg}]$$

The Clean Development Mechanism (CDM) Methodological Tool (Version 04.0) has been used to calculate the CO_2 emission factor for the electricity system in Mauritius. The operating grid emission factor for CO_2 has been calculated as 1.0170 $kgCO_2$/KWh [260]. However, no grid emission factors have been developed for CH_4 and N_2O. The emission factors used for CH_4 (0.00066 $kgCO_2e$/KWh) and N_2O (0.00153 $kgCO_2e$/KWh) have been adapted from those developed by the UK government for the UK electricity system [261]. Further studies will have to be done to refine these values for the Mauritian context.

5.5 Profitability calculation

The profits of the textile companies have been calculated using the following equations:

Gross profit = turnover - cost of sales

Profit/loss before tax = (gross profit + other income) – (distribution costs + administration costs + other expenses + finance costs)

Tax expense = 15% of profit/loss before tax

Net profit/Loss = profit/loss before tax – tax expense

5.6 Detailed list of indicators present in framework

The detailed list of indicators of the framework is presented in Table 12, 13 and 14. Each indicator is presented together with its corresponding benchmark, scoring criteria and credits.

Table 12: Environmental indicators

Category	Indicator	Unit	Benchmark	Scoring criteria	Credits
Water	Does your organization measure its monthly water consumption?	NA	NA	Yes= 2 and No= 0	7
	Total water use per month	m^3	NA	NA	NA
	Does your organization have a leak detection system?	NA	NA	Yes= 2 and No= 0	3
	Has your organization performed a water audit and identified ways to increase water use efficiency?	NA	NA	Yes= 2 and No= 0	5
	Does your organization recycle water for reuse?	NA	NA	Yes= 2 and No= 0	3
	Percentage of water recycled and reused	%	5	IF(AND(V>0,V<=5),"1", IF(AND(V>5,V<=100),"2","0"))	3
	Does your organization operate a boiler for steam generation?	NA	NA	Yes/ No	NA
	Is a boiler condensate recycling system installed?	NA	NA	Yes= 2 and No= 0	3
	Does your organization have a dyehouse operation?	NA	NA	Yes/ No	NA
	Does your organization carry out dyeing of yarn?	NA	NA	Yes/ No	NA
	Dyehouse water consumption per kilogram output of yarn	L/Kg	50 [b]	IF(AND(V>=0,V<=25),"2", IF(AND(V>25,V<=50),"1","0"))	5
	Does your organization carry out dyeing of knitted fabric?	NA	NA	Yes/ No	NA
	Dyehouse water consumption per kilogram output of knitted fabric	L/Kg	120 [b]	IF(AND(V>=0,V<=60),"2", IF(AND(V>60,V<=120),"1","0"))	5
	Does your organization carry out dyeing of woven fabric?	NA	NA	Yes/ No	NA
	Dyehouse water consumption per kilogram output of woven fabric	L/Kg	100 [b]	IF(AND(V>=0,V<=50),"2", IF(AND(V>50,V<=100),"1","0"))	5
	Has your organization adopted the innovative DyeCoo waterless dyeing technology using supercritical CO_2?	NA	NA	Yes= 2 and No= 0	5
	Has your organization adopted the innovative waterless AirDye technology?	NA	NA	Yes= 2 and No= 0	5
	Does your organization utilise automatic shut-off valve to control the flow of water into a process unit?	NA	NA	Yes= 2 and No= 0	3
	Does your organization have an on-site laundry operation?	NA	NA	Yes/ No	NA
	Has your organization implemented any one of the following water conservation technologies in laundry?	NA	NA	Batch water system= 2 Ozone washing= 2 Greywater recycling tank= 2 Polymer bead laundry system= 2 Water recovery tank= 2 Other= 2 None of them= 0	3
	Laundry water consumption per kilogram output?	L/Kg	26 [d]	IF(AND(V>=0,V<=13),"2", IF(AND(V>13,V<=26),"1","0"))	5
	Does your organization have a scouring operation?	NA	NA	Yes/ No	NA
	Scouring water consumption per kilogram output?	L/Kg	6 [b]	IF(AND(V>=0,V<=3),"2", IF(AND(V>3,V<=6),"1","0"))	5
	Has your organization optimized mechanical removal of water prior to the drying process?	NA	NA	Yes= 2 and No= 0	3
	Does your organization have a finishing operation?	NA	NA	Yes/ No	NA
	Does your organization use mechanical dewatering equipment to reduce water content of incoming fabric?	NA	NA	Yes= 2 and No= 0	3

	Does your organization have a printing operation?	NA	NA	Yes/ No	NA
	Does your organization reuse rinsing water leftover from cleaning the printing belt?	NA	NA	Yes= 2 and No= 0	3
	Does your organization use flow control devices to ensure that water only flows to a process when needed?	NA	NA	Yes= 2 and No= 0	3
	Do the bathroom facilities used by employees have low flush features?	NA	NA	Yes= 2 and No= 0	3
	Has your organization implemented any one of the following water conservation technologies in toilets?	NA	NA	Early closure valve= 2 Dual flush device= 2 Weighted flapper= 2 Displacement bag= 2 Other= 2 None of them= 0	3
	Percentage reduction in overall water consumption due to water conservation technologies	%	5	IF(AND(V>0,V<=5),"1", IF(AND(V>5,V<=100),"2","0"))	3
	Severity of impacts on water sources and related ecosystems by use of water	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact=0	7
Biodiversity	Severity of impacts of activities and operations on sensitive or protected areas	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact=0	7
	Has your organization adopted practices to protect and conserve biodiversity?	NA	NA	Yes= 2 and No= 0	5
Air Emissions	Does your organization track a normalized fossil fuel-use metric?	NA	NA	Yes= 2 and No= 0	7
	Type of coal used in your organization	NA	NA	Anthracite ☐ Bituminous ☐ Lignite ☐ Sub bituminous ☐ None of them ☐	NA
	Quantity of coal consumed per month	T	NA	NA	NA
	Direct CO_2 emissions from coal consumption at source	tCO_2	NA	NA	NA
	Direct N_2O emissions from coal consumption at source	tCO_2e	NA	NA	NA
	Direct CH_4 emissions from coal consumption at source	tCO_2e	NA	NA	NA
	Direct GHG emissions from coal consumption at source	tCO_2e	NA	NA	NA
	Quantity of heavy fuel oil (HFO) consumed per month	L	NA	NA	NA
	Direct CO_2 emissions from HFO consumption at source	tCO_2	NA	NA	NA
	Direct N_2O emissions from HFO consumption at source	tCO_2e	NA	NA	NA
	Direct CH_4 emissions from HFO consumption at source	tCO_2e	NA	NA	NA
	Direct GHG emissions from HFO consumption at source	tCO_2e	NA	NA	NA
	Quantity of liquefied petroleum gas (LPG) consumed per month	Kg	NA	NA	NA
	Direct CO_2 emissions from LPG consumption at source	t CO_2	NA	NA	NA
	Direct N_2O emissions from LPG consumption at source	tCO_2e	NA	NA	NA
	Direct CH_4 emissions from LPG consumption at source	tCO_2e	NA	NA	NA
	Direct GHG emissions from LPG consumption at source	tCO_2e	NA	NA	NA
	Quantity of diesel oil consumed per month	L	NA	NA	NA
	Direct CO_2 emissions from diesel oil consumption at source	tCO_2	NA	NA	NA

	Direct N_2O emissions from diesel oil consumption at source	tCO_2e	NA	NA	NA
	Direct CH_4 emissions from diesel oil consumption at source	tCO_2e	NA	NA	NA
	Direct GHG emissions from diesel oil consumption at source	tCO_2e	NA	NA	NA
	Quantity of gasoline consumed per month	L	NA	NA	NA
	Direct CO_2 emissions from gasoline consumption at source	t CO_2	NA	NA	NA
	Direct N_2O emissions from gasoline consumption at source	tCO_2e	NA	NA	NA
	Direct CH_4 emissions from gasoline consumption at source	tCO_2e	NA	NA	NA
	Direct GHG emissions from gasoline consumption at source	tCO_2e	NA	NA	NA
	Total direct CO_2 emissions from all fuels at source	tCO_2	NA	NA	NA
	Total direct N_2O emissions from all fuels at source	tCO_2e	NA	NA	NA
	Total direct CH_4 emissions from all fuels at source	tCO_2e	NA	NA	NA
	Total direct GHG emissions from all fuels at source	tCO_2e	NA	NA	NA
	Does your organization monitor its electricity consumption on a monthly basis?	NA	NA	Yes= 2 and No= 0	7
	Electricity consumption per month (CEB)	KW	NA	NA	NA
	Indirect CO_2 emissions from electricity consumption	tCO_2	NA	NA	NA
	Indirect N_2O emissions from electricity consumption	tCO_2e	NA	NA	NA
	Indirect CH_4 emissions from electricity consumption	tCO_2e	NA	NA	NA
	Total indirect GHG emissions from electricity consumption	tCO_2e	NA	NA	NA
	Total CO_2 emissions (direct + indirect)	tCO_2	NA	NA	NA
	Total N_2O emissions (direct + indirect)	tCO_2e	NA	NA	NA
	Total CH_4 emissions (direct + indirect)	tCO_2e	NA	NA	NA
	Total GHG emissions (direct + indirect)	tCO_2e	NA	NA	NA
	Does your organization produce electricity from renewable energy sources?	NA	NA	Yes= 2 and No= 0	7
	Electricity generation per month from renewable energy	KW	NA	NA	NA
	CO_2 offset from renewable energy	tCO_2	NA	NA	NA
	N_2O offset from renewable energy	tCO_2e	NA	NA	NA
	CH_4 offset from renewable energy	tCO_2e	NA	NA	NA
	GHG offset from renewable energy	tCO_2e	NA	NA	NA
	Has your organization carried out a life cycle carbon footprint to determine its carbon emissions associated with all activities in its products or services life cycle?	NA	NA	Yes= 2 and No= 0	5
	Life cycle carbon emissions	tCO_2e	NA	NA	NA
	Does your organization utilise refrigerants containing chlorofluorocarbons (CFCs)?	NA	NA	Yes= 0 and No= 2	7
	Has your organization implemented strategies to reduce its overall GHG emissions?	NA	NA	Yes= 2 and No= 0	7
	Does your organization carry out regular monitoring of stack emissions?	NA	NA	Yes= 2 and No= 0	7
	Carbon Monoxide (CO)	mg/m^3	1000 [a]	IF(AND(V>=0,V<=500),"2", IF(AND(V>500,V<=1000),"1","0"))	5
	Sulphur Dioxide (SO_2)	mg/m^3	2000 [b]	IF(AND(V>=0,V<=1000),"2", IF(AND(V>1000,V<=2000),"1","0"))	5
	Sulphur trioxide (SO_3)	mg/m^3	120 [a]	IF(AND(V>=0,V<=60),"2", IF(AND(V>60,V<=120),"1","0"))	5
	Oxides of Nitrogen (NOx)	mg/m^3	1000 [a]	IF(AND(V>=0,V<=500),"2", IF(AND(V>500,V<=1000),"1","0"))	5

	Actual Particulate Matter Load	mg/m³	200 [a]	IF(AND(V>=0,V<=100),"2", IF(AND(V>100,V<=200),"1","0"))	5
	Has your organization implemented one of these control technologies to reduce CO emissions?	NA	NA	Proper firing rate= 2 Burner maintenance= 2 Other= 2 None of them= 0	3
	Has your organization implemented one of these control technologies to reduce particulate matter emissions?	NA	NA	Fabric filters= 2 Electrostatic precipitator= 2 Cyclone separator= 2 Wet scrubber= 2 Other= 2 None of them= 0	5
	Has your organization implemented one of these control technologies to reduce NOx emissions ?	NA	NA	Water/steam injection= 2 Low-NOx burners= 2 Selective catalytic reduction= 2 Selective non-catalytic Reduction= 2 Other= 2 None of them= 0	5
	Has your organization implemented one of these control technologies to reduce SO_X emissions ?	NA	NA	Fuel switching= 2 Sorbent injection= 2 Wet flue gas desulphurization= 2 Other= 2 None of them= 0	5
	Does your organization use chemicals thet emit hydrogen sulphide gas (H_2S)?	NA	NA	Yes/ No	NA
	Hydrogen Sulphide (H_2S)	mg/Nm^3	5 [b]	IF(AND(V>=0,V<=2.5),"2", IF(AND(V>2.5,V<=5),"1","0"))	3
	Does your organization use organic solvents that emit volatile organic compounds (VOCs)?	NA	NA	Yes/ No	NA
	Volatile organic compounds (VOCs)	mg/Nm^3	75 [b]	IF(AND(V>=0,V<=37.5),"2", IF(AND(V>37.5,V<=75),"1","0"))	5
	Does your organization utilise organic solvents that emit Formaldehyde?	NA	NA	Yes/ No	NA
	Formaldehyde	mg/Nm^3	20 [b]	IF(AND(V>=0,V<=10),"2", IF(AND(V>10,V<=20),"1","0"))	7
Solid Waste	Does your organization track a normalised solid waste metric?	NA	NA	Yes= 2 and No= 0	7
	Total amount of waste generated per month	T	NA	NA	NA
	Does your organization transport, import, or export any waste deemed “hazardous”?	NA	NA	Yes= 0 and No= 2	5
	Does your organization produce any type of radioactive waste?	NA	NA	Yes= 0 and No= 2	5
	Does your organization recycle any type of waste material for reuse?	NA	NA	Yes= 2 and No= 0	3
	Percentage of waste recycled and reused	%	5	IF(AND(V>0,V<=5),"1", IF(AND(V>5,V<=100),"2","0"))	3
Effluent	Does your organization produce and discharge any industrial effluent?	NA	NA	Yes/ No	NA
	Average volume of effluent generated per month	m^3	NA	NA	NA
	Effluent generation per unit of product	L/kg	180 [b]	IF(AND(V>=0,V<=90),"2", IF(AND(V>90,V<=180),"1","0"))	7

	Does your organization have an effluent treatment plant?	NA	NA	Yes= 2 and No= 0	7
	Is the treatment plant onsite ?	NA	NA	Yes/ No	NA
	Has your organization implemented any one of these advanced effluent treatment technologies?	NA	NA	Reverse osmosis= 2 Membrane bioreactor= 2 Activated carbon= 2 Ultrafiltration= 2 Microfiltration= 2 Nanofiltration= 2 Other= 2 None of them= 0	5
	Does your organization carry out regular testing of the effluent?	NA	NA	Yes= 2 and No= 0	7
	Biological oxygen demand (BOD)	mg/l	40 [a]	IF(AND(V>=0,V<=20),"2", IF(AND(V>20,V<=40),"1","0"))	7
	Chemical oxygen demand (COD)	mg/l	120 [a]	IF(AND(V>=0,V<=60),"2", IF(AND(V>60,V<=120),"1","0"))	7
	pH	-	5 to 9 [a]	IF(AND(V>=5,V<=9),"2","0")	5
	Reactive Phosphorus	mg/l	1 [a]	IF(AND(V>=0,V<=0.5),"2", IF(AND(V>0.5,V<=1),"1","0"))	3
	Nitrate as N	mg/l	10 [a]	IF(AND(V>=0,V<=5),"2", IF(AND(V>5,V<=10),"1","0"))	3
	Nitrite as N	mg/l	1 [a]	IF(AND(V>=0,V<=0.5),"2", IF(AND(V>0.5,V<=1),"1","0"))	3
	Ammoniacal nitrogen	mg/l	1 [a]	IF(AND(V>=0,V<=0.5),"2", IF(AND(V>0.5,V<=1),"1","0"))	3
	Sulphate	mg/l	1500 [a]	IF(AND(V>=0,V<=750),"2", IF(AND(V>750,V<=1500),"1","0"))	3
	Sulphide	mg/l	0.002 [a]	IF(AND(V>=0,V<=0.001),"2", IF(AND(V>0.001,V<=0.002),"1","0"))	3
	Oil and grease	mg/l	10 [a]	IF(AND(V>=0,V<=5),"2", IF(AND(V>5,V<=10),"1","0"))	5
	Total Kjeldahl Nitrogen (TKN)	mg/l	25 [a]	IF(AND(V>=0,V<=12.5),"2", IF(AND(V>12.5,V<=25),"1","0"))	3
	Total suspended solids	mg/l	35 [a]	IF(AND(V>=0,V<=17.5),"2", IF(AND(V>17.5,V<=35),"1","0"))	7
	Temperature	^{0}C	40 [a]	IF(AND(V>=0,V<=40),"2","0")	3
	Detergents	mg/l	15 [a]	IF(AND(V>=0,V<=7.5),"2", IF(AND(V>7.5,V<=15),"1","0"))	5
	Zinc	mg/l	2 [a]	IF(AND(V>=0,V<=1),"2", IF(AND(V>1,V<=2),"1","0"))	3
	Copper	mg/l	0.5 [a]	IF(AND(V>=0,V<=0.25),"2", IF(AND(V>0.25,V<=0.5),"1","0"))	3
	Chromium	mg/l	0.05 [a]	IF(AND(V>=0,V<=0.025),"2", IF(AND(V>0.0025,V<=0.05),"1","0"))	3

	Is the sludge produced properly disposed?	NA	NA	Yes= 2 and No= 0	7
Eco Materials	Does your organization give preference to natural dyes instead of synthetic dyes?	NA	NA	Yes= 2 and No= 0	5
	Does your organization give preference to organic fibers instead of synthetic fibers?	NA	NA	Yes= 2 and No= 0	5
	Has your organization adopted the innovative technique of making clothes with polyester fabric derived from recycled plastic?	NA	NA	Yes= 2 and No= 0	5
	Does your organization utilise readily biodegradable detergents that do not give rise to toxic metabolites?	NA	NA	Yes= 2 and No= 0	5
	Does your organization use industrial enzymes to remove impurities from fabric instead of chemicals?	NA	NA	Yes= 2 and No= 0	5
	Does your organization give preference to dyestuff formulations that contain highly biodegradable dispersing agents?	NA	NA	Yes= 2 and No= 0	5
Hazardous materials management	Does your organization have a process to verify compliance with all chemicals in the Restricted Substances List?	NA	NA	Yes= 2 and No= 0	7
	Does your organization have chemical hazard signage in areas where chemicals are used?	NA	NA	Yes= 2 and No= 0	5
	Has your organization implemented a plan to improve its chemicals management program?	NA	NA	Yes= 2 and No= 0	5
	Does your organization have a quality assurance program that lays emphasis on the quality of chemicals?	NA	NA	Yes= 2 and No= 0	3
	Does your organization utilse AZO colorants as dyestuffs (Azodyes)?	NA	NA	Yes= 0 and No= 2	7
	Does your organization use non-biodegradable complexing agents in the dyeing processes?	NA	NA	Yes= 0 and No= 2	5
	Does your organization use toxic textile preservation chemicals like chlorinated compounds and dieldrin?	NA	NA	Yes= 0 and No= 2	5
	Does your organization have a bleaching operation?	NA	NA	Yes/No	NA
	Does your organization give preference to hydrogen peroxide bleaching agent instead of sulfur and chlorine based bleaches?	NA	NA	Yes= 2 and No= 0	3
Supply chain and products	Does your organization purchase from suppliers that have environmental criterias?	NA	NA	Yes= 2 and No= 0	7
	Severity of environmental impacts from principal products and services	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact=0	7
Compliance	Does your organization comply with all existing national environmental laws and regulations?	NA	NA	Yes= 2 and No= 0	7
	Did your organization previously have fines associated with environmental laws and treaties?	NA	NA	Yes= 0 and No= 2	3
Certifications	Select a maximum of five certifications achieved by your organization ?	NA	NA	ISO 14001=5 WRAP= 5 OEKO-Tex Organic blended content standard= 5 Fairtrade= 5 Global organic textile standard= 5 SMART= 5 Greenguard= 5 BCI= 5 EU Eco Label= 5 Others= 5	5
Transport	Severity of environmental impacts of transportation used for logistical purposes	NA	NA	Negligible impact=2 Marginal impact= 1	7

				Critical impact=0	
Energy	Does your organization track a normalized energy-use metric?	NA	NA	Yes= 2 and No= 0	7
	Total electricity use per month	KW	NA	NA	NA
	Percentage of electricity from renewable energy sources	%	5	IF(AND(V>0,V<=5),"1", .IF(AND(V>5,V<=100),"2","0"))	5
	Has your organization undertaken an energy audit and identified energy saving opportunities?	NA	NA	Yes= 2 and No= 0	5
	Does your organization have a purchasing policy that preferences energy efficient products?	NA	NA	Yes= 2 and No= 0	3
	Has your organization installed ENERGY STAR air conditioning with Eco refrigerants?	NA	NA	Yes= 2 and No= 0	5
	Has your organization installed ENERGY STAR laundries in its laundry operation?	NA	NA	Yes= 2 and No= 0	5
	Has your organization optimized its lighting system with any one of these techniques?	NA	NA	Digital daylight controls= 2 Plug load controls= 2 Task lighting= 2 Automatic light controls= 2 Electronic ballasts= 2 Hybrid ballast= 2 Cleaning= 2 Other= 2 None of the above= 0	5
	Lighting power density	W/m^2	11.8 [c]	IF(AND(V>=0,V<=5.9),"2", IF(AND(V>5.9,V<=11.8),"1","0"))	3
	Boiler combustion efficiency	%	80 [e]	IF(AND(V>=80,V<=90),"1", IF(AND(V>90,V<=100),"2","0"))	7
	Stack flue gas exit temperature	°C	260 [f]	IF(AND(V>=0.0001,V<=260),"2","0"))	7
	Has your organization carried out thermal lagging of all steam pipes to prevent heat loss?	NA	NA	Yes= 2 and No= 0	5
	Has your organization carried out thermal insulation of the boiler to prevent heat loss?	NA	NA	Yes= 2 and No= 0	5
	Does your organization carry out regular cleaning of boiler tubes to prevent fouling and scaling?	NA	NA	Yes= 2 and No= 0	5
	Has your organization implemented economizers in boilers to improve boiler efficiency?	NA	NA	Yes= 2 and No= 0	5
	Has your organization implemented turbulators in boilers to increase heat transfer efficiency?	NA	NA	Yes= 2 and No= 0	5
	Has your organization implemented air preheaters in boilers to preheat combustion air?	NA	NA	Yes= 2 and No= 0	5
	Has your organization optimized its process to enable dyeing of cloth at a lower temperature?	NA	NA	Yes= 2 and No= 0	7
	Thermal energy consumption for scouring per kilogram output	MJ/Kg	3.5 [b]	IF(AND(V>=0,V<=1.75),"2", IF(AND(V>1.75,V<=3.5),"1","0"))	5
	Thermal energy consumption for yarn dyeing per kilogram output	MJ/Kg	16 [b]	IF(AND(V>=0,V<=8),"2", IF(AND(V>8,V<=16),"1","0"))	5
	Thermal energy consumption for knitted fabric dyeing per kilogram output	MJ/Kg	20 [b]	IF(AND(V>=0,V<=10),"2", IF(AND(V>10,V<=20),"1","0"))	5
	Thermal energy consumption for woven fabric dyeing per kilogram output	MJ/Kg	30 [b]	IF(AND(V>=0,V<=15),"2", IF(AND(V>15,V<=30),"1","0"))	5

EPA [271]: [a]

IFC [262]: [b]

LEED [266]: [c] Sydney Water [263]: [d] IEA-ETSAP [264]: [e] RELIABLEPLANT [265]: [f]

Table 13: Economic indicators

Indicator	**Unit**	**Scoring criteria**	**Credits**
Turnover	Rs	NA	NA
Cost of Sales	Rs	NA	NA
Gross Profit	Rs	NA	NA
Other Income	Rs	NA	NA
Distribution Costs	Rs	NA	NA
Administration Costs	Rs	NA	NA
Other Expenses	Rs	NA	NA
Finance Costs	Rs	NA	NA
Profit/Loss Before Tax	Rs	NA	NA
Tax Expense	Rs	NA	NA
Profit/Loss	Rs	IF(V>0,"2","0")	7
Does your organisation invest funds in environmental related projects?	NA	Yes= 2 and No= 0	7
Expenditure on environmental related projects	Rs	NA	NA
Does your organisation invest funds in social projects?	NA	Yes= 2 and No= 0	7
Expenditure on social projects	Rs	NA	NA
Does your organisation invest funds in research and development?	NA	Yes= 2 and No= 0	5
Expenditure on research and development	Rs	NA	NA
Has your organisation received any subsidies from the Government to encourage sustainability into your business?	NA	Yes/ No	NA
Amount of money obtained from the Government	Rs	NA	NA

Table 14: Social indicators

Category	Indicator	Scoring criteria	Credits
Staff involvement in sustainability	Is the staff present in your organisation aware of the importance of sustainability?	Yes= 2 and No= 0	3
	Does the staff present in your organisation participate in sustainability practices?	Yes= 2 and No= 0	3
Health and safety	Does your organisation utilise dyes or chemicals that been proved to possess carcinogenic or allergic properties?	Yes=0 and No= 2	7
	Does your organisation have health and safety policies?	Yes= 2 and No= 0	3
	Do the health and safety committees comprise of senior management and worker representatives?	Yes= 2 and No= 0	3
	Does your organization carry out regular health checkup of their employees?	Yes= 2 and No= 0	7
	Is there a doctor working in your organisation?	Yes= 2 and No= 0	5
	Has there been any work related fatalities in your organisation?	Yes=0 and No= 2	3
	Has your organisation performed risk assessments to decrease the number of risks present in your organisation?	Yes= 2 and No= 0	7
	Has your organisation provided personal protective equipment (PPE) to the employees?	Yes= 2 and No= 0	7
	Has your organization implemented regular housekeeping procedures to maintain cleanliness in work areas?	Yes= 2 and No= 0	3
	Has your organisation installed dust extraction and ventilation systems to remove dust from work areas?	Yes= 2 and No= 0	5
	Does your organisation utilize asbestos fiber in its production process?	Yes= 2 and No= 0	7
	Has your organisation achieved OHSAS 180001 certification?	Yes= 2 and No= 0	7
Training and education	Does your organisation provide training to all employees including those in middle management, professional, technical, administrative, production, and maintenance?	Yes= 2 and No= 0	7
	Does your organisation put emphasis on programmes for skills management or for lifelong learning?	Yes= 2 and No= 0	3
	Do your employees receive a regular performance and career development review?	Yes= 2 and No= 0	3
Diversity and opportunity	Does the senior management and corporate governance bodies in your organisation include both male and female workers?	Yes= 2 and No= 0	7
Human rights	Have there been any cases of human rights violations in your organisation?	Yes=0 and No= 2	3
	Has your company developed a due diligence process to proactively identify and assess potential impacts and risks related to respecting human rights?	Yes= 2 and No= 0	5
	Does your origination have employees who are trained in human rights policies?	Yes= 2 and No= 0	3
Indoor air quality	Has your organisation installed HVAC systems within buildings to ensure thermal comfort and acceptable indoor air quality?	Yes= 2 and No= 0	7
Non-discrimination	Does your organisation provide equal remuneration for women and men for the same job position?	Yes= 2 and No= 0	7
Child labor	Has your organization taken measures to contribute to the effective abolition of child labor?	Yes= 2 and No= 0	3
Bribery and corruption	Have there been any cases of corruption in your organisation?	Yes=0 and No= 2	3
	Has your organization assessed its operations for risks related to corruption?	Yes= 2 and No= 0	3
Corporate social responsibility	Do your organizations have corporate social responsibility (CSR) programs?	Yes= 2 and No= 0	7
Institutional capacity	Does your organisation have university enrolments?	Yes= 2 and No= 0	3
Research and development	Does your organisation invest in research and development to improve the quality of its products?	Yes= 2 and No= 0	5

Global stewardship	Does your organization participate in international environmental agreements?	Yes= 2 and No= 0	3

5.7 Sustainability index calculation example

An example of how the sustainable manufacturing framework calculates the sustainability index is presented in Table 15, 16 and 17.

Table 15: Environmental indicators

Category	Indicator	Unit	Benchmark	Scoring criteria	Data for company A	x	y	z	yz	xz
Water	Does your organization measure its monthly water consumption?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Total water use per month	m^3	NA		19639					
	Does your organization have a leak detection system?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Has your organization performed a water audit and identified ways to increase water use efficiency?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Does your organization recycle water for reuse?	NA	NA	Yes= 2 and No= 0	No	0	2	3	6	0
	Does your organization operate a boiler for steam generation?	NA	NA	Yes/ No	Yes					
	Is a boiler condensate recycling system installed?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Does your organization have a dyehouse operation?	NA	NA	Yes/ No	Yes					
	Does your organization carry out dyeing of yarn?	NA	NA	Yes/ No	No					
	Does your organization carry out dyeing of knitted fabric?	NA	NA	Yes/ No	Yes					
	Dyehouse water consumption per kilogram output of knitted fabric	L/Kg	120 [b]	IF(AND(V>=0,V<=60),"2", IF(AND(V>60,V<=120),"1","0"))	45	2	2	5	10	10
	Does your organization carry out dyeing of woven fabric?	NA	NA	Yes/ No	Yes					
	Dyehouse water consumption per kilogram output of woven fabric	L/Kg	100 [b]	IF(AND(V>=0,V<=50),"2", IF(AND(V>50,V<=100),"1","0"))	28	2	2	5	10	10
	Has your organization adopted the innovative DyeCoo waterless dyeing technology using supercritical CO_2?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Has your organization adopted the innovative waterless AirDye technology?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Does your organization utilise automatic shut-off valve to control the flow of water into a process unit?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Does your organization have an on-site laundry operation?	NA	NA	Yes/ No	Yes					
	Has your organization implemented any one of these water conservation technologies in laundry?	NA	NA	Batch water system= 2 Ozone washing= 2 Greywater recycling tank= 2 Polymer bead laundry system= 2 Water recovery tank= 2 Other= 2 None of them= 0	Ozone washing	2	2	3	6	6
	Laundry water consumption per kilogram output?	L/Kg	26 [d]	IF(AND(V>=0,V<=13),"2", IF(AND(V>13,V<=26),"1","0"))	15	1	2	5	10	5
	Does your organization have a scouring operation?	NA	NA	Yes/ No	No					

	Does your organization have a finishing operation?	NA	NA	Yes/ No	Yes					
	Does your organization use mechanical dewatering equipment to reduce water content of incoming fabric?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Does your organization have a printing operation?	NA	NA	Yes/ No	Yes					
	Does your organization reuse rinsing water leftover from cleaning the printing belt?	NA	NA	Yes= 2 and No= 0	No	0	2	3	6	0
	Does your organization use flow control devices to ensure that water only flows to a process when needed?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Do the bathroom facilities used by employees have low flush features?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Has your organization implemented any one of these water conservation technologies in toilets?	NA	NA	Early closure valve= 2 Dual flush device= 2 Weighted flapper= 2 Displacement bag= 2 Other= 2 None of them= 0	Dual flush device	2	2	3	6	6
	Percentage reduction in overall water consumption due to water conservation technologies	%	5	IF(AND(V>0,V<=5),"1", IF(AND(V>5,V<=100),"2","0"))	5	1	2	3	6	3
	Severity of impacts on water sources and related ecosystems by use of water	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact= 0	Marginal impact	1	2	7	14	7
								Water score	∑	154	107
									%	69	
Biodiversity	Severity of impacts of activities and operations on sensitive or protected areas	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact= 0	Marginal impact	1	2	7	14	7
	Has your organization adopted practices to protect and conserve biodiversity?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
								Biodiversity score	∑	24	17
									%	71	
Air Emissions	Does your organization track a normalised fossil fuel-use metric?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Type of coal used in your organization	NA	NA	Bituminous Sub bituminous Lignite Anthracite	Sub bituminous					
	Quantity of coal consumed per month	T	NA		225					
	Direct CO_2 emissions from coal consumption at source	tCO_2	NA		408.67					
	Direct N_2O emissions from coal consumption at source	tCO_2e	NA		1.69					
	Direct CH_4 emissions from coal consumption at source	tCO_2e	NA		1.19					
	Direct GHG emissions from coal consumption at source	tCO_2e	NA		411.55					

	Quantity of heavy fuel oil (HFO) consumed per month	L	NA		225					
	Direct CO_2 emissions from HFO consumption at source	tCO_2	NA		0.7036					
	Direct N_2O emissions from HFO consumption at source	tCO_2e	NA		0.0014					
	Direct CH_4 emissions from HFO consumption at source	tCO_2e	NA		0.0025					
	Direct GHG emissions from HFO consumption at source	tCO_2e	NA		0.7076					
	Quantity of liquefied petroleum gas (LPG) consumed per month	Kg	NA		3470					
	Direct CO_2 emissions from LPG consumption at source	t CO_2	NA		10.357					
	Direct N_2O emissions from LPG consumption at source	tCO_2e	NA		0.0043					
	Direct CH_4 emissions from LPG consumption at source	tCO_2e	NA		0.023					
	Direct GHG emissions from LPG consumption at source	tCO_2e	NA		10.384					
	Quantity of diesel oil consumed per month	L	NA		7962					
	Direct CO_2 emissions from diesel oil consumption at source	tCO_2	NA		21.31					
	Direct N_2O emissions from diesel oil consumption at source	tCO_2e	NA		0.0457					
	Direct CH_4 emissions from diesel oil consumption at source	tCO_2e	NA		0.0805					
	Direct GHG emissions from diesel oil consumption at source	tCO_2e	NA		21.437					
	Quantity of gasoline consumed per month	L	NA		2342					
	Direct CO_2 emissions from gasoline consumption at source	t CO_2	NA		5.1746					
	Direct N_2O emissions from gasoline consumption at source	tCO_2e	NA		0.0119					
	Direct CH_4 emissions from gasoline consumption at source	tCO_2e	NA		0.0209					
	Direct GHG emissions from gasoline consumption at source	tCO_2e	NA		5.2074					
	Total direct CO_2 emissions from all fuels at source	tCO_2	NA		446.21					
	Total direct N_2O emissions from all fuels at source	tCO_2e	NA		1.75					
	Total direct CH_4 emissions from all fuels at source	tCO_2e	NA		1.32					
	Total direct GHG emissions from all fuels at source	tCO_2e	NA		449.28					
	Does your organization monitor its electricity consumption on a monthly basis?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Electricity consumption per month (CEB)	KW	NA		327218					
	Indirect CO_2 emissions from electricity consumption	tCO_2	NA		332.7807					
	Indirect N_2O emissions from electricity consumption	tCO_2e	NA		0.5006					
	Indirect CH_4 emissions from electricity consumption	tCO_2e	NA		0.2159					
	Total indirect GHG emissions from electricity consumption	tCO_2e	NA		333.49731					
	Total CO_2 emissions (direct + indirect)	tCO_2	NA		778.99					
	Total N_2O emissions (direct + indirect)	tCO_2e	NA		2.25					

	Total CH_4 emissions (direct + indirect)	tCO_2e	NA		1.53					
	Total GHG emissions (direct + indirect)	tCO_2e	NA		782.78					
	Does your organization produce electricity from renewable energy sources?	NA	NA	Yes= 2 and No= 0	No	0	2	7	14	0
	Electricity generation per month from renewable energy	KW	NA		0					
	CO_2 offset from renewable energy	tCO_2	NA		0					
	N_2O offset from renewable energy	tCO_2e	NA		0					
	CH_4 offset from renewable energy	tCO_2e	NA		0					
	GHG offset from renewable energy	tCO_2e	NA		0					
	Has your organization carried out a life cycle carbon footprint to determine its carbon emissions associated with all activities in its products or services life cycle?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Does your organization utilise refrigerants containing chlorofluorocarbons (CFCs)?	NA	NA	Yes=0 and No= 2	No	2	2	7	14	14
	Has your organization implemented strategies to reduce its overall GHG emissions?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Does your organization carry out regular monitoring of stack emissions?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Carbon Monoxide (CO)	mg/m^3	1000 [a]	IF(AND(V>=0,V<=500),"2", IF(AND(V>500,V<=1000),"1","0"))	495	2	2	5	10	10
	Sulphur Dioxide (SO_2)	mg/m^3	2000 [b]	IF(AND(V>=0,V<=1000),"2", IF(AND(V>1000,V<=2000),"1","0"))	520	2	2	5	10	10
	Sulphur trioxide (SO_3)	mg/m^3	120 [a]	IF(AND(V>=0,V<=60),"2", IF(AND(V>60,V<=120),"1","0"))	-	0	2	5	10	0
	Oxides of Nitrogen (NOx)	mg/m^3	1000 [a]	IF(AND(V>=0,V<=500),"2", IF(AND(V>500,V<=1000),"1","0"))	184	2	2	5	10	10
	Actual Particulate Matter Load	mg/m^3	200 [a]	IF(AND(V>=0,V<=100),"2", IF(AND(V>100,V<=200),"1","0"))	296	0	2	5	10	0
	Has your organization implemented any one of these control technologies to reduce CO emissions?	NA	NA	Proper firing rate= 2 Burner maintenance= 2 Other= 2 None of them= 0	None	0	2	3	6	0
	Has your organization implemented any one of these control technologies to reduce particulate matter emissions?	NA	NA	Fabric filters= 2 Electrostatic precipitator= 2 Cyclone separator= 2 Wet scrubber= 2 Other= 2 None of them= 0	Fabric filters	2	2	5	10	10
	Has your organization implemented any one of these control technologies to reduce NOx emissions?	NA	NA	Water/steam injection= 2 Low-NOx burners= 2 Selective catalytic reduction= 2	None	0	2	5	10	0

				Selective non-catalytic Reduction= 2 Other= 2 None of them= 0						
	Has your organization implemented any one of these control technologies to reduce SO_X emissions?	NA	NA	Fuel switching= 2 Sorbent injection= 2 Wet flue gas desulphurization= 2 Other= 2 None of them= 0	None	0	2	5	10	0
	Does your organization use chemicals that emit hydrogen sulphide gas (H_2S)?	NA	NA	Yes/ No	Yes					
	Hydrogen Sulphide (H_2S)	mg/Nm^3	5 [b]	IF(AND(V>=0,V<=2.5),"2", IF(AND(V>2.5,V<=5),"1","0"))		0	2	3	6	0
	Does your organization use organic solvents that emit volatile organic compounds (VOCs)?	NA	NA	Yes/ No	Yes					
	Volatile organic compounds (VOCs)	mg/Nm^3	75 [b]	IF(AND(V>=0,V<=37.5),"2", IF(AND(V>37.5,V<=75),"1","0"))		0	2	5	10	0
	Does your organization utilise organic solvents that emit Formaldehyde?	NA	NA	Yes/ No	No					
					Air emissions score			∑	196	110
								%	56	
Solid Waste	Does your organization track a normalised solid waste metric?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Total amount of waste generated per month	T	NA		32					
	Does your organization transport, import, or export any waste deemed “hazardous”?	NA	NA	Yes= 0 and No= 2	No	2	2	5	10	10
	Does your organization produce any type of radioactive waste?	NA	NA	Yes= 0 and No= 2	No	2	2	5	10	10
	Does your organization recycle any type of waste material for reuse?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Percentage of waste recycled and reused	%	5	IF(AND(V>0,V<=5),"1", IF(AND(V>5,V<=100),"2","0"))	7	2	2	3	6	6
					Solid waste score			∑	46	46
								%	100	
Effluent	Does your organization produce and discharge any industrial effluent?	NA	NA	Yes/ No	Yes					
	Average volume of effluent generated per month	m^3	NA		15000					
	Effluent generation per unit of product	L/kg	180 [b]	IF(AND(V>=0,V<=90),"2", IF(AND(V>90,V<=180),"1","0"))	-	0	2	7	14	0
	Does your organization have an effluent treatment plant?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Is the treatment plant onsite?	NA	NA	Yes/ No	Yes					
	Has your organization implemented any one of these advanced effluent treatment technologies?	NA	NA	Reverse osmosis= 2 Membrane bioreactor= 2 Activated carbon= 2 Ultrafiltration= 2	Other	2	2	5	10	10

				Microfiltration= 2 Nanofiltration= 2 Other= 2 None of them= 0						
	Does your organization carry out regular testing of the effluent?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Biological oxygen demand (BOD)	mg/l	40 [a]	IF(AND(V>=0,V<=20),"2", IF(AND(V>20,V<=40),"1","0"))	20	2	2	7	14	14
	Chemical oxygen demand (COD)	mg/l	120 [a]	IF(AND(V>=0,V<=60),"2", IF(AND(V>60,V<=120),"1","0"))	60	2	2	7	14	14
	pH	-	5 to 9 [a]	IF(AND(V>=5,V<=9),"2","0")	7.6	2	2	5	10	10
	Reactive Phosphorus	mg/l	1 [a]	IF(AND(V>=0,V<=0.5),"2", IF(AND(V>0.5,V<=1),"1","0"))	0.12	2	2	3	6	6
	Nitrate as N	mg/l	10 [a]	IF(AND(V>=0,V<=5),"2", IF(AND(V>5,V<=10),"1","0"))	1.2	2	2	3	6	6
	Nitrite as N	mg/l	1 [a]	IF(AND(V>=0,V<=0.5),"2", IF(AND(V>0.5,V<=1),"1","0"))	0.05	2	2	3	6	6
	Ammoniacal nitrogen	mg/l	1 [a]	IF(AND(V>=0,V<=0.5),"2", IF(AND(V>0.5,V<=1),"1","0"))	0.4	2	2	3	6	6
	Sulphate	mg/l	1500 [a]	IF(AND(V>=0,V<=750),"2", IF(AND(V>750,V<=1500),"1","0"))	30	2	2	3	6	6
	Sulphide	mg/l	0.002 [a]	IF(AND(V>=0,V<=0.001),"2", IF(AND(V>0.001,V<=0.002),"1","0"))	0.002	1	2	3	6	3
	Oil and grease	mg/l	10 [a]	IF(AND(V>=0,V<=5),"2", IF(AND(V>5,V<=10),"1","0"))	0.18	2	2	5	10	10
	Total Kjeldahl Nitrogen (TKN)	mg/l	25 [a]	IF(AND(V>=0,V<=12.5),"2", IF(AND(V>12.5,V<=25),"1","0"))	5.9	2	2	3	6	6
	Total suspended solids	mg/l	35 [a]	IF(AND(V>=0,V<=17.5),"2", IF(AND(V>17.5,V<=35),"1","0"))	12	2	2	7	14	14
	Temperature	^{0}C	40 [a]	IF(AND(V>=0,V<=40),"2","0")	28	2	2	3	6	6
	Detergents	mg/l	15 [a]	IF(AND(V>=0,V<=7.5),"2", IF(AND(V>7.5,V<=15),"1","0"))	-	0	2	5	10	0
	Zinc	mg/l	2 [a]	IF(AND(V>=0,V<=1),"2", IF(AND(V>1,V<=2),"1","0"))	0.01	2	2	3	6	6
	Copper	mg/l	0.5 [a]	IF(AND(V>=0,V<=0.25),"2", IF(AND(V>0.25,V<=0.5),"1","0"))	0.001	2	2	3	6	6
	Chromium	mg/l	0.05 [a]	IF(AND(V>=0,V<=0.025),"2", IF(AND(V>0.0025,V<=0.05),"1","0"))	0.001	2	2	3	6	6
	Is the sludge produced properly disposed?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
								Effluent score	∑	204	177
									%	87	
Eco	Does your organization give preference to natural dyes instead of	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10

Materials	synthetic dyes?									
	Does your organization give preference to organic fibers instead of synthetic fibers?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization adopted the innovative technique of making clothes with polyester fabric derived from recycled plastic?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Does your organization utilise readily biodegradable detergents that do not give rise to toxic metabolites?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Does your organization use industrial enzymes to remove impurities from fabric instead of chemicals?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Does your organization give preference to dyestuff formulations that contain highly biodegradable dispersing agents?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
					Eco materials score			∑	60	50
								%	83.3	
Hazardous materials management	Does your organization have a process to verify compliance with all chemicals in the Restricted Substances List?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Does your organization have chemical hazard signage in areas where chemicals are used?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization implemented a plan to improve its chemicals management program?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Does your organization have a quality assurance program that lays emphasis on the quality of chemicals?	NA	NA	Yes= 2 and No= 0	No	0	2	3	6	0
	Does your organization utilse AZO colorants as dyestuffs (Azodyes)?	NA	NA	Yes= 0 and No= 2	No	2	2	7	14	14
	Does your organization use non-biodegradable complexing agents in the dyeing processes?	NA	NA	Yes= 0 and No= 2	No	2	2	5	10	10
	Does your organization use toxic textile preservation chemicals like chlorinated compounds and dieldrin?	NA	NA	Yes= 0 and No= 2	No	2	2	5	10	10
	Does your organization have a bleaching operation?	NA	NA	Yes/No	Yes					
	Does your organization give preference to hydrogen peroxide bleaching agent instead of sulfur and chlorine based bleaches?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
					Hazardous materials management score			∑	80	64
								%	80	
Supply chain and products	Does your organization purchase from suppliers that have environmental criterias?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Severity of environmental impacts from principal products and services	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact= 0	Marginal impact	1	2	7	14	7
					Supply chain and products score			∑	28	21
								%	75	
Compliance	Does your organization comply with all existing national	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14

	environmental laws and regulations?									
	Did your organization previously have fines associated with environmental laws and treaties?	NA	NA	Yes= 0 and No= 2	No	2	2	3	6	6
					Compliance score			∑	20	20
								%	100	
Certification	Select a maximum of five certifications achieved by your organization	NA	NA	Yes= 2 and No= 0	ISO 14001	0	2	5	10	0
				Yes= 2 and No= 0	WRAP ✔	2	2	5	10	10
				Yes= 2 and No= 0	OEKO-Tex ✔	2	2	5	10	10
				Yes= 2 and No= 0	Organic blended content standard	0	2	5	10	0
				Yes= 2 and No= 0	Fairtrade ✔	2	2	5	10	10
				Yes= 2 and No= 0	Global organic textile standard ✔	2	2	5	10	10
				Yes= 2 and No= 0	SMART	0	2	5	10	0
				Yes= 2 and No= 0	Greenguard	0	2	5	10	0
				Yes= 2 and No= 0	BCI	0	2	5	10	0
				Yes= 2 and No= 0	EU Eco Label ✔	2	2	5	10	10
				Yes= 2 and No= 0	Others	0	2	5	10	0
					Certification score			∑	100/2	50
								%	100	
Transport	Severity of environmental impacts of transportation used for logistical purposes	NA	NA	Negligible impact=2 Marginal impact= 1 Critical impact= 0	Marginal impact	1	2	7	14	7
					Transport score			∑	14	7
								%	50	
Energy	Does your organization track a normalised energy-use metric?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Total electricity use per month	KW	NA		327218					
	Percentage of electricity from renewable energy sources	%	5	IF(AND(V>0,V<=5),"1",IF(AND(V>5,V<=100),"2","0"))	0	0	2	5	10	0
	Has your organization undertaken an energy audit and identified energy saving opportunities?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Does your organization have a purchasing policy that preferences energy efficient products?	NA	NA	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Has your organization installed ENERGY STAR air conditioning with Eco refrigerants?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Has your organization installed ENERGY STAR laundries in its laundry operation?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization optimised its lighting system with anyone of these techniques?	NA	NA	Digital daylight controls= 2 Plug load controls= 2	Automatic light controls	2	2	5	10	10

				Task lighting= 2 Automatic light controls= 2 Electronic ballasts= 2 Hybrid ballast= 2 Cleaning= 2 Other= 2 None of the above= 0						
	Lighting power density	W/m^2	11.8 [c]	IF(AND(V>=0,V<=5.9),"2",IF(AND(V>5.9,V<=11.8),"1","0"))	5.6	2	2	3	6	6
	Boiler combustion efficiency	%	80 [e]	IF(AND(V>=80,V<=90),"1",IF(AND(V>90,V<=100),"2","0"))	85.3	1	2	7	14	7
	Stack flue gas exit temperature	°C	260 [f]	IF(AND(V>=0,V<=260),"2","0")	174	2	2	7	14	14
	Has your organization carried out thermal lagging of all steam pipes to prevent heat loss?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization carried out thermal insulation of the boiler to prevent heat loss?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Does your organization carry out regular cleaning of boiler tubes to prevent fouling and scaling?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization implemented economisers in boilers to improve boiler efficiency?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization implemented turbulators in boilers to increase heat transfer efficiency?	NA	NA	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Has your organization implemented air preheaters in boilers to preheat combustion air?	NA	NA	Yes= 2 and No= 0	No	0	2	5	10	0
	Has your organization optimised its process to enable dyeing of cloth at a lower temperature?	NA	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Thermal energy consumption for knitted fabric dyeing per kilogram output	MJ/Kg	20 [b]	IF(AND(V>=0,V<=10),"2",IF(AND(V>10,V<=20),"1","0"))	-	0	2	5	10	0
	Thermal energy consumption for woven fabric dyeing per kilogram output	MJ/Kg	30 [b]	IF(AND(V>=0,V<=15),"2",IF(AND(V>15,V<=30),"1","0"))	-	0	2	5	10	0
					Energy score			∑	198	131
								%	66	
					Environmental score			∑	**1074**	**800**
								%	**74**	
	EPA [271]: [a] IFC [262]: [b] LEED [266]: [c] Sydney Water [263]: [d]									

	IEA-ETSAP [264]: [e] RELIABLEPLANT [265]: [f]

Table 16: Economic indicators

Indicator	Unit	Scoring criteria	Data for company A	x	y	z	yz	xz
Turnover	Rs		801046757					
Cost of Sales	Rs		735241196					
Gross Profit	Rs		65805561					
Other Income	Rs		2269433					
Distribution Costs	Rs		15654549					
Administration Costs	Rs		60646546					
Other Expenses	Rs		-124351285					
Finance Costs	Rs		38619527					
Profit/Loss Before Tax	Rs		77505657					
Tax Expense	Rs		11625848.55					
Profit/Loss	Rs	IF(V>0,"2","0")	65879808.45	2	2	7	14	14
Does your organisation invest funds in environmental related projects?	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
Expenditure on environmental related projects	Rs		-					
Does your organisation invest funds in social projects?	NA	Yes= 2 and No= 0	Yes	2	2	7	14	14
Expenditure on social projects	Rs		-					
Does your organisation invest funds in research and development?	NA	Yes= 2 and No= 0	No	0	2	5	10	0
Expenditure on research and development	Rs		0					
Has your organisation received any subsidies from the Government to encourage sustainability into your business?	NA	Yes/ No	No					
Amount of money obtained from the Government	Rs		0					
			Economic score			∑	**52**	**42**
						%	**81**	

Table 17: Social indicators

Category	Indicator	Scoring criteria	Data for company A	x	y	z	yz	xz
Staff involvement in sustainability	Is the staff present in your organisation aware of the importance of sustainability?	Yes= 2 and No= 0	No	0	2	3	6	0
	Does the staff present in your organisation participate in sustainability practices?	Yes= 2 and No= 0	No	0	2	3	6	0
Health and safety	Does your organisation utilise dyes or chemicals that been proved to possess carcinogenic or allergic properties?	Yes=0 and No= 2	No	2	2	7	14	14
	Does your organisation have health and safety policies?	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Do the health and safety committees comprise of senior management and worker representatives?	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Does your organization carry out regular health checkup of their employees?	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Is there a doctor working in your organisation?	Yes= 2 and No= 0	No	0	2	5	10	0
	Has there been any work related fatalities in your organisation?	Yes=0 and No= 2	No	2	2	3	6	6
	Has your organisation performed risk assessments to decrease the number of risks present in your organisation?	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Has your organisation provided personal protective equipment (PPE) to the employees?	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Has your organization implemented regular housekeeping procedures to maintain cleanliness in work areas?	Yes= 2 and No= 0	Yes	2	2	3	6	6
	Has your organisation installed dust extraction and ventilation systems to remove dust from work areas?	Yes= 2 and No= 0	Yes	2	2	5	10	10
	Does your organisation utilize asbestos fiber in its production process?	Yes= 2 and No= 0	No	2	2	7	14	14
	Has your organisation achieved OHSAS 180001 certification?	Yes= 2 and No= 0	No	0	2	7	14	0
Training and education	Does your organisation provide training to all employees including those in middle management, professional, technical, administrative, production, and maintenance?	Yes= 2 and No= 0	Yes	2	2	7	14	14
	Does your organisation put emphasis on programmes for skills management or for lifelong learning?	Yes= 2 and No= 0	No	0	2	3	6	0
	Do your employees receive a regular performance and career development review?	Yes= 2 and No= 0	Yes	2	2	3	6	6
Diversity and opportunity	Does the senior management and corporate governance bodies in your organisation include both male and female workers?	Yes= 2 and No= 0	Yes	2	2	7	14	14
Human rights	Have there been any cases of human rights violations in your organisation?	Yes=0 and No= 2	No	2	2	3	6	6
	Has your company developed a due diligence process to proactively identify and assess potential impacts and risks related to respecting human rights?	Yes= 2 and No= 0	No	0	2	5	10	0
	Does your origination have employees who are trained in human rights policies?	Yes= 2 and No= 0	No	0	2	3	6	0
Indoor air quality	Has your organisation installed HVAC systems within buildings to ensure thermal comfort and acceptable indoor air quality?	Yes= 2 and No= 0	Yes	2	2	7	14	14
Non-discrimination	Does your organisation provide equal remuneration for women and men for the same job position?	Yes= 2 and No= 0	Yes	2	2	7	14	14
Child labor	Has your organization taken measures to contribute to the effective abolition of child labor?	Yes= 2 and No= 0	Yes	2	2	3	6	6
Bribery and corruption	Have there been any cases of corruption in your organisation?	Yes=0 and No= 2	No	2	2	3	6	6
	Has your organization assessed its operations for risks related to corruption?	Yes= 2 and No= 0	No	0	2	3	6	0
Corporate social responsibility	Do your organizations have corporate social responsibility (CSR) programs?	Yes= 2 and No= 0	Yes	2	2	7	14	14
Institutional capacity	Does your organisation have university enrolments?	Yes= 2 and No= 0	Yes	2	2	3	6	6

Research and development	Does your organisation invest in research and development to improve the quality of its products?	Yes= 2 and No= 0	No	0	2	5	10	0
Global stewardship	Does your organization participate in international environmental agreements?	Yes= 2 and No= 0	Yes	2	2	3	6	6
					Social score	∑	**284**	**210**
						%	**74**	

The sustainability index is then calculated using the following formula:

$$\sum_{i=1}^{n} \frac{x_i z_i}{y_i z_i} x100 = \frac{x_1 z_1 + x_2 z_2 + x_3 z_3 + x_4 z_4 + \ldots.. + x_n z_n}{y_1 z_1 + y_2 z_2 + y_3 z_3 + y_4 z_4 + \ldots.. + y_n z_n} x100$$

$$\text{Sustainability index} = \frac{(107+17+110+46+177+50+64+21+20+7+131+42+\quad)}{(154+24+196+46+204+60+80+28+20+14+198+52+284)} x\ 100$$

$$= 75\%$$

CHAPTER 6

FRAMEWORK TESTING AND DISCUSSION OF RESULTS

6.0 Framework testing

The framework has been tested in 5 textile companies in Mauritius which have accepted to cooperate in the project. Data collection has been done and the framework has generated a scores based on the environmental, economic and social data of the companies. The score obtained for each company is presented below.

6.1 Environmental score

The textile industry contributes to the depletion of scarce natural resources and because of this it faces unprecedented confronts. Since many years, climate alteration, water stresses and swelling raw materials prices are threatening to destabilize the innovation aptitude of this industry. The textile industry has several impacts on the ecosystem. The sustainable manufacturing framework has generated scores for the environmental aspects of the textile companies present in Mauritius (Figure 15).

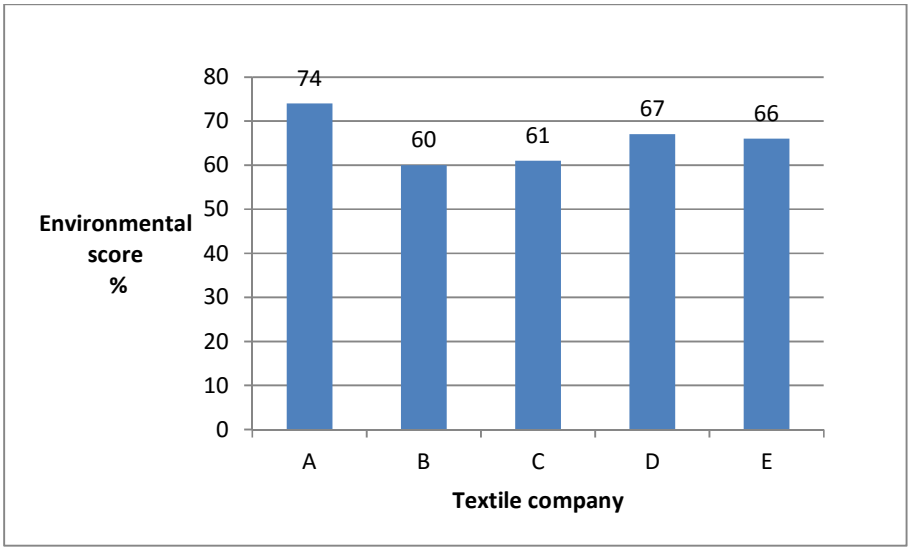

Figure 15: Environmental score of textile companies

Company A has received the highest environmental score of 74% and the minimum score of 60% was obtained by company B. The main indicator categories used to assess the environmental sustainability of textile companies are mainly water, biodiversity, air emissions, solid waste, effluent, eco materials, hazardous materials management, supply chain and products, compliance, certifications, transport and energy. Each one of these categories is further enumerated below.

6.1.1 Water

Water is at the core of sustainable development and is critical for socio-economic development, healthy ecosystems and for human survival itself. Textile companies are great consumers of water. Water is mainly used in dye houses for the dyeing of fabric and woven cloth and in washing departments [113, 255]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to water use (Figure 16).

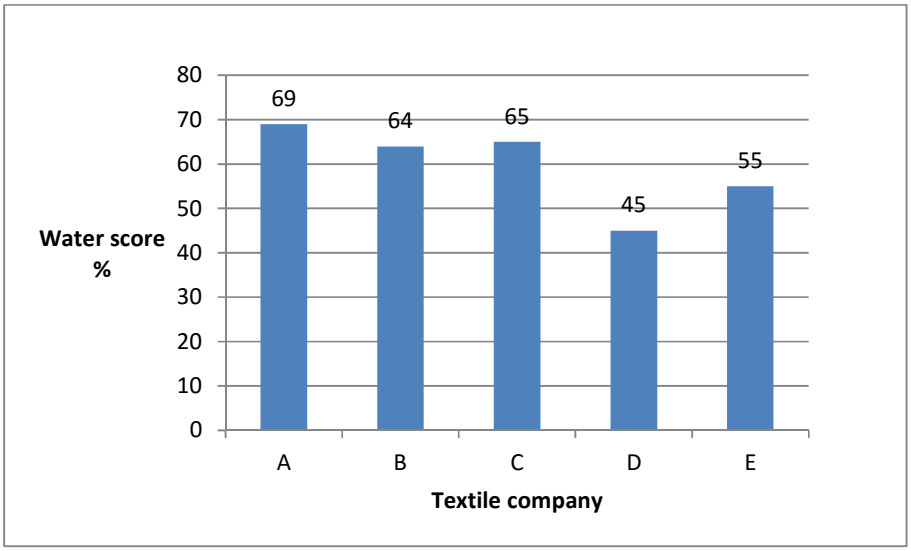

Figure 16: Score for water

Company A has received the highest score of 69% and the minimum score of 45% was obtained by company D. Several indicators were used to assess the level of sustainability of companies with respect to water use. The indicators are presented in Table 18.

Table 18: Water indicators

Indicators	Unit	Benchmark	Company				
			A	B	C	D	E
Measurement of monthly water consumption	NA	NA	✔	✔	✔	✔	✔
Total water use per month	m^3	NA	19639	2321	18952	33500	36000
Leak detection system	NA	NA	✔	✔	✔	✔	✔
Water audit	NA	NA	✔	✔	✔	✔	✔
Percentage of water recycled	%	5	0	0	0	0	3
Boiler condensate recycling system	NA	NA	✔	✖	✔	✔	✔
Dyehouse water consumption per kilogram output of yarn	L/Kg	50	NA	NA	15	-	NA
Dyehouse water consumption per kilogram output of knitted fabric	L/Kg	120	45	NA	NA	-	-
Dyehouse water consumption per kilogram output of woven fabric	L/Kg	100	28	NA	NA	-	NA
Innovative DyeCoo waterless dyeing technology	NA	NA	✖	NA	✖	✖	✖
Innovative waterless AirDye technology	NA	NA	✖	NA	✖	✖	✖
Automatic shut-off valve	NA	NA	✔	✖	✔	✖	✖
Water conservation technologies in laundry	NA	NA	✔	NA	NA	NA	NA
Laundry water consumption per kilogram output	L/Kg	26	15	NA	NA	NA	NA
Scouring water consumption per kilogram output	L/Kg	6	NA	NA	-	-	NA
Mechanical dewatering equipment	NA	NA	✔	NA	✔	✔	✔
Reuse of rinsing water leftover from cleaning the printing belt	NA	NA	✔	NA	NA	NA	NA
Flow control devices	NA	NA	✔	✔	✔	✔	✔
Low flush features in bathroom facilities	NA	NA	✔	✔	✔	✔	✔
Water conservation technologies in toilets	NA	NA	✔	✔	✔	✖	✔
Percentage reduction in overall water consumption	%	5	5	-	3	2	-
Severity of impacts on ecosystems by use of water	NA	NA	Marginal	Marginal	Marginal	Marginal	Marginal

The data obtained show that the textile companies in Mauritius are big consumers of water. Among the 5 companies interviewed, company E has the highest water consumption of 36000 m^3 per month. Company E is a textile company which has a dyehouse operation and hence has a large demand for water for dyeing of fabric (Figure 17).

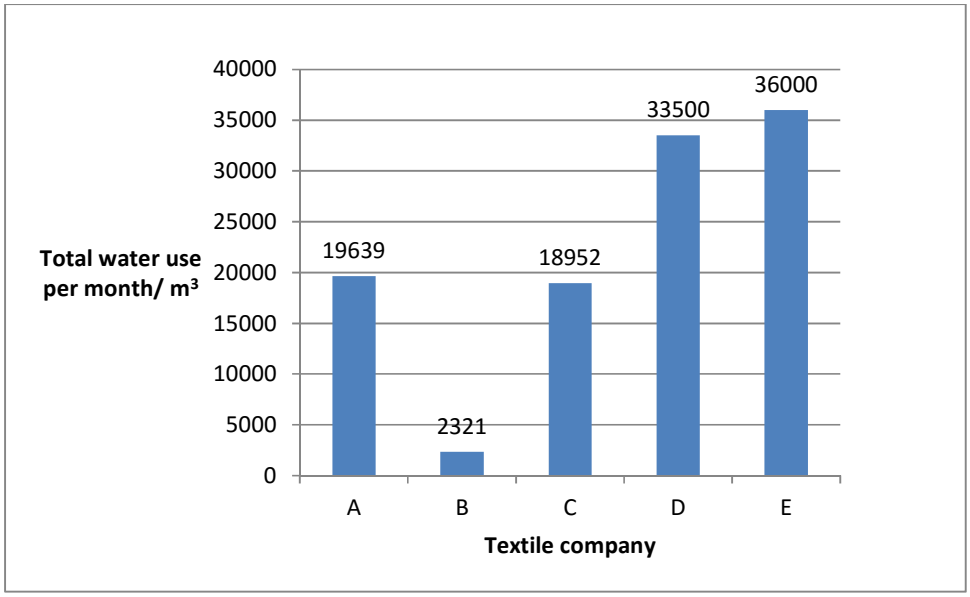

Figure 17: Total water use per month / m^3

Water conservation should become a priority for these companies to achieve their sustainability targets. The survey has shown that companies are mostly lacking in innovative waterless dyeing technologies. New technologies have appeared which reduce the dependency on water for the dyeing of fabric. Two such technologies are the DyeCoo waterless dyeing technology and the waterless AirDye technology. Also, some companies are lacking in automatic shut off valves. These valves can reduce the amount of water wastage during dyeing operations. Companies are also deficient in water conservation technologies for toilets. All these factors will have to be addressed by the companies to increase their score for water use.

6.1.2 Biodiversity

With respect to biodiversity, all the textile companies have received an equal score of 71% (Figure 18). Biodiversity was assessed using two indicators. The first one is the severity of impacts of activities and operations on sensitive or protected areas. All the companies have reported to have a marginal impact on the sensitive areas. The second indicator is whether companies adopt practices to protect and conserve biodiversity. All the companies interviewed have affirmed that they indulge environmentally friendly practices.

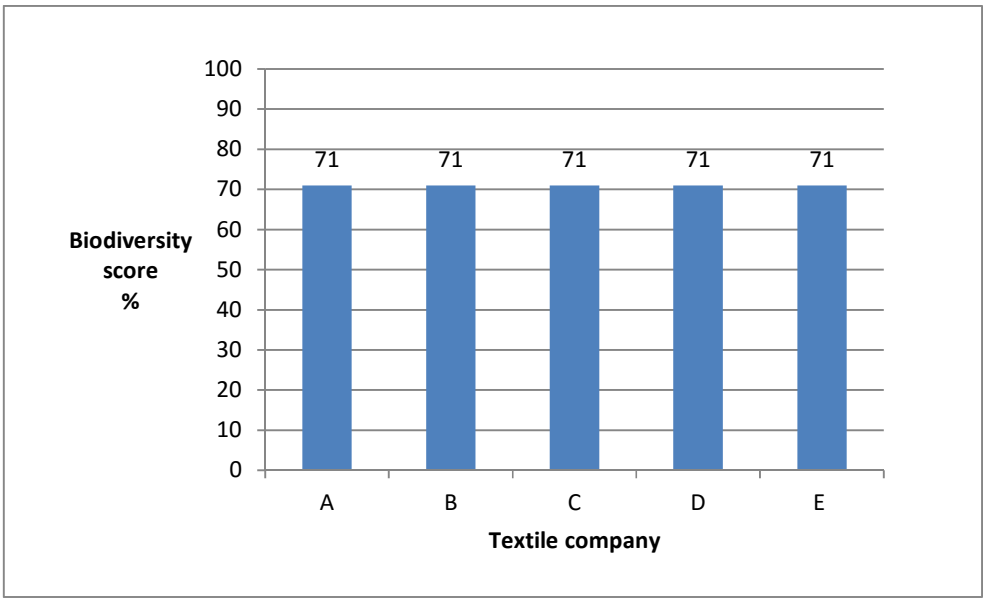

Figure 18: Biodiversity score

6.1.3 Air emissions

Textile companies contribute to a great extent to air pollution in Mauritius. GHG emissions from textile companies are a great source of air pollution. Carbon emissions of the textile supply chain are mainly from electricity and thermal energy (steam) consumption [69,205]. It is therefore important to seek energy saving measures for electricity and steam consumption [205]. The sustainable manufacturing framework has generated scores for air emissions for each company (Figure 19).

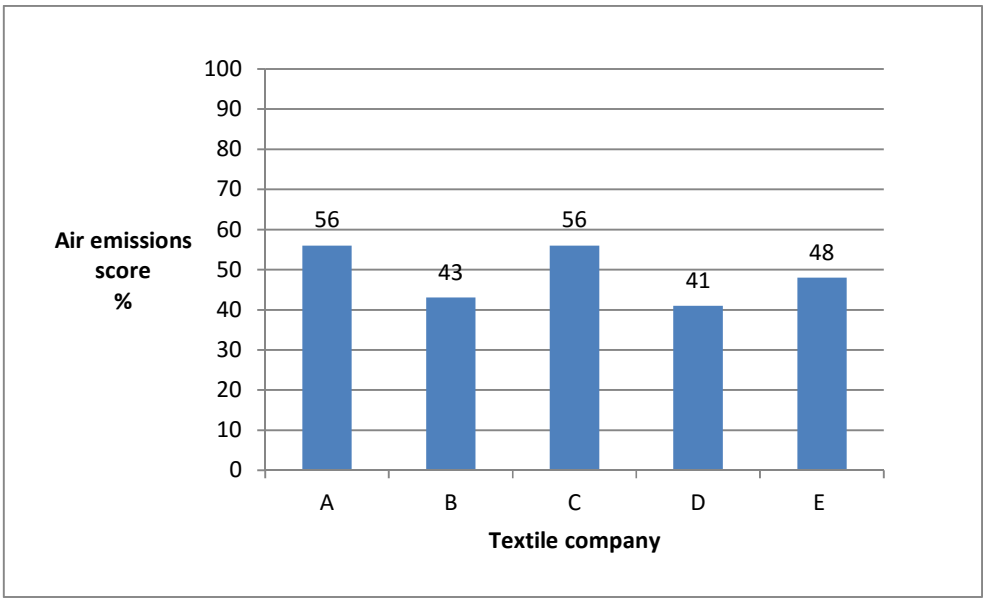

Figure 19: Air emissions score

Company A and C have received the highest score of 56% and the lowest score of 41% has been obtained by company D. Several indicators were used to assess the level of sustainability of companies with respect to air emissions. The indicators are presented in Table 19.

Table 19: Air emission indicators

Indicators	Unit	Benchmark	Company				
			A	B	C	D	E
Measurement of monthly fossil fuel consumption	NA	NA	✔	✔	✔	✔	✔
Total direct GHG emissions from all fuels at source	tCO_2e	NA	449	13	368	873	382
Electricity consumption per month	KW	NA	327218	125322	253952	210384	326985
Total indirect GHG emissions from electricity consumption	tCO_2e	NA	333	127	258	214	333
Total GHG emissions (direct + indirect)	tCO_2e	NA	782	141	627	1088	715
Electricity generation per month from renewable energy	KW	NA	0	0	0	0	0
GHG offset from renewable energy	tCO_2e	NA	0	0	0	0	0
Life cycle carbon emissions	tCO_2e	NA	-	-	-	-	-
Use of chlorofluorocarbons (CFCs)	NA	NA	✖	✖	✖	✖	✖
Implementation of strategies to reduce overall GHG emissions	NA	NA	✔	✔	✔	✔	✔
Stack emissions monitoring	NA	NA	✔	✖	✔	✖	✔
Carbon Monoxide (CO)	mg/m^3	1000	425	-	235	-	259
Sulphur Dioxide (SO_2)	mg/m^3	2000	520	-	365	-	629
Sulphur trioxide (SO_3)	mg/m^3	120	-	-	-	-	253
Oxides of Nitrogen (NO_x)	mg/m^3	1000	184	-	-	-	233
Actual Particulate Matter Load	mg/m^3	200	296	-	-	-	152
Control technologies to reduce CO emissions	NA	NA	✖	-	✖	-	✖
Control technologies to reduce particulate matter emissions	NA	NA	✔	-	✔	-	✖
Control technologies to reduce NO_x emissions	NA	NA	✖	-	✖	-	✖
Control technologies to reduce SO_X emissions	NA	NA	✖	-	✖	-	✖
Hydrogen Sulphide (H_2S)	mg/Nm^3	5	-	NA	NA	-	-
Volatile organic compounds (VOCs)	mg/Nm^3	75	-	NA	NA	NA	-
Formaldehyde	mg/Nm^3	20	-	NA	NA	NA	-

The data obtained from the survey show that textile companies in Mauritius are high emitters of greenhouse gas. Among the 5 companies interviewed, company D has the highest GHG emissions of 1088 tCO_2e. The lowest GHG emissions of 141 tCO_2e have been noted for company B (Figure 20).

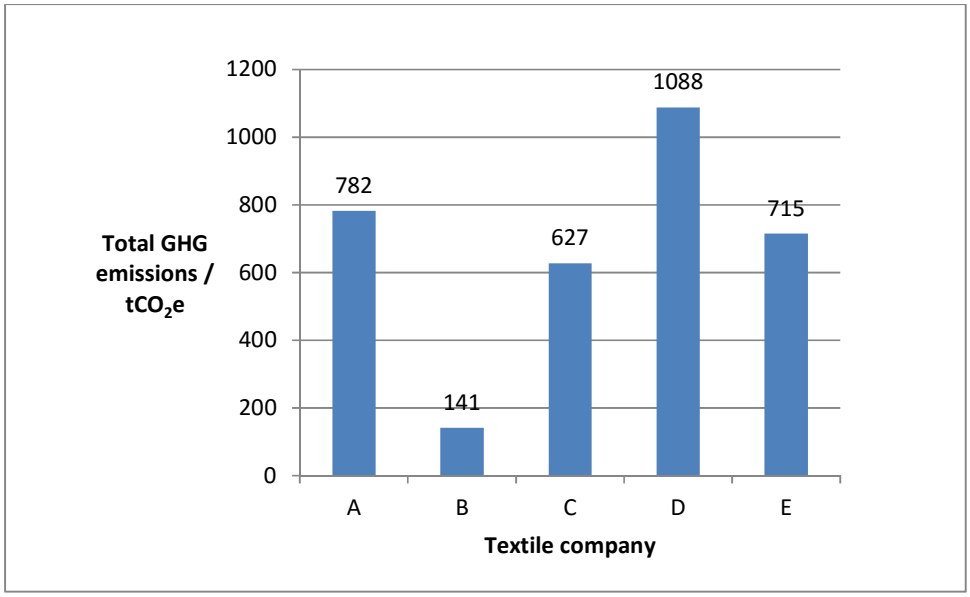

Figure 20: GHG emissions from textile companies

Sustainable development is a great source of technological innovation. In the recent years, more and more companies have started allotting considerable amounts of funding to research and to develop new solutions [85]. Workplace innovation (WPI) has the capacity of bringing radical modifications in the workers' milieu and thus can improve the turnover of companies [48]. Workplace innovation (WPI) is the deployment of innovative interventions in the work planning and organization, human resource management and manufacturing technologies [50]. The survey has shown that companies are mostly lacking in control technologies for air emissions. Companies that operate boilers to produce high temperature steam consume great quantities of coal and heavy fuel oil as energy source. However, combustion of these fossil fuels liberate gaseous emissions namely carbon monoxide (CO), sulphur dioxide (SO_2), sulphur trioxide (SO_3), oxides of nitrogen (NO_x) and carbon dioxide (CO_2). Particulate matter (PM) is also released into the atmosphere as a result of coal combustion. With the advancements in engineering, new control technologies have been developed that can aid in reducing the environmental impacts of coal and fuel oil boilers (Table 20).

Table 20: Control technologies for air emissions

PM	SO_x	NO_x	CO
- Cyclone separator - Electrostatic precipitator - Fabric filters - Wet scrubber	- Dry flue gas desulfurization - Fuel switching - Sorbent injection - Wet flue gas desulfurization	- Flue gas recirculation - Low excess-air firing - Low-NOx burners - Selective catalytic reduction - Selective non-catalytic reduction - Staged combustion - Water/steam injection	- Automatic excess air rate control - Proper firing rate - Burner maintenance

In order to increase their score for air emission, companies will have to implement any one of these control technologies for carbon monoxide (CO), sulphur dioxide (SO_2), sulphur trioxide (SO_3), oxides of nitrogen (NO_x) and particulate matter (PM). These technologies will enable companies to have a lower impact on the ecosystem due to air emissions. As far as GHG emissions are concerned, companies are encouraged to invest in renewable energy to reduce their dependency on purchased electricity. This will decrease their indirect GHG emissions. However, no practicable control technologies exist for direct GHG emissions. Regular monitoring of air emission related parameters is also encouraged. None of the companies carry out monitoring for hydrogen sulphide (H_2S), volatile organic compounds (VOCs) and formaldehyde. Therefore, all these factors will have addressed by the companies to increase their score.

6.1.4 Solid waste

Adverse outcomes that appear from the occurrence of waste materials on the ecosystem are great predicaments worldwide and emphasis is laid on the recycling and reuse processes [145]. The textile manufacturing process generates a noteworthy quantity of solid waste [212] Removal and management of textile wastes have caused global concerns to rise. Textile wastes comprise of wastes that are produced from the streams of fiber, textile production process, the biological and primary sludge retrieved from the wastewater treatment plant and wastes coming from commercial service and consumption [207, 212]. Due to the fact that

post-consumer textile waste cannot be straightforwardly decomposed, buildup of these wastes can create infectious diseases, draw pests and spread noxious odors in the ecosystem [208]. In the present century, textile waste management comprises of reusing wastes as second-hand textiles and filling materials, landfilling, and incineration [211, 209]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to solid waste generation (Figure 21).

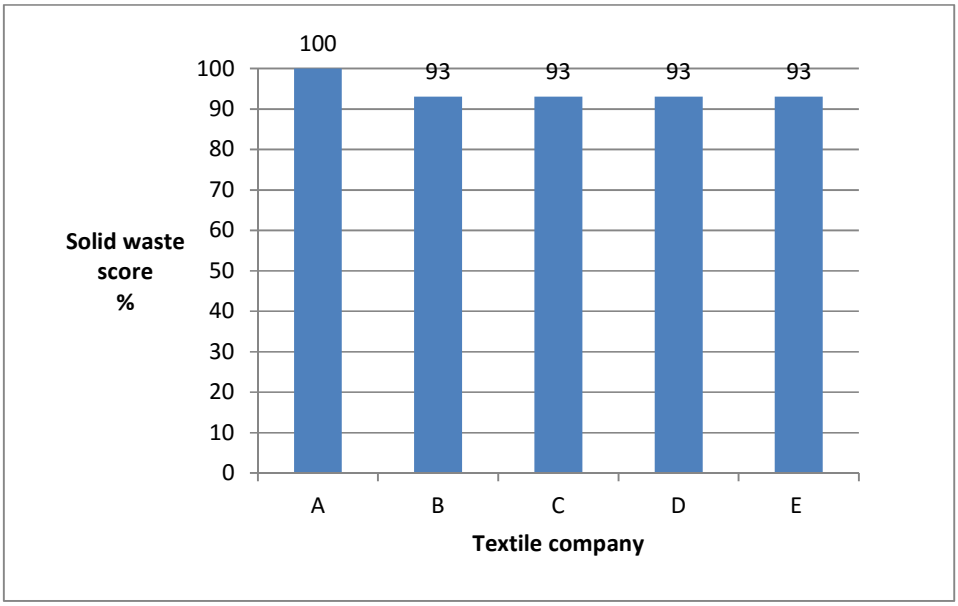

Figure 21: Solid waste score

Company A has received the highest score of 100% and the other companies received scores of 93%. Several indicators were used to assess the level of sustainability of companies with respect to solid waste generation. The indicators are presented in Table 21.

Table 21: Solid waste indicators

Indicators	Unit	Company				
		A	B	C	D	E
Monthly measurement of amount of solid waste generated	NA	✔	✔	✔	✔	✔
Total amount of waste generated per month	T	32	8.5	510	2200	27
Transportation of any hazardous waste	NA	✖	✖	✖	✖	✖
Production of any type of radioactive waste	NA	✖	✖	✖	✖	✖

Recycling of any type of waste material for reuse	NA	✔	✔	✔	✔	✔
Percentage of waste recycled and reused	%	7	3	3	5	3

The survey has shown that all the 5 companies interviewed carry out regular monitoring of the amount of waste generated.

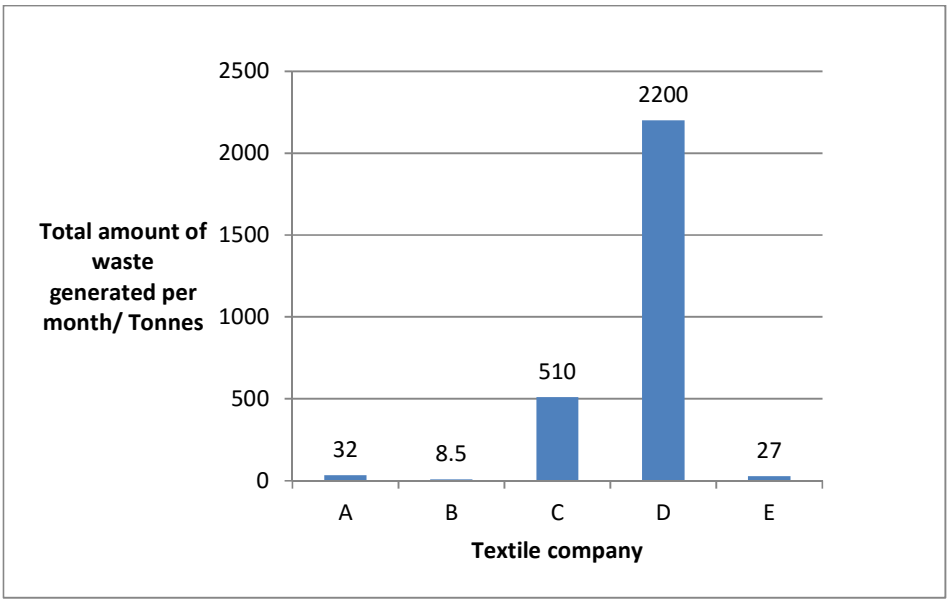

Figure 22: Total amount of wastes generated per month by the textile companies

As shown in Figure 22, the highest amount of wastes (2200 tonnes) is generated by company D and the lowest amount of wastes generated (8.5 tonnes) has been noted for company B. None of the companies interviewed transport any hazardous wastes and none produce any type of radioactive waste. All the companies recycle waste materials for reuse and company A has the highest recycling rate of 7%.

6.1.5 Effluent

The textile industry is a noteworthy contributor to the pollution of water bodies and maybe second only to tanneries and pulp & paper industry [197]. Textile companies are a great consumer of chemicals, dyes and water for manufacturing of clothing [113]. Dye is said to be among the highly troublesome constituents in textile wastewater treatment due to its intricate chemical structure [114]. Throughout the fabric dyeing process, the majority of the dye is exhausted in the fabric material. However, the unfixed dye is released into the effluent and this generates a colored effluent [119, 117, 118]. Elimination of dye from the textile effluent is a significant ecological dilemma. The textile effluent is highly toxic and has carcinogenic and mutagenic properties which can cause various health disorders. The effluent has low biodegradability which has a great impact on photosynthesis [116, 120]. Suspended solids are other classes of pollutants in textile effluents. Suspended solids are formed oil, grease, clay, silt and gritty are mixed together [121, 122]. High amounts of suspended solids have the capacity of choking the breathing organ of aquatic fish and this can cause decreased growth in fish. Other parameters of importance are the biological and chemical oxygen demand of the effluent [121, 122]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to effluent generation (Figure 23).

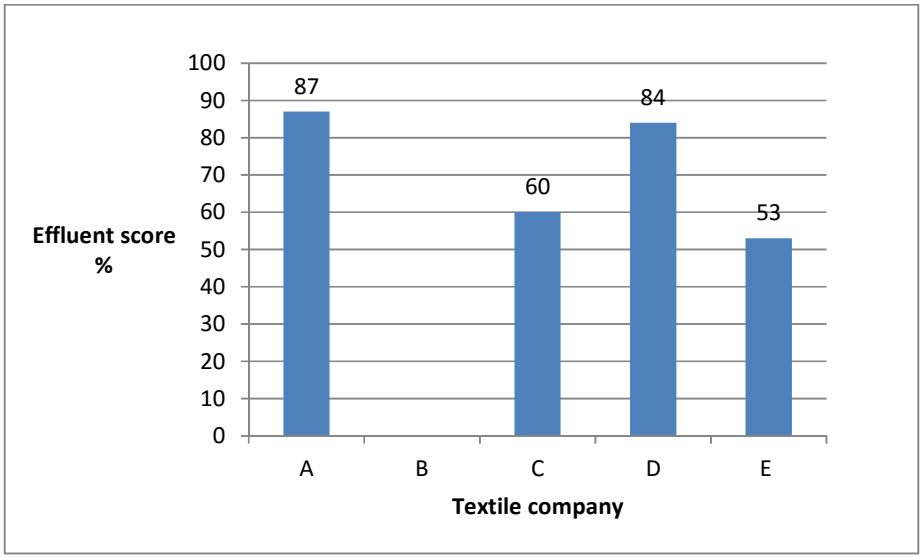

Figure 23: Effluent score

Company A has received the highest score of 87% and the minimum score of 53% was obtained by company E. As far as company B is concerned, it does not generate any effluent.

Several indicators were used to assess the level of sustainability of companies with respect to effluent generation. The indicators are presented in Table 22.

Table 22: Effluent indicators

Indicators	Unit	Benchmark	Company				
			A	B	C	D	E
Production and discharge of industrial effluent	NA	NA	✔	✖	✔	✔	✔
Average volume of effluent generated per month	m^3	NA	15000	NA	1582	2200	30000
Effluent generation per unit product	L/kg	180	-	NA	-	-	-
Effluent treatment plant	NA	NA	✔	NA	✔	✔	✔
Implementation of advanced effluent treatment technologies	NA	NA	✖	NA	✖	✖	✖
Regular analytical testing of effluent	NA	NA	✔	NA	✔	✔	✔
Biological oxygen demand (BOD)	mg/l	40	20	NA	18.5	14	23
Chemical oxygen demand (COD)	mg/l	120	60	NA	46	81	52
Ph	-	5 to 9	7.6	NA	7.2	8.1	6.8
Reactive Phosphorus	mg/l	1	0.12	NA	0.12	0	0.19
Nitrate as N	mg/l	10	1.2	NA	-	6.6	-
Nitrite as N	mg/l	1	0.05	NA	-	0	-
Ammoniacal nitrogen	mg/l	1	0.4	NA	-	0	-
Sulphate	mg/l	1500	30	NA	-	51	-
Sulphide	mg/l	0.002	0.002	NA	-	0	-
Oil and grease	mg/l	10	0.18	NA	1.5	0.18	0.2
Total Kjeldahl Nitrogen (TKN)	mg/l	25	5.9	NA	-	0	2.3
Total suspended solids	mg/l	35	12	NA	6.5	18	18
Temperature	°C	40	28	NA	24.6	27.9	25
Detergents	mg/l	15	-	NA	-	0	-
Zinc	mg/l	2	0.01	NA	0.05	0.01	-
Copper	mg/l	0.5	0.001	NA	-	0	-
Chromium	mg/l	0.05	0.001	NA	-	0.001	-
Proper disposal of sludge	NA	NA	✔	NA	✔	✔	✔

The data obtained from the survey show that textile companies in Mauritius generate a huge volume of effluent. Among the 5 companies interviewed, the highest volume of effluent generated has been noted for company E (30000 m^3). The other companies generated lower volumes of effluent (Figure 24).

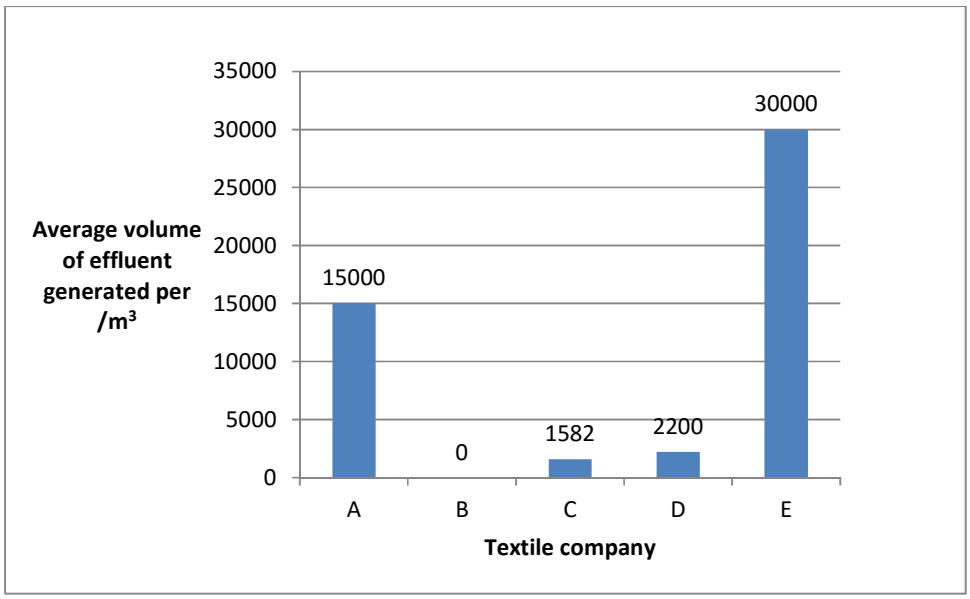

Figure 24: Average volume of effluent generated per month /m^3

The results obtained from the survey have also shown that some textile companies do not monitor all the important parameters related to effluent. Besides, it has been found that companies are lacking in advanced effluent treatment technologies. With the progress in engineering, state of the art technologies have appeared which enable a higher degree of wastewater treatment. Examples of such technologies are activated carbon, membrane bioreactor, microfiltration, nanofiltration, reverse osmosis and ultrafiltration. These advanced technologies can decrease the concentration of contaminants present in the effluent and hence lower the environmental impacts of the textile company. All these factors will have to be addressed by the companies to increase their score for effluent generation.

6.1.6 Eco materials

Small and medium enterprises (SMEs) have to face severe troubles to compete in the world market, particularly in the textile sector, where clients ask for enhanced ecological performance as criteria for supply. Therefore, the textile industry has been developing

sustainable actions by considering the principles of eco-efficiency. Eco-efficiency aims at adopting best environmental practices that also result in cost savings. This must show positively on the ecological and financial performance of the companies [201, 202, 3]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to eco materials (Figure 25).

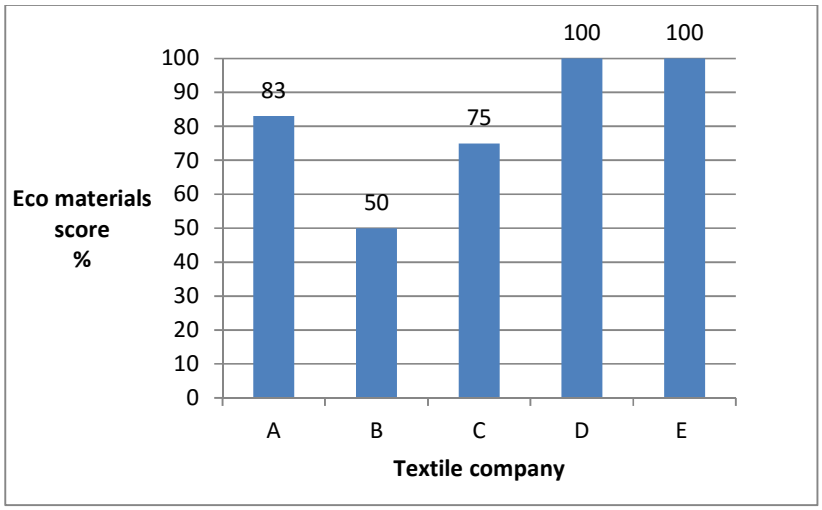

Figure 25: Eco materials score

Company D and E have received the highest score of 100% and the minimum score of 50% was obtained by company B. Several indicators were used to assess the level of sustainability of companies with respect to eco materials. The indicators are presented in Table 23.

Table 23: Eco materials indicators

Indicators	Company				
	A	B	C	D	E
Preference to natural dyes instead of synthetic dyes	✔	NA	✔	✔	✔
Preference to organic fibers instead of synthetic fibers	✔	✔	✔	✔	✔
Adoption of the innovative technique of making clothes with polyester fabric derived from recycled plastic	✖	✖	NA	✔	✔
Utilization of readily biodegradable detergents that do not give rise to toxic metabolites	✔	NA	NA	NA	NA
Utilization of industrial enzymes to	✔	NA	NA	NA	NA

remove impurities from fabric instead of chemicals					
Preference to dyestuff formulations that contain highly biodegradable dispersing agents	✔	NA	✔	✔	✔

The survey has shown that companies are mostly lacking in innovative fabric making technologies. With the progress in science and engineering, new technologies have been developed which can reduce our dependency on conventional materials for the manufacture of fabric. Recently, certain companies have started to make clothes with polyester fabric derived from recycled plastic. This can help reduce the impacts plastics have on the environment.

6.1.7 Hazardous materials management

Textile companies are consumers of dyes, acids, alkalis and various other chemicals which can possess hazardous properties. It is therefore important for textile companies to utilize chemicals which are environmental friendly to reduce their impacts on the ecosystem. Sustainable chemistry is of great importance when talking about hazardous chemicals. One of the main intents of sustainable chemistry is to make use of chemicals which are ecologically friendly. The chemicals must not have any untoward effect on both human beings and the ecosystem and their use in products ought to be sustainable [69, 71]. With respect to hazardous chemical, sustainable chemistry calls for the defensive principle. For some chemicals, the hazardous property of a substance is enough to activate the implementation of safety measures [69, 71]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to hazardous materials management (Figure 26).

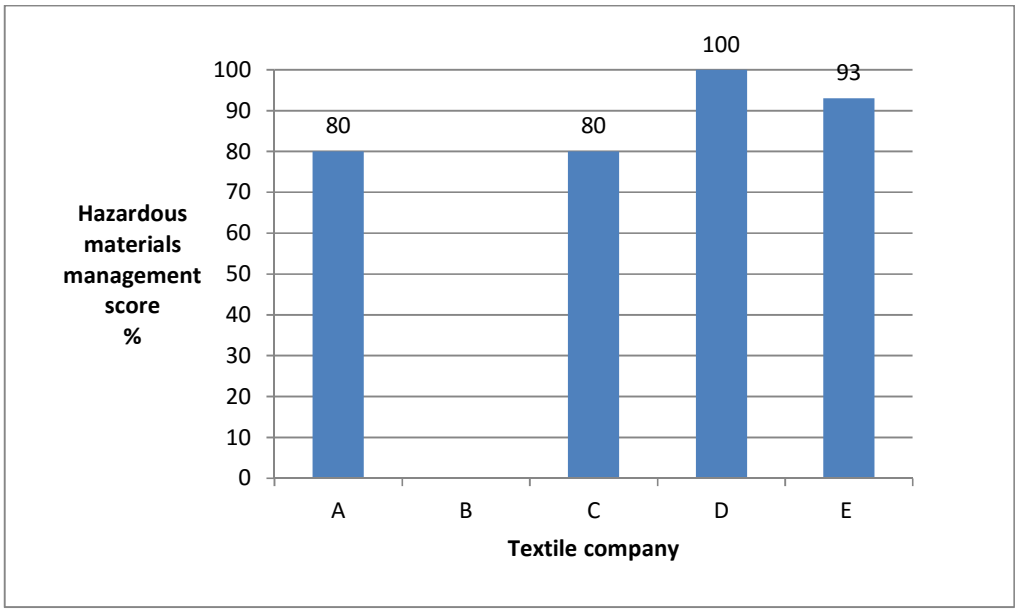

Figure 26: Hazardous materials management score

Company D has received the highest score of 100% and the minimum score of 80% was obtained by company A and C. As far as company B is concerned, it does not utilize any hazardous materials. Several indicators were used to assess the level of sustainability of companies with respect to hazardous materials. The indicators are presented in Table 24.

Table 24: Hazardous materials management indicators

Indicators	Company				
	A	B	C	D	E
Compliance with all chemicals in the Restricted Substances List	✔	NA	✔	✔	✔
Chemical hazard signage in areas where chemicals are used	✔	NA	✔	✔	✔
Plan to improve chemicals management program	✖	NA	✖	✔	✔
Quality assurance program that lays emphasis on the quality of chemicals	✖	NA	✖	✔	✖
Utilisation of AZO colorants as dyestuffs (Azodyes)	✖	NA	✖	✖	✖
Use of non-biodegradable complexing agents in the dyeing processes	✖	NA	✖	✖	✖
Use toxic textile preservation chemicals like chlorinated compounds and dieldrin	✖	NA	✖	✖	✖
Preference to hydrogen peroxide bleaching agent instead of sulfur and chlorine based bleaches	✔	NA	✔	✔	✔

The survey has shown that all the 5 companies interviewed comply with all chemicals in the Restricted Substances List. All of them have chemical hazard signage in areas where chemicals are used. None of the companies use azodyes which are known to possess carcinogenic properties. Moreover, none of them use toxic textile preservation chemicals like chlorinated compounds and dieldrin and none use non-biodegradable complexing agents in the dyeing processes. All the 5 companies interviewed give preference to hydrogen peroxide bleaching agent instead of sulfur and chlorine based bleaches. However, it has been found that companies are mostly lacking in plans to improve their chemical management program. Certain companies are also lacking in quality assurance program that lays emphasis on the quality of chemicals. Hence, all these aspects will have to be considered in order to increase their score for hazardous materials management.

6.1.8 Supply chain and products

The textile industry has environmental impacts along its supply chain. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to supply chain and products (Figure 27).

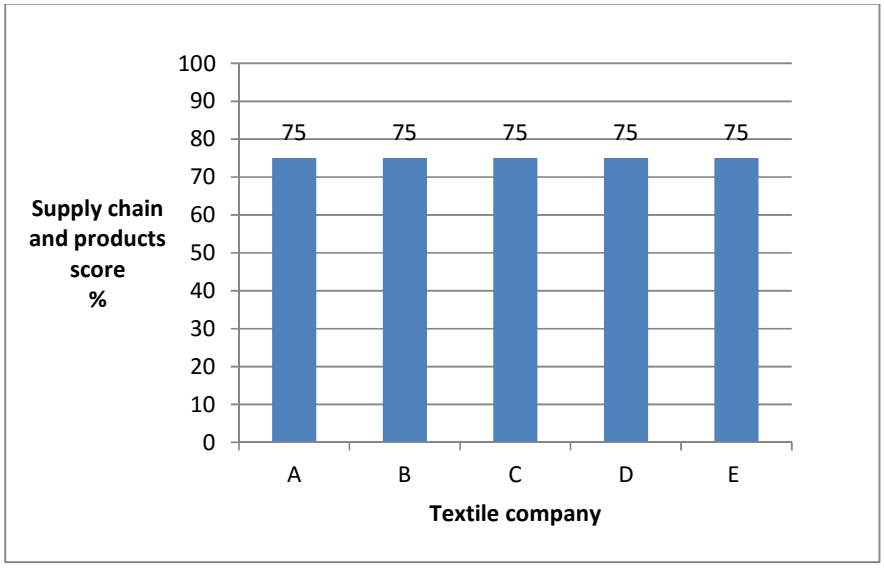

Figure 27: Supply chain and products score

All the companies have received the score of 75%. Two indicators were used to assess level of sustainability of textile companies with respect to supply chain and products. The first qualitative indicator is whether companies purchase from suppliers that have environmental criteria. All the companies have given a positive reply to this question. The second indicator is the severity of environmental impacts from principal products and services. All the companies interviewed have reported to have a marginal impact on the environment.

6.1.9 Environmental compliance

The textile industry has several impacts on the ecosystem and this warns about the likelihood of worsening ecological conditions [126]. Environmental compliance helps by stabilizing and decreasing the environmental burdens [127]. These environmental burdens can be aspects like global warming, pollution of water bodies, noise pollution, land pollution and acid rain [128]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to hazardous materials management (Figure 28).

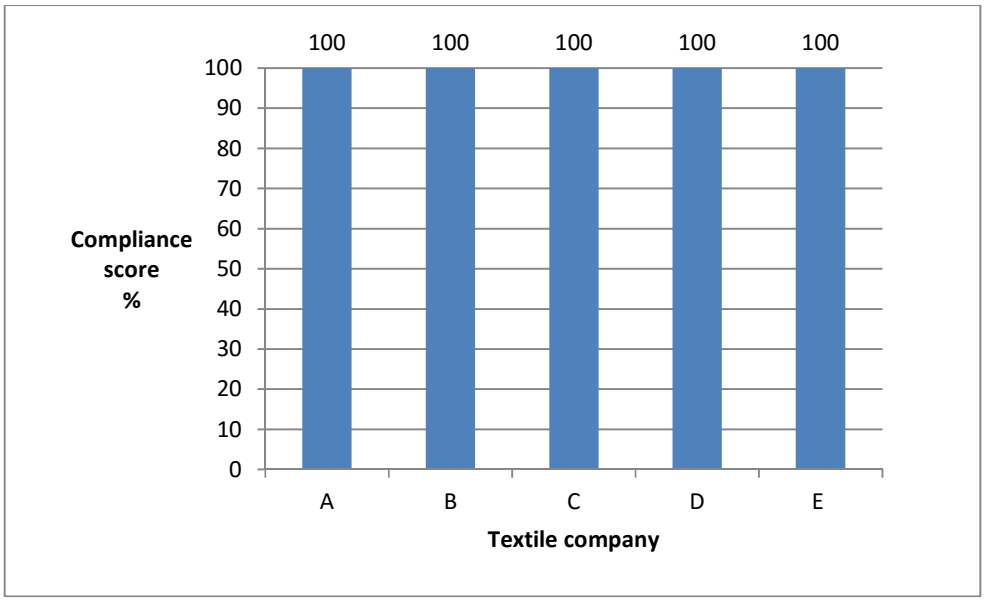

Figure 28: Compliance score

All the companies have received the score of 100%. Two indicators were used to assess level of sustainability of textile companies with respect to compliance. The first qualitative indicator is whether companies comply with all existing national environmental laws and regulations. All the companies have given a positive reply to this question. The second

indicator is whether the companies had fines associated with environmental laws and treaties. None of the companies had fines associated with environmental laws.

6.1.10 Certification

The textile industry has always been associated with ecologically harmful processing, animal welfare problems and complicated communal compliance issues such as child labor, employess' wages, benefits and also health and safety. The requirement for certified, sustainable products is now mounting. The awareness of the public and the demand for traceability have risen. Several global brands by now have a dedicated fashion collection totally manufactured from certified sustainable content [256]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to certification (Figure 29).

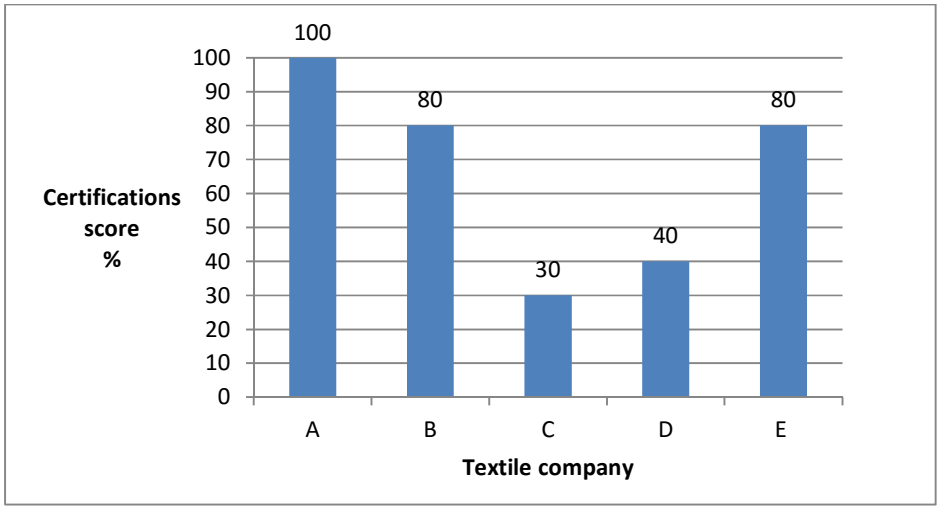

Figure 29: Certifications score

Company A received the highest score of 100% and the lowest score of 30% was obtained by company C. Several indicators were used to assess the level of sustainability of companies with respect to certification. They are presented in Table 25.

Table 25: Certification indicators

Indicators	Company				
	A	B	C	D	E
ISO 14001					

WRAP	✔	✔			✔
OEKO-Tex	✔	✔	✔	✔	
Organic blended content standard					
Fairtrade	✔	✔			
Global organic textile standard	✔		✔		✔
SMART					
Greenguard					
Better cotton initiative				✔	✔
EU Eco Label			✔		

From the results, it can be seen that the companies are lacking in terms of certifications. Hence, the companies will have to achieve more certifications to increase their score. Achieving more certifications will result in lower environmental impacts and more stakeholder satisfaction.

6.1.11 Transportation and logistics

Logistics is a tiny but noteworthy component of the huge textile industry. Logistics and supply chain aid in the easy transportation of goods in the textile industry. Textile industry in whole can be thought to be a very time sensitive industry. Goods have to reach a desired location on time. Companies have to export their goods across cities, states, and even continents. Logistic companies aid in the easy transportation of goods. They can transport goods by the medium of land, sea, and air [258]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to transportation and logistics (Figure 30).

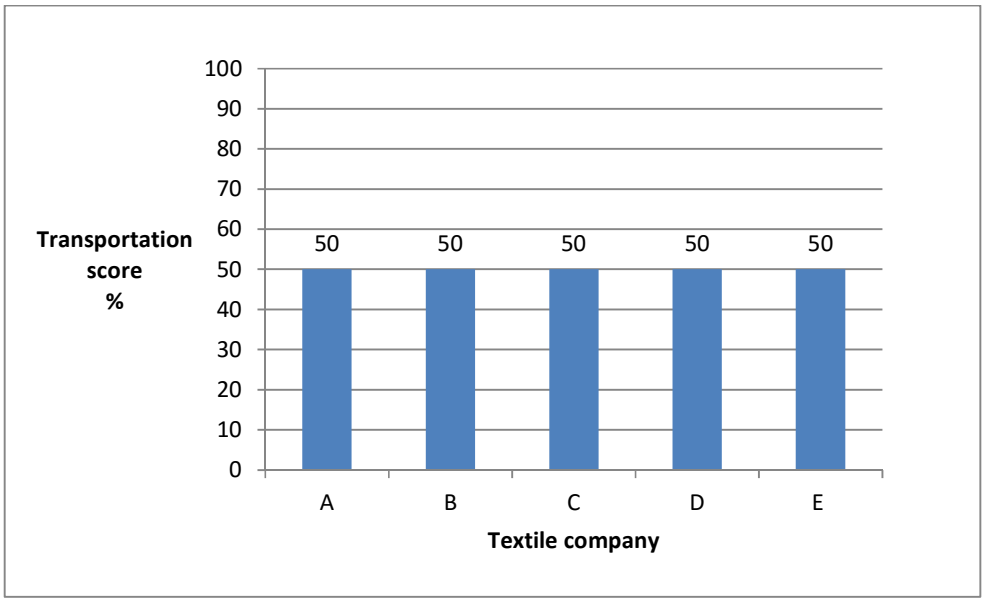

Figure 30: Transportation score

All the textile companies have received the equal score of 50%. The indicator used questioned the severity of environmental impacts of transportation used for logistical purposes. All the companies have reported to have a marginal environmental impact.

6.1.12 Energy

The textile industry is a great consumer of energy in terms of steam and electricity. Energy is one of the chief cost factors in the textile industry. Particularly in times of high energy price volatility, improving energy-efficiency should be a main concern for textile companies. There are several energy-efficiency opportunities that exist in every textile companies, many of which are economically feasible [257]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to energy (Figure 31).

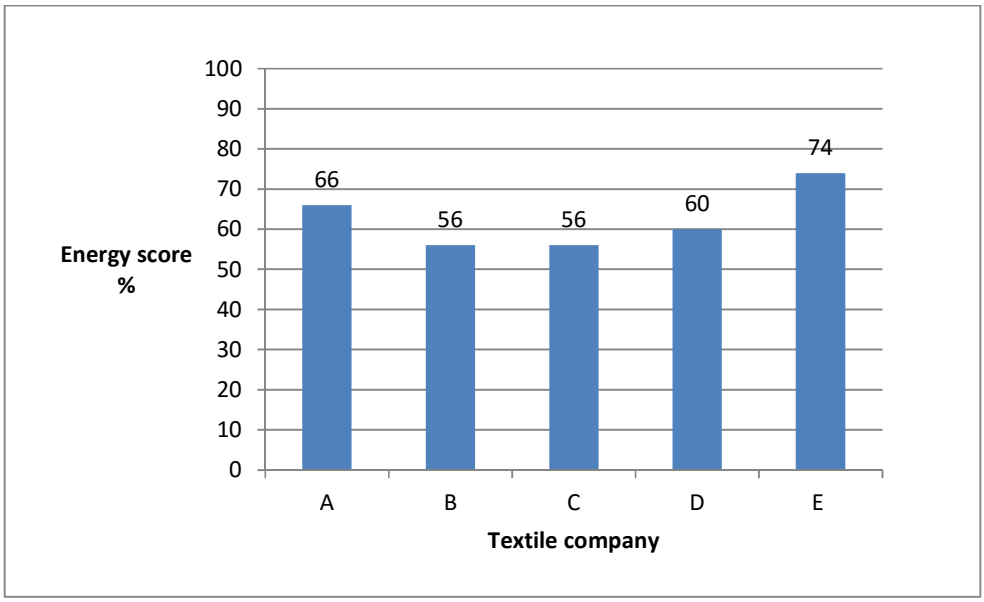

Figure 31: Energy score

Company E has received the highest score of 74% and the minimum score of 56% was obtained by company B and C. Several indicators were used to assess the level of sustainability of companies with respect to energy use. The indicators are presented in Table 26.

Table 26: Energy indicators

Indicators	Unit	Benchmark	Company				
			A	B	C	D	E
Monthly measurement of electricity consumption	NA	NA	✔	✔	✔	✔	✔
Total electricity use per month	KW	NA	327218	125322	253952	210384	326985
Percentage of electricity from renewable energy sources	%	NA	0	0	0	0	0
Energy audit	NA	NA	✔	✔	✔	✔	✔
Purchasing policy that preferences energy efficient products	NA	NA	✔	✔	✔	✔	✔
ENERGY STAR air conditioning with Eco refrigerants	NA	NA	✖	✖	✖	✖	✖
ENERGY STAR laundries	NA	NA	✔	NA	NA	NA	NA
Optimisation of lighting system	NA	NA	✔	✔	✔	✔	✔
Lighting power density	W/m^2	11.8	5.6	-	-	6.9	-
Boiler combustion efficiency	%	80	85.3	85.6	86.2	85	92.2
Stack flue gas exit temperature	°C	260	174	-	153	219	186
Thermal lagging of steam pipes to prevent heat loss	NA	NA	✔	✔	✔	✔	✔
Thermal insulation of boiler to prevent heat loss	NA	NA	✖	✖	✖	✔	✔
Regular cleaning of boiler tubes to prevent fouling and scaling	NA	NA	✔	✔	✔	✔	✔
Implementation of economisers in boilers to improve boiler efficiency	NA	NA	✔	✔	✔	✔	✔
Implementation of turbulators in boilers to increase heat transfer efficiency	NA	NA	✔	✔	✖	✖	✔
Implementation of air preheaters in boilers to preheat combustion air	NA	NA	✖	✖	✖	✖	✖
Optimisation of process to enable dyeing at lower	NA	NA	✔	NA	✔	✔	✔

temperature							
Thermal energy consumption for yarn dyeing per kilogram output	MJ/Kg	16	NA	NA	-	-	NA
Thermal energy consumption for knitted fabric dyeing per kilogram output	MJ/Kg	20	-	NA	NA	-	-
Thermal energy consumption for woven fabric dyeing per kilogram output	MJ/Kg	30	-	NA	NA	-	NA

The data obtained from the survey has shown that the textile companies are high consumers of electricity. The highest electricity consumption of 327218 KW has been noted for company A and the lowest electricity consumption of 125322 KW has been noted for company B (Figure 32).

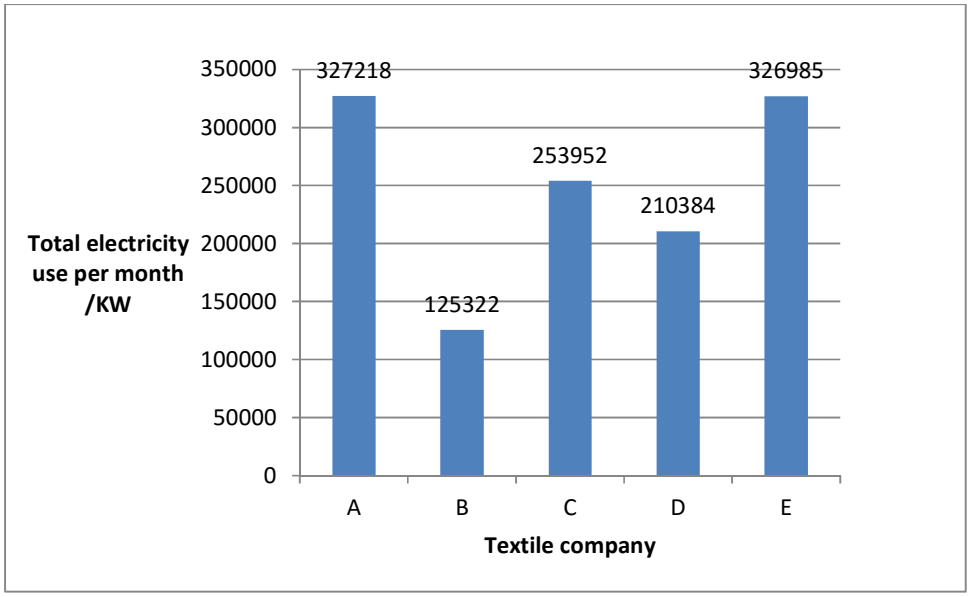

Figure 32: Total electricity consumption per month/ KW

The survey has also shown that companies are lacking in several energy related technologies. None of the companies interviewed utilize energy from renewable energy and none have ENERGY STAR air conditioning with Eco refrigerants. Furthermore, none have implemented air preheaters in boilers to preheat combustion air. Certain companies have not implemented thermal insulation of boiler to prevent heat loss and some have not implemented turbulators in boilers to increase heat transfer efficiency. It has also been found that certain companies do not carry out regular monitoring of energy related parameters like lighting power density, stack flue gas exit temperature and thermal energy consumption per kilogram output of dyed material. Hence, all these factors will have to be addressed in order to increase the energy score of the textile companies.

6.2 Economic

The notion of economic development is seen as one of the three pillars of sustainable growth [143]. Sustaining economic growth is a vital and globally accepted idea for the broad public. [153].The significance of economic sustainability is currently increasingly recognized even by highest political delegates [153]. Economic sustainability comprises of factors like the degree of economic returns, related financial needs and the accessibility of finance [151]. The textile industry in Mauritius has a key role in the economy for creation of employment in the value of industrial manufacturing [213]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to the economic aspects of the textile industry (Figure 33).

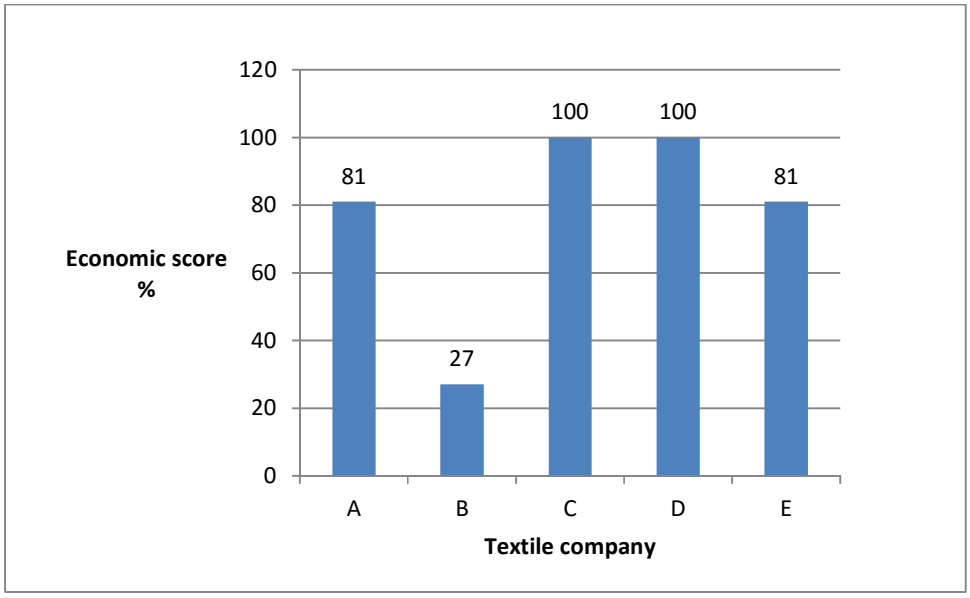

Figure 33: Economic score

Company C and D have received the highest score of 100% and the minimum score of 27% has been obtained by company B. Several indicators were used to assess the level of sustainability of companies with respect to its economic aspects. They are presented in Table 27.

Table 27: Economic indicators

Indicator	Unit	Company				
		A	B	C	D	E
Turnover	Rs	801046757	176473888	728349195	1000900653	918640131
Cost of Sales	Rs	735241196	143969308	450172176	904704548	430781907
Gross Profit	Rs	65805561	32504580	278177019	96196105	487858224
Other Income	Rs	2269433	0	19003893	18222374	5242676
Distribution Costs	Rs	15654549	0	0	0	0
Administration Costs	Rs	60646546	49208536	242596509	37660506	414801569
Other Expenses	Rs	-124351285	0	18215025	0	32814351
Finance Costs	Rs	38619527	-673207	9225065	24240265	2614123
Profit/Loss Before Tax	Rs	77505657	-16030749	27144313	52517708	42870857
Tax Expense	Rs	11625848.55	-2404612.35	4071646.95	7877656.2	6430628.55
Profit/Loss	Rs	65879808.45	-13626136.65	23072666.05	44640051.8	36440228.45
Expenditure on environmental related projects	Rs	-	✖	-	995000	-
Expenditure on social projects	Rs	-	-	-	829266	-
Expenditure on research and development	Rs	✖	✖	-	-	✖
Subsidies obtained from the Government	Rs	✖	✖	✖	✖	✖

The data obtained from the survey has shown that 4 of the companies interviewed have made high profits and 1 company has made loss. The highest profit has been noted for company A with a profit of Rs 77,505,657 and the lowest profit of Rs 27,144,313 has been noted for company C. As for company B, it has made a loss of Rs 16,033,749 (Figure 34).

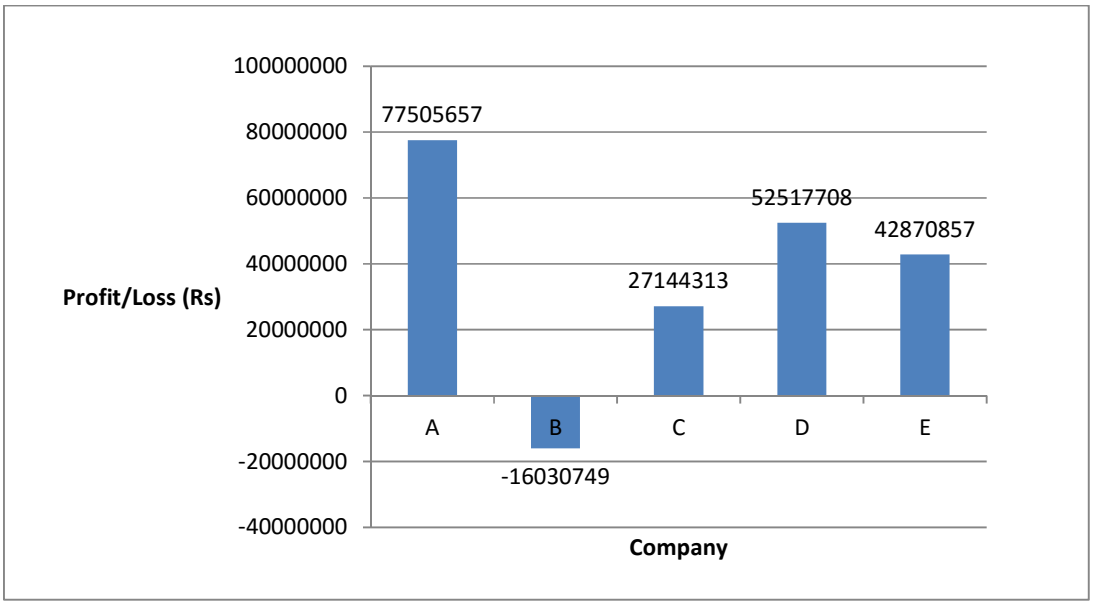

Figure 34: Profit/loss

The survey has also shown that the majority of textile companies invest in environmental and social related projects and express their commitment to sustainable development. However, it has been found that companies do not invest in advanced research and development to improve the quality of their product. This factor will have to be addressed by the companies to increase their economic score.

6.3 Social impacts of textile companies

Textile fabrics are in close contact with our skin every day. They are absolutely all over the place at any moment of our lives. They are present in the clothes we wear on our body, in our bed and linens, in our transportation systems and they are used to protect wounds. It is thus primordial that textile fabrics do not impair human health [215]. However, many chemicals utilized in household products have been found to have adverse effects on human health and the environment and this includes chemicals used in the textile industry. The human health impacts can range from mild allergies to toxic chemicals that can lead to birth defects. Some dyes used in textiles have been shown to be extremely toxic to human health. For example, heavy metals like lead and cadmium present in dyes and pigments are highly prone to bioaccumulation in the human body. This can eventually have mutagenic and carcinogenic

effects on the human body [216, 214]. Studies have demonstrated that reproductive toxicity in human beings could be caused by exposure to textile materials that contain brominated flame retardants, highly fluorinated water and stain repellants, phthalates, and antibacterial agents. [217]. Serious attempts have been made in the current years to have a better control on the quantity of chemicals utilized in textile industries and trim down those that are the most toxic to humans [215]. The sustainable manufacturing framework has assessed the level of sustainability of companies with respect to the social aspects of textile companies (Figure 35).

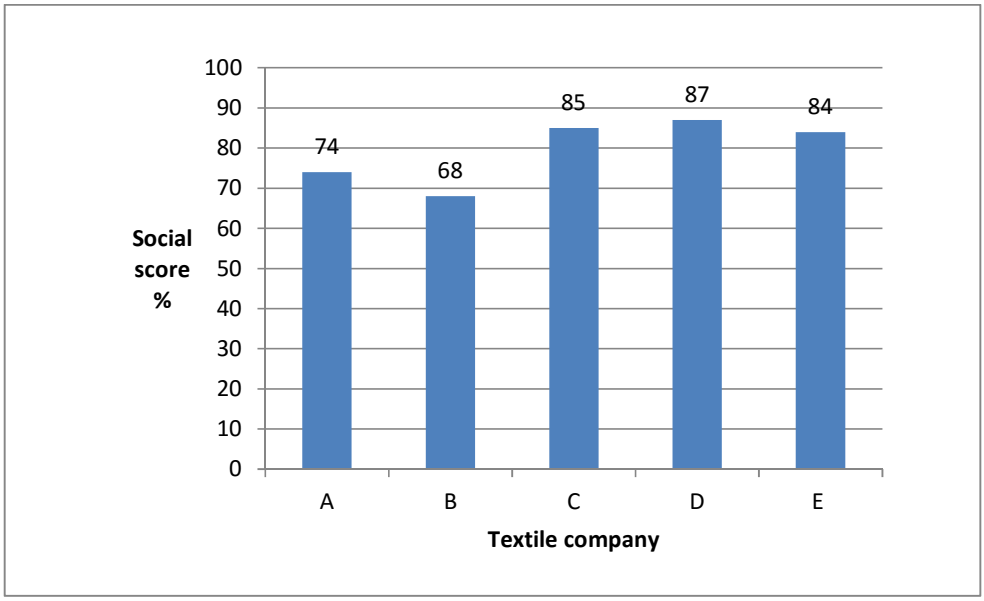

Figure 35: Social score

Company D has received the highest score of 87% and the lowest score of 68% has been obtained by company B. Several indicators were used to assess the level of sustainability of companies with respect to the social aspects of the companies. The indicators are presented in Table 28.

Table 28: Social indicators

Indicators	Company				
	A	B	C	D	E
Staff awareness of the importance of sustainability	✖	✖	✔	✔	✔
Participation of staff in sustainability practices	✖	✖	✔	✔	✔
Cancer causing dyes	✖	✖	✖	✖	✖

Health and safety policies	✔	✔	✔	✔	✔
Senior management and worker representatives in health and safety committees	✔	✔	✔	✔	✔
Regular health checkup of employees	✔	✔	✔	✔	✔
Doctor working in the organization	✖	✔	✔	✔	✔
Work related fatalities in the organization	✖	✖	✖	✖	✖
Risk assessments	✔	✔	✔	✔	✔
Personal protective equipment (PPE)	✔	✔	✔	✔	✔
Implementation of regular housekeeping procedures	✔	✔	✔	✔	✔
Dust extraction and ventilation systems	✔	✔	✔	✔	✔
Asbestos fibre	✖	✖	✖	✖	✖
OHSAS 180001 certification	✖	✖	✖	✖	✖
Training to all employees	✔	✔	✔	✔	✔
Programmes for skills management or for lifelong learning	✖	✖	✖	✖	✔
Regular performance and career development review	✔	✖	✔	✔	✔
Both male and female workers in governance bodies	✔	✔	✔	✔	✔
Human rights violations	✖	✖	✖	✖	✖
Process to assess potential impacts and risks related to respecting human rights	✖	✖	✖	✖	✖
Employees trained in human rights policies	✖	✖	✖	✖	✖
HVAC systems	✔	✔	✔	✔	✔
Equal remuneration for women and men for the same job position	✔	✔	✔	✔	✔
Measures to contribute to the effective abolition of child labor	✔	✔	✔	✔	✔
Cases of corruption	✖	✖	✖	✖	✖
Asssessment of operations for risks related to corruption	✖	✖	✖	✔	✖
Corporate social responsibility (CSR) programs	✔	✖	✔	✔	✔
University enrolments	✔	✔	✔	✔	✔
Research and development	✖	✖	✔	✔	✖
Participation in international environmental agreements	✔	✖	✔	✔	✔

The survey has shown that companies are lacking in several social aspects. Some companies have not employed doctors and have not implemented programmes for skills management or for lifelong learning. Certain companies do not carry out regular performance and career development review and some do not have corporate social responsibility (CSR) programs. Some companies have not carried out assessment of operations for risks related to corruption

and some do not invest in research and development. Hence, all these factors will have to be addressed in order for the social scores of the companies to rise.

6.4 Sustainability index

The sustainable manufacturing framework has generated an overall score for each company and it is known as the sustainability index. This index gives an indication on the level of sustainability of the textile company (Figure 36).

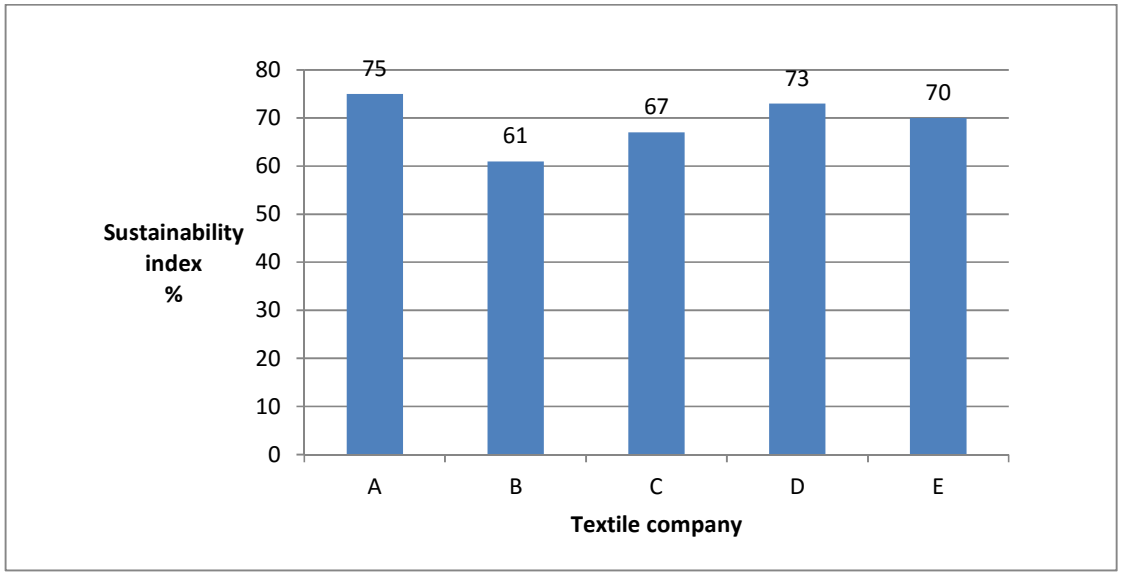

Figure 36: Sustainability index of textile companies

Company A has received the highest sustainability index of 75% and the lowest sustainability index of 61% has been obtained by company B. It can be said that the textile companies are on the path of sustainable development but further improvements have to be made to increase their level of sustainability. These improvements are in the form of:

- Innovative waterless dyeing technologies
- Water conservation technologies
- Advanced air emission control technologies
- Regular monitoring of air emission parameters

- Advanced effluent treatment technologies
- Regular monitoring of effluent parameters
- Commitments to eco efficiency
- Proper hazardous chemicals management practices
- Energy conservation practices
- Investments in R and D
- Investment in environmental projects
- Investment in the CSR projects
- Health and safety of employees
- Human rights policies
- Anticorruption

By working on these parameters, companies will be able to increase their sustainability index. This will help companies to lessen their impacts on the environment, contribute to the GDP and increase their contribution to the society. In the end, this will be beneficial not only to the textile companies but also to Mauritius Island.

CHAPTER 7
CONCLUSION

Textile companies contribute to a great extent to environmental degradation in Mauritius. Seeking sustainability is one of the key methodologies to strengthen society. Sustainability in the Mauritian textile industry has lately received a mounting amount of consideration. It is thought to be a successful solution for the incessant growth of the textile industry. Integrating sustainability practices in business is crucial if the industry wants to keep on expanding, innovating and creating employment in a world of increasingly limited resources. A survey has shown that the majority of textile companies in Mauritius are on the path of sustainable development. All the companies affirmed that they fully include all the aspects of sustainability namely environmental, economic and social into their operations.

Novel approaches of manufacturing are essential to influence development in such a manner that long-term sustainability goals are met [69]. The notions of sustainability are steadily integrating the majority of science and engineering disciplines [108, 112]. Science and engineering mutually generate technologies in the present world, while sustainability offers confronts and opportunities to the conception of a green economy [108]. Scientists from various arenas like physical, biological, and social scientists together with engineers bring scientific facts, tools, and approaches to aid society in developing elucidations for important sustainability challenges and at the same time help societies to go forward [139]. The hunt for more sustainable development strategies obviously requires to a large extent more than just challenging evaluation and innovative theorizing. It demands creative ideas, based on triumphant experience, that are practically and cost-effectively implementable. [206]. The rising intricacy of products and services and swiftly changing market demands call for novel or dissimilar capabilities and management practices to effectively develop innovations and sustain an organisation's competitive advantage. These capabilities consist of what is called ‘organizational intelligence’ [267]. Innovation has been frequently defined as the effective application of novel ideas resulting from manufacturing processes in which diverse resources are combined. In the recent years, several innovative technologies have appeared in the textile industry. Examples of innovative waterless dyeing technologies are the DyeCoo waterless dyeing technology using supercritical CO_2 and the waterless AirDye technology [268]. Moreover, advanced effluent treatment technologies like ultrafiltration, microfiltration and nanofiltration lessen the environmental impacts of textile companies and enable companies to reach a higher level of sustainability [268]. The Mauritian textile industry is in need of an innovative sustainability framework that comprises of all the highly innovative, advanced and latest manufacturing technologies and approaches. Innovation is the foundation

for economic development and can be a great source of sustainable competitive advantage. Textile companies have to continuously innovate in order to remain competitive as they face pressures from several other countries.

In order to provide guidance to sustainability, an innovative sustainability index framework has been developed using 174 environmental, 15 economic and 30 social indicators. It is in the form of an interactive questionnaire on Microsoft Excel 2010. The framework has been tested in 5 textile companies in Mauritius and it has generated the scores of 75%, 61%, 67%, 73% and 70% for company A, B, C, D and E respectively. This innovative sustainability index framework will give the Mauritian textile companies an insight as to where they are situated in the level of sustainability. A low score in sustainability index indicates areas that need improvement. This innovative sustainability framework will enable textile companies to truly evaluate their level of sustainability. This will have an overall benefit not only on the textile companies but on Mauritius Island as a whole.

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APPENDIX

APPENDIX 1: TEXTILE COMPANIES CONTACTED FOR THE PROJECT

No	Company name	Company info	Contact persons details
1	Esquel Ltd	Location: Beau Bassin Company number: 401 9850 Established in: 1972 No. of Employees: 5700 Products: woven shirt Export countries: Asia and America	Name : Miss Triyasha Work position: HR manager Mobile number: 59037016 Email address: bhobeechunt@esquel.com
2	RT Knits	Location: Port Louis Company number: 2068888 Established in: 1970 No. of Employees: 1800 Products : Garments Export countries: Europe, USA and South Africa	Name: Mr Rohit Sultanti Work position: HR Manager Mobile number: 52574551 Email address: rohit.s@rtknits.com

			Name: Mr Anil Work position: Assistant HR manager Mobile number: Email address: anil.d@rtknits.com
3	Wensum Ltd	Location: La Brasserie, Curepipe Company number: 6700540 Established in: 1972 No. of Employees: 427 Products : High end suits for men and women Export countries: UK, Singapore and Europe	Name: Mrs. Deeya Chummun Work position: HR Manager Email address: Deeya.chummun@wensum.mu
4	Star Knitwear	Location: Industrial Zone, Coromandel Company number: 4053200 Established in: 1987 No. of Employees: 1285	Name: Mr Radha Kownden Work position: HR manager Mobile number: 52501375 Email address: rada.kownden@starknitweargroupltd.com

		Products : T-shirts, polo shirts, sweatshirt, dresses Export countries: UK, South Africa	Name: Yanishta Hurree Work position: Trainee chemical and environmental engineering officer Mobile number: 58216772 Email address: yanishta.hurree@gmail.com
5	Laguna Clothing	Location: Quatres Bornes Company number: 4021100 Established in: 1994 No. of Employees: 500 Products: shirts Export countries: United States, Europe, South Africa	Name: Mr Nilesh Bucktowar Work position: Sustainability engineer Mobile number: 57288954 Email address: nbucktowar@aquarelle-clothing.com
6	Ferney Spinning Mills	Location: Forest Side, Curepipe Company number: 6011000 Established in: 1978 No. of Employees: 450	Name: Mrs Dayasatee Kodye Work position: Environmental engineer Mobile number: 54283389 Email address: Dkodye@floreal.intnet.mu

		Products : Yarn Export countries: Madagascar, South Africa, Europe	
7	Tropic Knits Ltd	Location: Route Royale, Curepipe Company number: 602 1000 Established in: 1984 No. of Employees: 3500 Products: Garments Export countries: UK, Europe, South Africa and USA	Name: Mrs Khodabaccus Work position: Part time environmental engineer Email address: ZKHODABOCUS@tropicknits.com
8	World Knits Ltd	Location: Quartier Militaire, New Rd Company number: 403 8552 Established in: 1993 No. of Employees: 700 Products : T-shirts Export countries: Europe and U.S.A	Name: Mrs Moorghen Work position: HR manager Email address: prodhr@wknits.com

9	FM Denim Ltd	Location: La Tour Koenig, Pointe Aux Sables Company number: 2333000 Established in: 2010 No. of Employees: 496 Products : Denim fabric Export countries: United States, Europe, South Africa	Name: Mr Parik Work position: General Manager Email address: ddp@fmdenim.com
			Name: Mr Mahen Bissesar Work position: HR manager Email address: mahenb@fmdenim.com
			Name: Mr Ashok Bissesar Work position: Environmental engineer Mobile number: 54222407 Email address: ashokb@fmdenim.com
10	Consolidated Fabrics Ltd	Location: Solitude Company number: 204 1670 Established in: 1989 No. of Employees: 575	Name: Mr Mohabir Work position: HR manager Mobile number: 54210130 Email address: smohabir@consolidated-fabrics.com

		Products : textile products Export countries: America, Europe, South Africa	Name: Mr Vencatasamy Work position: Maintenance manager Mobile number: 54221053 Email address: naden@consolidated-fabrics.com
11	CDL limited	Location: Route Royale, Curepipe Company number: 601 3000	Name: Mrs Khodabaccus Work position: Part time environmental engineer Email address: ZKHODABOCUS@tropicknits.com
12	Firemount Ltd	Location: La Tour Koenig, Pointe Aux Sables Company number: 2067999 Established in: 1984 No. of Employees: 890 Products : denims wear Export countries: Europe	Name: Mr Sannand Work position: HR manager Email address: sannand@firemount.mu
			Name: Mrs. Ramanah Rooma Devi Work position: Chemical and Environmental Engineer Mobile number: 57728027 Email address: rooma@firemount.mu
13	DDI Ltd	Location: Route Royale, Ile d'Ambre, Rivière du	Name: Mr Ravi Appanah

		Rempart Company number: 412 5190	Work position: HR manager Mobile number: 57448010 Email address: appanahr@ddi.mu
			Name: Mr Shakil Ramjaun Work position: Production Manager Email address: shakilr@ddi.mu
14	Aquarelle Clothing	Location: Quatres Bornes Company number: 4021100 Established in: 1994 No. of Employees: 1000 Products : shirts Export countries: United States, Europe, South Africa	Name: Mr Nilesh Bucktowar Work position: Sustainability engineer Mobile number: 57288954 Email address: nbucktowar@aquarelle-clothing.com

15	Palmar Limitee	Location: Mon Loisir, Riviere du Rempart Company number: 4017000 Established in: 1988 No. of Employees: 1400 Products : T-shirts, poloshirts, jogging suits, children's wear Export countries: South Africa, England, Italy, France	Name: Mr. Joel Jeantou Work position: Fabric Mill Manager Mobile number: 54997019 Email address: jjeantou@palmar.intnet.mu
16	Tara Knitwear/ Rossana Textiles Ltd	Location: Zone Industrielle, Plaine Lauzun, Port Louis Company number: 212 2902	Name: HR manager Email address: tara104@taragroup.intnet.mu

17	Compagnie Mauricienne de Textile Ltée	Location: DBM Industrial Estate, Vacoas-Phoenix Company number: 601 8888 No. of Employees: 10000 Products : fast-fashion jerseywear products Export countries: UK, France	Name: HR manager Email address: info@cmt.mu
18	Maxiwear Ltd	Location: Piton Company number: 2649640	Name: HR manager Email address: hr.maxiwear@intnet.mu

APPENDIX 2: COMPANY FINANCIAL SUMMARY/STATEMENTS

Table 29: Financial summary/statements for Esquel Limited

ESQUEL (MAURITIUS) LTD	
PROFIT AND LOSS STATEMENT Financial Year Ended: 31/12/2015 Date Approved: 20/06/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	4224198956
Less cost of Sales	3899897437
Gross Profit	324301519
Other Income	0
Less distribution Costs	28362118
Administration Costs	95567998
Other Expenses	20463233
Finance Costs	-473568
Profit/Loss Before Tax	180381738
Tax Expense	25219385
Profit/Loss for the period	155162353
BALANCE SHEET Financial Year Ended: 31/12/2015 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	309265893
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	0

Other Investments	0
Biological Assets	0
Others	0
Total	309265893
Current Assets	
Inventories	668896465
Trade & Other recv.	491626335
Cash & cash eqiv.	8742851
Others	0
Total	1169265651
Total Assets	1478531544
Equity & Liabilities	
Share Capital	20000000
Other reserves	1285885
Retained Earnings	734432128
Others	0
Total	755718013
Non Current Liabilities	
Long term Borrowings	0
Deferred Tax	0
Long term Provisions	169139000
Others	0
Total	169139000
Current Liabilities	
Trade and other Payables	541004317
Short Term Borrowings	0
Current Tax payable	12670214
Short Term Provisions	0
Others	0
Total Current Liabilities	553674531

Total Liabilities	722813531
Total Equity & liabilities	1478531544

Table 30: Financial summary/statements for RT Knits Ltd

RT Knits Ltd	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 30/12/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	1336430146
Less cost of Sales	967973427
Gross Profit	368456719
Other Income	875178
Less distribution Costs	55946852
Administration Costs	171531128
Other Expenses	0
Finance Costs	-8828471
Profit/Loss Before Tax	150682388
Tax Expense	0
Profit/Loss for the period	150682388
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	545293020
Invest. Properties	0

Intangible Assets	0
Invest in Subsidiaries	0
Other Investments	11788800
Biological Assets	0
Others	0
Total	557081820
Current Assets	
Inventories	237577316
Trade & Other recv.	318045402
Cash & cash eqiv.	148877827
Others	0
Total	704500545
Total Assets	1261582365
Equity & Liabilities	
Share Capital	10000000
Other reserves	-5914
Retained Earnings	482775392
Others	0
Total	492769478
Non Current Liabilities	
Long term Borrowings	31216066
Deferred Tax	0
Long term Provisions	57201294
Others	522859058
Total	611276418
Current Liabilities	
Trade and other Payables	124549559
Short Term Borrowings	12986910
Current Tax payable	0
Short Term Provisions	0

Others	20000000
Total Current Liabilities	157536469
Total Liabilities	768812887
Total Equity & liabilities	1261582365

Table 31: Financial summary/statements for Wensum LTD

WENSUM LTD	
PROFIT AND LOSS STATEMENT Financial Year Ended: 31/12/2016 Date Approved: 30/06/2017 Currency: Mauritius Rupee Unit: 1	
Turnover	176473888
Less cost of Sales	143969308
Gross Profit	32504580
Other Income	0
Less distribution Costs	0
Administration Costs	49208536
Other Expenses	0
Finance Costs	-673207
Profit/Loss Before Tax	-16030749
Tax Expense	-734792
Profit/Loss for the period	-15295957
BALANCE SHEET Financial Year Ended: 31/12/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	

Prop, Plant & Equip.	35424680
Invest. Properties	0
Intangible Assets	63582
Invest in Subsidiaries	0
Other Investments	0
Biological Assets	0
Others	524712
Total	36012974
Current Assets	
Inventories	35638444
Trade & Other recv.	60587061
Cash & cash eqiv.	2969966
Others	136291
Total	99331762
Total Assets	135344736
Equity & Liabilities	
Share Capital	3000000
Other reserves	6240000
Retained Earnings	-833780
Others	0
Total	8406220
Non Current Liabilities	
Long term Borrowings	62716891
Deferred Tax	0
Long term Provisions	23591654
Others	0
Total	86308545
Current Liabilities	
Trade and other Payables	13551363
Short Term Borrowings	27078608

Current Tax payable	0
Short Term Provisions	0
Others	0
Total Current Liabilities	40629971
Total Liabilities	126938516
Total Equity & liabilities	135344736

Table 32: Financial summary/statements for Star Knitwear Limited

STAR KNITWEAR LIMITED	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/09/2009 Date Approved: 14/06/2012 Currency: Mauritius Rupee Unit: 1	
Turnover	6949258
Less cost of Sales	16638225
Gross Profit	-9688967
Other Income	5243444
Less distribution Costs	0
Administration Costs	7759161
Other Expenses	5099144
Finance Costs	9362428
Profit/Loss Before Tax	-26666256
Tax Expense	0
Profit/Loss for the period	-26666256
BALANCE SHEET Financial Year Ended: 30/09/2009 Currency: Mauritius Rupee	

Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	80557402
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	3741668
Other Investments	0
Biological Assets	0
Others	0
Total	84299070
Current Assets	
Inventories	0
Trade & Other recv.	112878845
Cash & cash eqiv.	5319744
Others	0
Total	118198589
Total Assets	202497659
Equity & Liabilities	
Share Capital	100000000
Other reserves	-918999
Retained Earnings	6724654
Others	0
Total	105805655
Non Current Liabilities	
Long term Borrowings	6703848
Deferred Tax	5359207
Long term Provisions	0
Others	0
Total	12063055
Current Liabilities	

Trade and other Payables	262143
Short Term Borrowings	81783360
Current Tax payable	2583446
Short Term Provisions	0
Others	0
Total Current Liabilities	84628949
Total Liabilities	96692004
Total Equity & liabilities	202497659

Table 33: Financial summary/statements for Laguna Clothing (Mauritius) Ltd

Laguna Clothing (Mauritius) Ltd	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 01/12/2016 Currency: Mauritius Rupee Unit: 1000	
Turnover	756552
Less cost of Sales	589093
Gross Profit	167459
Other Income	0
Less distribution Costs	0
Administration Costs	146598
Other Expenses	3631
Finance Costs	5923
Profit/Loss Before Tax	11307
Tax Expense	0

Profit/Loss for the period	11307
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1000	
Non Current Assets	
Prop, Plant & Equip.	25346
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	146
Other Investments	0
Biological Assets	0
Others	0
Total	25492
Current Assets	
Inventories	77550
Trade & Other recv.	207841
Cash & cash eqiv.	99
Others	0
Total	285490
Total Assets	310982
Equity & Liabilities	
Share Capital	20000
Other reserves	-3241
Retained Earnings	-35496
Others	101
Total	-18636
Non Current Liabilities	
Long term Borrowings	5933
Deferred Tax	0

Long term Provisions	8320
Others	0
Total	14253
Current Liabilities	
Trade and other Payables	241431
Short Term Borrowings	73934
Current Tax payable	0
Short Term Provisions	0
Others	0
Total Current Liabilities	315365
Total Liabilities	329618
Total Equity & liabilities	310982

Table 34: Financial summary/statements for Ferney Spinning Mills Limited

FERNEY SPINNING MILLS LIMITED	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 07/11/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	728349195
Less cost of Sales	450172176
Gross Profit	278177019
Other Income	19003893
Less distribution Costs	0
Administration Costs	242596509

Other Expenses	18215025
Finance Costs	9225065
Profit/Loss Before Tax	27144313
Tax Expense	4699579
Profit/Loss for the period	22444734
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	466787354
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	0
Other Investments	0
Biological Assets	0
Others	0
Total	466787354
Current Assets	
Inventories	393547743
Trade & Other recv.	242875866
Cash & cash eqiv.	458813
Others	0
Total	636882422
Total Assets	1103669776
Equity & Liabilities	
Share Capital	15314217
Other reserves	209664015
Retained Earnings	297311819
Others	0

Total	522290051
Non Current Liabilities	
Long term Borrowings	2047628
Deferred Tax	63611992
Long term Provisions	23684735
Others	3083035
Total	92427390
Current Liabilities	
Trade and other Payables	137995185
Short Term Borrowings	349807857
Current Tax payable	1149293
Short Term Provisions	0
Others	0
Total Current Liabilities	488952335
Total Liabilities	581379725
Total Equity & liabilities	1103669776

Table 35: Financial summary/statements for Tropic Knits Limited

TROPIC KNITS LIMITED	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 07/11/2016 Currency: Mauritius Rupee Unit: 0	
Turnover	1848298165
Less cost of Sales	1759765605
Gross Profit	88532560

Other Income	0
Less distribution Costs	0
Administration Costs	0
Other Expenses	16734624
Finance Costs	6519405
Profit/Loss Before Tax	65278531
Tax Expense	11484577
Profit/Loss for the period	53793954
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 0	
Non Current Assets	
Prop, Plant & Equip.	368448148
Invest. Properties	0
Intangible Assets	2056184
Invest in Subsidiaries	200000000
Other Investments	0
Biological Assets	0
Others	0
Total	570504332
Current Assets	
Inventories	237872335
Trade & Other recv.	840816193
Cash & cash eqiv.	7175795
Others	0
Total	1085864323
Total Assets	1656368655
Equity & Liabilities	
Share Capital	115000000

Other reserves	-21224315
Retained Earnings	434825176
Others	0
Total	528600861
Non Current Liabilities	
Long term Borrowings	3643046
Deferred Tax	12604270
Long term Provisions	42427132
Others	0
Total	58674448
Current Liabilities	
Trade and other Payables	575171832
Short Term Borrowings	422761258
Current Tax payable	3740574
Short Term Provisions	10500000
Others	56919682
Total Current Liabilities	1069093346
Total Liabilities	1127767794
Total Equity & liabilities	1656368655

Table 36: Financial summary/statements for World Knits Ltd

WORLD KNITS LTD
PROFIT AND LOSS STATEMENT
Financial Year Ended: 30/06/2016
Date Approved: 05/10/2017
Currency: Mauritius Rupee

Unit: 1	
Turnover	1670549463
Less cost of Sales	1416148136
Gross Profit	254401327
Other Income	4838258
Less distribution Costs	117261203
Administration Costs	95529987
Other Expenses	0
Finance Costs	37566884
Profit/Loss Before Tax	8881511
Tax Expense	4307943
Profit/Loss for the period	4573568
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	261176603
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	30660788
Other Investments	251000
Biological Assets	0
Others	13595969
Total	305684360
Current Assets	
Inventories	321465839
Trade & Other recv.	688045303
Cash & cash eqiv.	23449275

Others	274470
Total	1033234887
Total Assets	1338919247
Equity & Liabilities	
Share Capital	40002000
Other reserves	-7082631
Retained Earnings	150475233
Others	0
Total	183394602
Non Current Liabilities	
Long term Borrowings	136087708
Deferred Tax	0
Long term Provisions	14512128
Others	31283000
Total	181882836
Current Liabilities	
Trade and other Payables	173602515
Short Term Borrowings	430801797
Current Tax payable	0
Short Term Provisions	6302107
Others	362935390
Total Current Liabilities	973641809
Total Liabilities	1155524645
Total Equity & liabilities	1338919247

Table 37: Financial summary/statements for FM Denim Co Ltd

FM DENIM CO LTD	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 23/02/2017 Currency: Mauritius Rupee Unit: 1	
Turnover	1000900653
Less cost of Sales	904704548
Gross Profit	96196105
Other Income	18222374
Less distribution Costs	0
Administration Costs	37660506
Other Expenses	0
Finance Costs	24240265
Profit/Loss Before Tax	52517708
Tax Expense	2362738
Profit/Loss for the period	50154970
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	0
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	0
Other Investments	0
Biological Assets	0
Others	0

Total	0
Current Assets	
Inventories	0
Trade & Other recv.	0
Cash & cash eqiv.	0
Others	0
Total	0
Total Assets	0
Equity & Liabilities	
Share Capital	0
Other reserves	0
Retained Earnings	0
Others	0
Total	0
Non Current Liabilities	
Long term Borrowings	0
Deferred Tax	0
Long term Provisions	0
Others	0
Total	0
Current Liabilities	
Trade and other Payables	0
Short Term Borrowings	0
Current Tax payable	0
Short Term Provisions	0
Others	0
Total Current Liabilities	0
Total Liabilities	0
Total Equity & liabilities	0

Table 38: Financial summary/statements for Consolidated Fabrics Limited

CONSOLIDATED FABRICS LIMITED	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 21/11/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	918640131
Less cost of Sales	430781907
Gross Profit	487858224
Other Income	5242676
Less distribution Costs	0
Administration Costs	414801569
Other Expenses	32814351
Finance Costs	2614123
Profit/Loss Before Tax	42870857
Tax Expense	7182009
Profit/Loss for the period	35688848
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	552442883
Invest. Properties	0
Intangible Assets	2496423
Invest in Subsidiaries	0
Other Investments	0
Biological Assets	0
Others	0

Total	554939306
Current Assets	
Inventories	213344284
Trade & Other recv.	260400690
Cash & cash eqiv.	13108380
Others	0
Total	486853354
Total Assets	1041792660
Equity & Liabilities	
Share Capital	175743091
Other reserves	226388793
Retained Earnings	170965626
Others	0
Total	573097510
Non Current Liabilities	
Long term Borrowings	19100110
Deferred Tax	62178767
Long term Provisions	16070713
Others	0
Total	97349590
Current Liabilities	
Trade and other Payables	157068357
Short Term Borrowings	214136328
Current Tax payable	140875
Short Term Provisions	0
Others	0
Total Current Liabilities	371345560
Total Liabilities	468695150
Total Equity & liabilities	1041792660

Table 39: Financial summary/statements for CDL Knits Limited

CDL Knits Limited	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 07/11/2016 Currency: Mauritius Rupee Unit: 1000	
Turnover	1083255
Less cost of Sales	652564
Gross Profit	430691
Other Income	23293
Less distribution Costs	0
Administration Costs	296186
Other Expenses	18113
Finance Costs	-3911
Profit/Loss Before Tax	143596
Tax Expense	24572
Profit/Loss for the period	119024
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1000	
Non Current Assets	
Prop, Plant & Equip.	145432
Invest. Properties	0
Intangible Assets	477
Invest in Subsidiaries	0
Other Investments	0
Biological Assets	0
Others	18473

Total	164382
Current Assets	
Inventories	197458
Trade & Other recv.	431248
Cash & cash eqiv.	3539
Others	0
Total	632245
Total Assets	796627
Equity & Liabilities	
Share Capital	173000
Other reserves	-4392
Retained Earnings	384797
Others	0
Total	553405
Non Current Liabilities	
Long term Borrowings	16770
Deferred Tax	62
Long term Provisions	12977
Others	1985
Total	31794
Current Liabilities	
Trade and other Payables	170971
Short Term Borrowings	16824
Current Tax payable	7053
Short Term Provisions	14185
Others	2395
Total Current Liabilities	211428
Total Liabilities	243222
Total Equity & liabilities	796627

Table 40: Financial summary/statements for Firemount Textiles Ltd

Firemount Textiles Ltd	
Financial Year Ended: 30/06/2016 Date Approved: 23/02/2017 Currency: Mauritius Rupee Unit: 1	
Turnover	2162864288
Less cost of Sales	1676069770
Gross Profit	486794518
Other Income	33267076
Less distribution Costs	204121624
Administration Costs	103677055
Other Expenses	0
Finance Costs	32999905
Profit/Loss Before Tax	179263010
Tax Expense	18985229
Profit/Loss for the period	160277781
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	1033744833
Invest. Properties	0
Intangible Assets	133280
Invest in Subsidiaries	0
Other Investments	169857681
Biological Assets	0
Others	0
Total	1203735794

Current Assets	
Inventories	499564795
Trade & Other recv.	618460648
Cash & cash eqiv.	62548641
Others	0
Total	1180574084
Total Assets	2384309878
Equity & Liabilities	
Share Capital	4433500
Other reserves	238538357
Retained Earnings	726450118
Others	0
Total	969421975
Non Current Liabilities	
Long term Borrowings	409723803
Deferred Tax	67517352
Long term Provisions	0
Others	493422155
Total	
Current Liabilities	
Trade and other Payables	323362384
Short Term Borrowings	373681263
Current Tax payable	4425352
Short Term Provisions	219996749
Others	0
Total Current Liabilities	921465748
Total Liabilities	1414887903
Total Equity & liabilities	2384309878

Table 41: Financial summary/statements for DENIM DE L'ILE LIMITED

DENIM DE L'ILE LIMITED	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 03/10/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	1485827735
Less cost of Sales	1201089484
Gross Profit	284738251
Other Income	9978318
Less distribution Costs	37100765
Administration Costs	92801462
Other Expenses	-11844231
Finance Costs	24798113
Profit/Loss Before Tax	151860460
Tax Expense	25922315
Profit/Loss for the period	125938145
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	597469239
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	65746310
Other Investments	50000
Biological Assets	0
Others	122472882

Total	785738431
Current Assets	
Inventories	492149218
Trade & Other recv.	274826554
Cash & cash eqiv.	6745231
Others	0
Total	773721003
Total Assets	1559459434
Equity & Liabilities	
Share Capital	559000000
Other reserves	223926234
Retained Earnings	21296149
Others	0
Total	804222383
Non Current Liabilities	
Long term Borrowings	173967246
Deferred Tax	0
Long term Provisions	18223000
Others	1673724
Total	193863970
Current Liabilities	
Trade and other Payables	387318070
Short Term Borrowings	134399926
Current Tax payable	0
Short Term Provisions	4501019
Others	35154066
Total Current Liabilities	561373081
Total Liabilities	755237051
Total Equity & liabilities	1559459434

Table 42: Financial summary/statements for Aquarelle Clothing Limited

AQUARELLE CLOTHING LIMITED	
PROFIT AND LOSS STATEMENT Financial Year Ended: 30/06/2016 Date Approved: 21/11/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	1265383654
Less cost of Sales	716594150
Gross Profit	548789504
Other Income	3475259
Less distribution Costs	0
Administration Costs	467976091
Other Expenses	18764042
Finance Costs	2081825
Profit/Loss Before Tax	63442805
Tax Expense	18113237
Profit/Loss for the period	45329568
BALANCE SHEET Financial Year Ended: 30/06/2016 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	238761080
Invest. Properties	0
Intangible Assets	6019116
Invest in Subsidiaries	10000000
Other Investments	150000000
Biological Assets	0
Others	0

Total	404780196
Current Assets	
Inventories	118546416
Trade & Other recv.	506570653
Cash & cash eqiv.	30054302
Others	0
Total	655171371
Total Assets	1059951567
Equity & Liabilities	
Share Capital	180000000
Other reserves	-9907184
Retained Earnings	364394817
Others	0
Total	534487633
Non Current Liabilities	
Long term Borrowings	1192240
Deferred Tax	13403671
Long term Provisions	49564490
Others	0
Total	64160401
Current Liabilities	
Trade and other Payables	278866679
Short Term Borrowings	69488811
Current Tax payable	8725164
Short Term Provisions	0
Others	104222879
Total Current Liabilities	461303533
Total Liabilities	525463934
Total Equity & liabilities	1059951567

Table 43: Financial summary/statements for Palmar Limitee

PALMAR LIMITEE	
PROFIT AND LOSS STATEMENT Financial Year Ended: 31/12/2015 Date Approved: 24/06/2016 Currency: Mauritius Rupee Unit: 1	
Turnover	801046757
Less cost of Sales	735241196
Gross Profit	65805561
Other Income	2269433
Less distribution Costs	15654549
Administration Costs	60646546
Other Expenses	-124351285
Finance Costs	38619527
Profit/Loss Before Tax	77505657
Tax Expense	0
Profit/Loss for the period	77505657
BALANCE SHEET Financial Year Ended: 31/12/2015 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	94593563
Invest. Properties	0
Intangible Assets	3027035
Invest in Subsidiaries	18668167
Other Investments	378595546
Biological Assets	0
Others	0

Total	494884311
Current Assets	
Inventories	67878769
Trade & Other recv.	137626224
Cash & cash eqiv.	12739530
Others	0
Total	218244523
Total Assets	713128834
Equity & Liabilities	
Share Capital	824810
Other reserves	-290726904
Retained Earnings	-498070843
Others	696440211
Total	-91532726
Non Current Liabilities	
Long term Borrowings	5495258
Deferred Tax	0
Long term Provisions	48454653
Others	0
Total	53949911
Current Liabilities	
Trade and other Payables	274852154
Short Term Borrowings	475859495
Current Tax payable	0
Short Term Provisions	0
Others	0
Total Current Liabilities	750711649
Total Liabilities	804661560
Total Equity & liabilities	713128834

Table 44: Financial summary/statements for Maxiwear Ltd

Maxiwear Ltd	
Financial Year Ended: 30/06/2017 Date Approved: 29/12/2017 Currency: Mauritius Rupee Unit: 1	
Turnover	112647634
Less cost of Sales	90022188
Gross Profit	22625446
Other Income	570451
Less distribution Costs	4310264
Administration Costs	9034309
Other Expenses	0
Finance Costs	662245
Profit/Loss Before Tax	9189079
Tax Expense	1418463
Profit/Loss for the period	7770616
BALANCE SHEET Financial Year Ended: 30/06/2017 Currency: Mauritius Rupee Unit: 1	
Non Current Assets	
Prop, Plant & Equip.	8765575
Invest. Properties	0
Intangible Assets	0
Invest in Subsidiaries	0
Other Investments	0
Biological Assets	0

Others	0
Total	8765575
Current Assets	
Inventories	19450713
Trade & Other recv.	18703034
Cash & cash eqiv.	9088692
Others	0
Total	47242439
Total Assets	56008014
Equity & Liabilities	
Share Capital	4500000
Other reserves	0
Retained Earnings	20564013
Others	0
Total	25064013
Non Current Liabilities	
Long term Borrowings	5000000
Deferred Tax	0
Long term Provisions	0
Others	0
Total	5000000
Current Liabilities	
Trade and other Payables	22263511
Short Term Borrowings	3256417
Current Tax payable	424073
Short Term Provisions	0

Others	0
Total Current Liabilities	25944001
Total Liabilities	30944001
Total Equity & liabilities	56008014

APPENDIX 3: QUESTIONNAIRE

NO: Date: / /

UNIVERSITY OF MAURITIUS

FACULTY OF ENGINEERING

MECHANICAL AND PRODUCTION ENGINEERING DEPARTMENT

Thank you for taking time to participate in this survey which is part of the MRC funded research project entitled: 'Development of a Sustainability Index Framework for the Mauritian Textile Industry'. We humbly request you to fill in this questionnaire, which will enable us to have a clear picture of the level of awareness of sustainability drivers and practices in the Mauritian textile industry. Kindly note that all organization related information collected through this survey will be treated with strict confidentiality.

A. ORGANIZATION PROFILE

Organization: …….. Main Address: …….…….

Contact Person: ……. Position: …….……...…

Phone: …….…… Email: …….……..

Products manufactured: ……...…….

Export countries: ……...

No. of Employees: …….....

Year of Establishment: ……..

B. SUSTAINABILITY AWARENESSS

1. Is your organization engaged in sustainable development? ☐ Yes ☐ No

2. What are your sustainability objectives and targets?

Objectives	Targets	Extent to which objective has been met
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5
		1 2 3 4 5

3. Does your organization have a sustainability report? Yes ☐ No ☐

If yes, is it an internal or public report?

C. ENVIRONMENTAL POLICIES, PROCEDURES and AWARENESS

1. Does the organization track environmental performance metrics Yes ☐ No ☐

If yes, please list the main metrics used:

1	
2	
3	
4	
5	
6	

2. Does the organization have an environmental policy statement endorsed by top management? Yes ☐ No ☐

3. Is your organization certified ISO 14000? Yes ☐ No ☐

If no, does your organization have other environmental certifications? Yes ☐ No ☐

If yes, please specify:

4. Has your organization carried out an environmental impact assessment (EIA) to determine its environmental impacts? Yes ☐ No ☐

D. SOLID WASTE GENERATION

1. Does the organization track a normalized solid waste metric? Yes ☐ No ☐

If yes, please list the metrics used for solid waste measurement:

1	
2	
3	
4	
5	

2. Please provide (if available) the average solid waste generation per month:……

3. How is the solid waste generated disposed?

……
……
……

4. Does your organization recycle scrap garment materials? Yes ☐ No ☐

5. Does your organization has a policy for recycling of the following items:

Cardboard ☐

Scrap materials ☐

Used oil ☐

Plastic containers ☐

E. WASTEWATER GENERATION

1. Does your organization produce and discharge any industrial effluent? Yes ☐ No ☐

   If yes, does your organization possess a valid effluent discharge permit? Yes ☐ No ☐

2. Does the organization track a normalized effluent metric? Yes ☐ No ☐

   If yes, please list the metrics used for waste water:

1	
2	
3	
4	
5	

3. Please provide (if available) the average effluent generation per month:……..

3. Does your organization have an effluent treatment plant? Yes ☐ No ☐

4. Is the effluent treatment plant properly maintained? Yes ☐ No ☐

5. Does your organization carry out regular testing of the effluent? Yes ☐ No ☐

If yes, does your organization monitor the following effluent parameters?

Biological oxygen demand (BOD) ☐

Chemical oxygen demand (COD) ☐

Soluble chemical oxygen demand (SCOD) ☐

pH ☐

Total solids ☐

Volatile solids ☐

Phosphate ☐

Nitrate ☐

Nitrite ☐

Total nitrogen ☐

Ammonia nitrogen ☐

Kjedahl nitrogen ☐

Total suspended solids ☐

6. Does your organization respect all the permissible limits for effluent discharge specified in the environmental protection act (EPA) 2002? Yes ☐ No ☐

F. GASEOUS EMISSION FROM BOILERS

1. What type of boiler is utilized in your organization?

Water tube ☐

Fire tube ☐

2. Does your organization carry out regular maintenance of the boilers to prevent problems like scaling and fouling? Yes ☐ No ☐

If yes, please specify the frequency of maintenance:……

3. Does your organization carry out regular monitoring of stack emissions? Yes ☐ No ☐

If yes, does your organization monitor the following parameters?

Stack flue gas differential pressure ☐

Stack flue gas velocity ☐

Stack flue gas exit temperature ☐

Stack flue gas flow-rate ☐

Stack flue gas moisture content ☐

Stack combustion excess air ☐

Boiler combustion efficiency ☐

Oxygen (O_2) ☐

Carbon Dioxide (CO_2) ☐

Carbon Monoxide (CO) ☐

Sulphur Dioxide (SO_2) ☐

Oxides of Nitrogen (NO_x) ☐

Actual Particulate Matter Load ☐

4. Does your organization have air pollution control equipment? Yes ☐ No ☐

If yes, please specify the installed equipment:

……
……
……
……

……
……
.

G. HAZARDOUS CHEMICAL USE

1. Does the organization maintain an electronic inventory of all hazardous chemicals used on site? Yes ☐ No ☐

2. Does your organization generate any hazardous waste? Yes ☐ No ☐

   If yes, is it safely disposed at an official disposal site? Yes ☐ No ☐

3. Does the organization track a normalised hazardous chemical use metric Yes ☐ No ☐

   If yes, please list the metrics used:

1	
2	
3	
4	
5	

4. Does the organization have a spot removal operation? Yes ☐ No ☐

If yes, refer to the spot remover/solvent MSDS to specify the health and safety characteristics of the product.

Carcinogenic ☐

Teratogenic/Mutagenic ☐

Neurotoxic ☐

H. WATER USE

1. Does the organization track a normalized water-use metric? Yes ☐ No ☐

If yes, please provide the normalized average water use per month: ……

2. Does the organization have a documented leak detection program? Yes ☐ No ☐

3. Does your organization have an on-site laundry operation? Yes ☐ No ☐

If yes, does the organization track the water used per rupee of material washed? Yes ☐ No ☐

If yes, please indicate whether the organization has implemented any one of the following water conservation technologies

Batch washer system ☐

Water recovery tanks ☐

Ozone washing ☐

Other: ☐

4. Does the organization operate a boiler for steam generation or other use? Yes ☐ No ☐

If yes, is a boiler condensate recycling system installed? Yes ☐ No ☐

5. Are bathrooms facilities for employees used during normal Yes ☐ No ☐

operating hours have low-flow features?

If yes, please indicate whether the organization has implemented any of the following water conservation technologies for toilets

Low-flush toilet ☐

Early closure valve ☐

Weighted flapper ☐

Dual flush device ☐

Displacement bag ☐

Toilet dam ☐

6. Does the organization provide bathroom and shower facilities for use by residents in on-site dormitories Yes ☐ No ☐

If yes, please indicate whether the organization has implemented any of the following water conservation technologies for toilets.

Low-flush toilet ☐
Early closure valve ☐
Weighted flapper ☐
Dual flush device ☐
Displacement bag ☐
Toilet dam ☐

If yes, do the installed showerheads use less than 2.2 gallons of water per minute? Yes ☐ No ☐

I. ENVIRONMENTAL COMPLIANCE

1. Has the organization previously had incidents of, or fines associated with non-compliance of applicable environmental laws and regulations? Yes ☐ No ☐

If yes, please describe below:

……
……
……
……
……

3. Are you aware of any initiatives or policies from the Government to encourage sustainability in the Textile Industry Yes ☐ No ☐

If yes, please list the initiatives you are aware of:

……
……
……
……...

J. ENERGY USE

1. Does the organization track a normalized energy-use metric? Yes ☐ No ☐

If yes, please list the metrics used:

1	
2	
3	
4	
5	

If yes, is it possible to have the recorded normalized energy use per month:……..

2. Has the organization performed a formal energy audit and identified energy efficiency opportunities? Yes ☐ No ☐

3. Has the organization optimized current lighting systems using any of the following?

Adjust light proximity	☐
Task lighting	☐
Automatic light controls	☐
Cleaning/maintenance	☐
Group replacement	☐
Other:	☐

4. Has the organization upgraded lighting system-efficient systems with any of the following energy-efficient technologies?

Electronic ballasts	☐
Hybrid ballast	☐
T8 or T5 lamps	☐
Compact fluorescent	☐
LED exit signs	☐
Other:	☐

5. Has your organization conducted a formal study to determine appropriate lighting levels for each process or task? Yes ☐ No ☐

6. Does your organization have a documented environmentally preferable purchasing policy that includes preference to energy-efficient products? Yes ☐ No ☐

If yes, please describe below:

……
……
……
……

7. Has the organization installed an energy-efficient heating or cooling system? Yes ☐ No ☐

If yes, please describe below:

……
……
……
……
……
……

8. Does the organization operate a boiler for steam generation or other use? Yes ☐ No ☐

If yes, does the organization have a written maintenance schedule to inspect the system for steam leaks? Yes ☐ No ☐

If yes, please describe any upgrades or programs the organization has implemented to improve the energy-efficiency of the boiler.

……
……
……
……

9. What are the fossil fuels utilized in your organization for steam generation

Coal ☐

Heavy fuel oil (HFO) ☐

Liquefied petroleum gas (LPG) ☐

Diesel

Petrol ☐

10. Does your organization use energy from renewable energy sources? Yes ☐ No ☐
If yes, please describe below:

…….

K. ECONOMIC

1. Annual Turnover (Rs. Million)

Please Tick:

<100 ☐ 100-150 ☐ 150-250 ☐

250-350 ☐ 50-500 ☐ >500 ☐

L. SOCIAL

1. Is your staff aware of sustainability practices? 1 2 3 4 5

2. Does your staff participate in sustainability practices? 1 2 3 4 5

If yes, please specify how?

……
……
……
……

3. Do you have corporate social responsibility (CSR) plans? Yes ☐ No ☐

If yes, please specify.

……
……
……
……

4. Do you use customer feedback on sustainability to improve the quality of your service to customers? Yes ☐ No ☐

5. Do you get complaints from customers related to sustainability policies? Yes ☐ No ☐

6. Do you have health and safety policies? Yes ☐ No ☐

9. Do you do regular health check of your employees? Yes ☐ No ☐

8. Have there been cases of work related illness in your employees? Yes ☐ No ☐

If yes, what have been the health problems faced by your workers?

……
……
……

10. Is there any doctor working at your organization Yes ☐ No ☐

11. Is the doctor employed full time or part time basis Yes ☐ No ☐

13. What measures have been taken to improve the working conditions in your organization?

……
……
……
……
……....

14. Have there been work related incidents at work? Yes ☐ No ☐

If yes, please specify how many? ……

15. What new measures have been taken to increase safety in the work area?

……
……
……
……

16. Have incidents decreased with the new measures? Yes ☐ No ☐

17. Is your organization certified with SA 8000? Yes ☐ No ☐

M. SECOND PHASE OF PROJECT

The second phase of the project will focus on the development of a sustainability index framework for the Mauritian textile industry.

Would your organization be interested in participating in the project? Yes ☐ No ☐

Filled in by:

Name:

Position:

Email:

Phone:

Signature

Thank you for your contribution to this research work

Sanmooga Savoo, Research Assistant

Mechanical and Production Engineering Department, University of Mauritius

Mobile: 59061237

Email: sanmooga.savoo2@umail.uom.ac.mu

APPENDIX 4: AMBIENT AIR QUALITY AND EMISSIONS STANDARDS MAURITIUS

Standards for Air Regulations
LEGAL SUPPLEMENT

to the Government of Mauritius No. 92 of 29 August 1998

Government Notice No.105 of 1998

THE ENVIRONMENT PROTECTION ACT 1991

Regulations made by the Minister under Section 35 of the Environment Protection Act 1991

1. These regulations may be cited as the Environment Protection (Standards for Air) Regulations 1998.

2. In these regulations -

"Act" means the Environment Protection Act 1991;

"chimney" means a structure or opening from or through which a product of combustion or an air pollutant is emitted into the atmosphere;

"enforcing agency" means the agency specified in paragraph 2(1)(a) of the Fourth Schedule to the Act;

"existing factories" means factories which entered into operation before the commencement of these regulations;

“factory” has the same meaning as in section 2 of the Labour Act;

"industrial process" means any process operated at a factory which may entail a pollutant being emitted into the atmosphere;

"smoke" includes all particulate matter in smoke.

3. (1) The national environmental standards for the emission of pollutants in the atmosphere shall be those set out in the First Schedule.

(2) Every factory shall comply with the emission standards set out in the First Schedule.

(3) Existing factories shall comply with the emission standards set out in the First Schedule as from 1 February 1999

4. (1) The enforcing agency may require that a chimney serving an industrial process be fitted with an aperture for the insertion of a probe to measure the composition, characteristics and quantities of emissions.

(2) The aperture shall be in the chimney wall and of such size and within such height as the enforcing agency may require.

(3) The enforcing agency may require that a safe means of access to the aperture be provided for the purpose of monitoring emissions from the chimney.

(4) Notwithstanding the other provisions of these regulations, the enforcing agency may decide that certain parameters in the First Schedule shall not apply to any specific chimney.

5. (1) The national environmental standards for ambient air shall be those set out in the Second Schedule.

(2) In exercising its powers under these regulations, the enforcing agency may take account of the national environmental standards set out in the Second Schedule.

6. (1) The enforcing agency may use measuring instruments for the purpose of assessing the quality of air.

(2) Measuring instruments shall, for the purpose of these regulations include -

(a) any apparatus for separating any air impurity from the gas or liquid medium in which it is carried;

(b) any device to indicate or record air pollution or give warning of excessive air pollution; and

(c) any other device used for the purposes of preventing or limiting air pollution.

Made by the Minister on 24th August, 1998.

First Schedule

(regulation 3)

Emission Standards

The following standards are maximum limits for the corresponding pollutant.

Pollutant	*Applicable to*	*Standard*
(i) Smoke	All stationary fuel burning source	Ringelmann No. 2 or equivalent opacity (not to exceed more that 5 minutes in any period of one hour)
(ii) Solid particles	(a) Any trade, industry, process, industrial plant or fuel-burning equipment (b) Any existing trade, industry process or industrial plant using bagasse as fuel	200 mg/m^3 400 mg/m^3

(iii) Sulphuric acid mist or Sulphur Trioxide	(a) Any trade, industry or process (other than combustion processes and plants for the manufacture of sulphuric acid) (b) Any trade, industry or process in which sulphuric acid is manufactured	120 mg/m^3 as sulphur trioxide 30 000 mg/m^3 as sulphur trioxide
(iv) Fluorine compounds	Any trade, industry or process in the operation of which fluorine, hydrofluoric acid or any inorganic fluorine compounds are emitted	100 mg/m^3 as hydrofluoric acid
(v) Hydrogen Chloride	Any trade, industry or process	200 mg/m^3 as hydrogen chloride
(vi) Chlorine	Any trade, industry or process	100 mg/m^3 as chlorine
(vii) Hydrogen sulphide	Any trade, industry or process	5 ppm as hydrogen sulphide gas
(viii) Nitric acid or	Any trade, industry or process in which the manufacture of	2 000 mg/m^3 as nitrogen dioxide

oxides of nitrogen	nitric acid is carried out	
(ix) Nitric acid or oxides of nitrogen	Any trade, industry or process other than nitric acid plant	1 000 mg/m^3 as nitrogen dioxide
(x) Carbonmonoxide	Any trade, industry or process	1 000 mg/m^3 as carbon monoxide

SECOND SCHEDULE

(*regulation 5)*

Ambient Air Quality Standards and Measurement Methods

Ambient Pollutant	*Standard* *(ug/m3)* *maximum*	*Averaging Time*	*Measurement Method**
Total suspended particles	150 50	24-hour Annual average	Hi-volume Sampler
PM10	100	24-hour	Hi-volume Sampler

Sulphur Dioxide	350 200 50	1-hour 24-hour Annual average	Fluorescence SO_2 Analyser, Colorimetry
Nitrogen Dioxide	200	24-hour	Sodium Arsenite, Chemiluminescence
Carbon Monoxide	25,000 10,000	1-hour 8-hour	Nondispersive Infrared Photometry
Lead	1.5	3-month average	Hi-volume Sampler with Atomic Absorption
Ozone	100	1-hour	Ozone Analyzer, Chemiluminescence

*the measurement methods are those indicated or other methods acceptable to the enforcing agency.

APPENDIX 5: STANDARDS FOR EFFLUENT DISCHARGE REGULATIONS

General Notice No.44.of 2003

THE ENVIRONMENT PROTECTION ACT 2002

Regulations made by the Minister under sections 39 and 96 of the Environment Protection Act 2002

1. These regulations may be cited as the Environment Protection (Standards for effluent discharge) Regulations
2003.

2. In these regulations -

(b)"effluent" means water sullied or contaminated by any matter, in solution or suspension and derived from the use of the water in connection with domestic, industrial or other activities;

"HWM" means the High Water Mark at spring tide;

"influent" means water diverted from a river, stream, spring, canal, underground or water supply network used in connection with any activity listed in the First Column of the First Schedule;

"parameter" means, in relation to an effluent, the characteristics or constituent elements set out in the Second Column of the First Schedule in respect of the corresponding activity set out in the First Column of the First Schedule;

"Wastewater system" –

(a) means a sewer, conduit, pump, engine or other appliance used or intended to be used for the reception, conveyance, removal, treatment and disposal of effluent; and

(b) does not include house sewers;

"waterbody" includes a stream, a river, a canal, a lake, a pond, a reservoir, an estuary, a wetland and
underground water;

"watercourse" means any natural or artificial channel, pipe or conduit, excluding the sewerage system,
carrying, or that may carry, and discharging water directly or indirectly into a water body;

3.No person shall discharge effluent onto land, into a watercourse or into a waterbody unless he ensures that the
parameters of the effluent do not exceed the permissible limits set out in the Second Schedule.

4.Not withstanding regulation 3 or any other enactment, no person shall discharge or cause to be discharged any
effluent into a waterbody or watercourse used or earmarked to be used for potable water supply.

5.Notwithstanding regulation 3, any person using an influent, the limits concentration or value of the any
parameters of which exceeds the permissible limit for that parameter set out in the Second Schedule, shall
ensure that the concentration or value of the parameters of in the effluent does not exceed those that of the
influent.

6. Any industry existing prior to the promulgation of these regulations and which is within a distance of 200 metres from the HWM shall comply with the permissible limits set out in the Third Schedule.

7. These regulations shall come into operation on 01 September 2003.

Made by the Minister on 05 February 2003

FIRST SCHEDULE

(regulation 2)

List of parameters for each industrial activity

INDUSTRIAL ACTIVITY	PARAMETERS
Textile manufacturing	Colour, Temperature, pH, COD, BOD_5, Reactive Phosphorus, TSS, Chloride, Sulphate, Sulphide, Ammoniacal Nitrogen, Nitrate as N, Oil & Grease, Total Pesticides
Metal Plating & Galvanising	Temperature, pH, COD, Free Chlorine, TSS, Chloride, Sulphate, Sulphide, Nitrate as N, Cyanide, Cadmium, Total Chromium, Cobalt, Copper, Iron, Lead, Nickel, Zinc, Oil &Grease, Total Organic Halides.
Slaughtering	Temperature, pH, COD, BOD_5, TSS, Chloride, Nitrate as N, TKN, Oil & Grease, Total Coliforms, E. Coli
Canning & Food Processing	Temperature, pH, COD, BOD_5,Free Chlorine, TSS, Chloride, Nitrate as N, TKN, Sodium, Oil & Grease, Total Coliforms.
Dairy Processing	Temperature, pH, COD, BOD_5,TSS, Selenium, Oil & Grease, Detergents, Ammoniacal Nitrogen.
Soft Drink Bottling	Temperature, pH, COD, BOD_5, TSS, Sodium, Zinc, Detergents.
Breweries & Distilleries	Temperature, pH, COD, BOD_5,TSS, Nitrate as N, Selenium, Zinc, Oil & Grease, Detergents, Ammoniacal Nitrogen.
Laundry processes	Temperature, pH, COD, BOD_5, Reactive Phosphorus, Free Chlorine, TSS, Nitrate as N, Total Chromium, Copper, Iron, Lead, Oil & Grease, Total Organic Halides,

	Detergents
Edible Oil Refining	Temperature, pH, COD, BOD_5, TSS, Chloride, Sodium, Oil & Grease, Total Organic Halides, Phenols, Detergents.
Paint Manufacturing	Colour, Temperature, pH, COD, BOD_5, TSS, Chloride, Sulphate, Sulphide, Aluminium, Cadmium, Total Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Zinc, Oil & Grease, Total Organic Halides.
Mechanical Workshop	pH, COD, BOD_5, Oil & Grease, Total Chromium, Lead, Manganese, Zinc.
Thermal Power Plant	Temperature, pH, TSS, Oil & Grease, Total Chromium, Copper, Iron, Zinc.
Soap & Detergents Manufacturing	Temperature, pH, COD, BOD_5, Reactive Phosphorus, Free Chlorine¸ TSS, Oil & Grease, Total Organic Halides, Detergents**,** Ammoniacal Nitrogen.
Manufacture of Pharmaceutical products	Temperature, pH, COD, BOD_5, Reactive Phosphorus, TSS, Sulphide, Oil & Grease, Phenols and Detergents.
Tanning	Colour, Temperature, pH, COD, BOD_5, Reactive Phosphorus, TSS, Sulphate, Sulphide, Nitrate as Nitrogen, Cadmium, Total Chromium, Mercury, Oil & Grease, Total Organic Halides, Total Coliforms, E. Coil Coli, Ammoniacal Nitrogen.
Manufacture of Chemical Fertilizers	Temperature, pH, COD, BOD_5, Reactive Phosphorus, TSS, Sulphate, Oil & Grease, Ammoniacal Nitrogen.
Livestock Breeding	pH,COD, BOD_5, Reactive Phosphorus, TSS, Nitrate as Nitrogen, TKN, Total Coliforms, E. Coli, Ammoniacal

	Nitrogen.

SECOND SCHEDULE

(regulation 4)

Effluent discharge Standards

Parameter	**Unit**	**Maximum permissible limit**	
		Land/ Underground	**Surface water courses**
Total coliforms	MPN per 100 ml	-	<400
E. Coli	MPN per 100 ml	<1000	<200
Free Chlorine	mg/l	-	0.5
Total Suspended Solids (TSS)	l	45	35
Reactive Phosphorus	mg/l	10	1
	mg/l		
Colour	-	Not objectionable	
Temperature	^{0}C	40	
pH	-	5 – 9	

Chemical Oxygen Demand (COD)	mg/l	120
Biochemical Oxygen Demand (BOD_5)	mg/l	40
Chloride	mg/l	750
Sulphate	mg/l	750
Sulphide	mg/l	0.002
Ammoniacal Nitrogen	mg/l	1
Nitrate as N	mg/l	10
Total Kjeldahl Nitrogen (TKN)	mg/l	25
Nitrite as N	mg/l	1
Aluminium	mg/l	5
Arsenic	mg/l	0.1
Beryllium	mg/l	0.1
Boron	mg/l	0.75
Cadmium	mg/l	0.01
Cobalt	mg/l	0.05
Copper	mg/l	0.5
Iron	mg/l	2.0
Lead	mg/l	0.05
Lithium	mg/l	2.5

Manganese	mg/l	0.2
Mercury	mg/l	0.005
Molybdenum	mg/l	0.01
Nickel	mg/l	0.1
Selenium	mg/l	0.02
Sodium	mg/l	200
Total Chromium	mg/l	0.05
Vanadium	mg/l	0.1
Zinc	mg/l	2
Oil & Grease	mg/l	10
Total Pesticides	mg/l	0.025
Total organic halides	mg/l	1
Cyanide (as CN^-) *or Free cyanide*	mg/l	0.1
Phenols	mg/l	0.5
Detergents (as LAS*)	mg/l	15

* Linear Alkylate Sulphonate

THIRD SCHEDULE

(regulation 6)

Effluent discharge Standards

Parameter	**Unit**	**Maximum permissible limit**
Total coliforms	MPN per 100 ml	<400
E. Coli	MPN per 100 ml	<200
Free Chlorine	mg/l	0.5
Total Suspended Solids (TSS)	mg/l	35
Reactive Phosphorus	mg/l	1
Colour	-	Not objectionable
Temperature	^0C	40
pH	-	5 – 9
Chemical Oxygen Demand (COD)	mg/l	120
Biochemical Oxygen Demand (BOD_5)	mg/l	40
Chloride	mg/l	1500
Sulphate	mg/l	1500
Sulphide	mg/l	0.002

Ammoniacal Nitrogen	mg/l	1
Nitrate as N	mg/l	10
Total Kjeldahl Nitrogen (TKN)	mg/l	25
Nitrite as N	mg/l	1
Aluminium	mg/l	5
Arsenic	mg/l	0.1
Beryllium	mg/l	0.1
Boron	mg/l	0.75
Cadmium	mg/l	0.01
Cobalt	mg/l	0.05
Copper	mg/l	0.5
Iron	mg/l	2.0
Lead	mg/l	0.05
Lithium	mg/l	2.5
Manganese	mg/l	0.2
Mercury	mg/l	0.005
Molybdenum	mg/l	0.01
Nickel	mg/l	0.1
Selenium	mg/l	0.02
Sodium	mg/l	200

Total Chromium	mg/l	0.05
Vanadium	mg/l	0.1
Zinc	mg/l	2
Oil & Grease	mg/l	10
Total Pesticides	mg/l	0.025
Total organic halides	mg/l	1
Cyanide (as CN^-)	mg/l	0.1
Phenols	mg/l	0.5
Detergents (as LAS*)	mg/l	15

* Linear Alkylate Sulphonate