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THE ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEMS AS A MOTIVATION TOWARDS SUSTAINABLE DEVELOPMENT

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ABSTRACT

The ISO 14001 Environmental Management System (EMS) standard has become an extensive environmental tool in the field of corporate responses to sustainability. Some organizations in Mauritius have actively participated in implementing this standard and much need to be done to train experts in formulating investment projects so as to move towards ISO 14001 implementation and certification, thus preserving the natural environment. The aim of the project was to investigate if the ISO 14000:1994 standards can be a pathway to environmental sustainability in industries in Mauritius. A set of eco-efficiency indicators (water and energy indicators) were adopted to measure the environmental performance of organizations and to support the implementation of the standard. Two case studies were selected namely Plant A (a dairy plant) and Plant B (a dyeing plant from a Textile industry). Plant A is already ISO 14001 certified and it is making use these indicators for its energy and water consumption to monitor its performance. The same set of eco-efficiency indicators were implemented for plant B which is not yet certified. Plant B is following the guidelines of the ISO 14001 standards to achieve its environmental objectives. Results obtained show that both plants affirmed that they are adequately monitoring their key significant aspects and they are complying with environmental laws and regulations. The number of companies in Mauritius having implemented ISO 9001:2000 amounts to 259 (ISO survey 2007). Out of this, there are about fourteen ISO 14000:1994 certified companies to date. The remaining companies feel a great need to integrate the ISO 14000 system into their

existing management system. The only problem is that the environmental standard is more costly and need more infrastructures to build up. But this does not stop the company from following the guidelines of the ISO 14000 series and to monitor its environmental performance from its eco-efficiency indicators taken up from the standards.

Keywords:

ISO 14000, Sustainable Development, Eco-Indicators, Environmental Sustainability

1.0 INTRODUCTION

Environmental problems are becoming an increasingly important issue across the globe, with pressure to minimize environmental impacts coming from a number of sources: local and national governments, customers, employees and shareholders. These growing problems, due to an increase in production and consumption, have contributed to the concept of sustainable development. Although many authors provide different definitions of the concept, in most cases, the focus of sustainable development in developing countries is rather on socio-economic development (e.g. reducing poverty, access to health care and education, stimulating economic growth) (Rao,2000) where as for higher developed nations, the tendency is to focus on environmental aspect of economic development (Fortunski 2008). The International Standards Organization (ISO) plays an important role here by stimulating proper environmental management systems, for the better understanding of sustainable development as eco-development for the environmental integrity of the planet. The Environmental Management Standard (EMS) ISO 14001: 2004 standards can provide significant tangible benefits including: Reduced raw material use, reduced energy consumption, improved process efficiency, reduced waste generation and disposal costs as well as utilization of recovered resources. The standard is one of the principal tools being used by organisations everywhere to meet their environmental challenges. The standard aims to create sustainable improvements in the practices of participating firms through its implementation and integration. Empirical studies have indicated that implementation of EMS helped firms in the reduction of inputs, raw material utilization and operational safety. Besides The 1992 Earth Summit recognized the important role that indicators can play in helping countries to make informed decisions concerning sustainable development. The International Chamber of Commerce (ICC) announced the "Business Charter for Sustainable development", and emphasized the responsibility of organisations for the maintenance of a global environment.

Industry is an integrated part of society and provides means for progress in all tiers of sustainable development, including economic, environmental and social factors. At the same time, industry also has a large potential for counteracting sustainable development through depletion of natural resources and inadequate management practices. Mauritius contains inherent vulnerabilities of a small-island developing state; balancing preservation of the state of the terrestrial and marine environment with further development of economic sectors such as tourism, agriculture and industries. This vision is well articulated in the National Environmental Strategies (NES) and the National Environmental Action Plan published in

1999 (NEAP II), which are blueprints for the sustainable development in Mauritius. (UNDP, 2007). The National Environmental Policy (NEP) published in 2006 also aims to adopt sustainable production and consumption patterns, to ensure efficient use of energy and environmental resources and to achieve a recycled-based society. It tends to integrate environmental concerns into policies, plans and programmes for the economic and social development in order to meet the needs and aspirations of present and future generations.

Moreover, with the project "***Maurice Ile Durable***", the country is planning the introduction of industrial waste audit regulations to encourage industries to self-regulate and adopt cleaner technologies, as a precursor to the eventual adoption of ISO 14000 series. Sustainable production activities are mainly focused on the implementation of ISO 14001 EMS or Green Globe Certification. Hence, there is a need for ISO 14001 EMS program towards sustainable development in Mauritius, although it's not a highly developed state. More must be placed upon the ISO 14001 foundation to create a complete sustainable system especially in the Mauritian industries in view of allowing them to benchmark and monitor their productivity or resource efficiency.

2.0 LITERATURE REVIEW

2.1 ISO 14000:2004 and the Environment

The ISO 14000:2004 refers to a family of voluntary standards developed by the International Organization for Standardizations (ISO). It is the most visible part of ISO's work for the environment. The standards provide a framework for a strategic approach to an organisation's environmental policies, plans and actions. The main thrust for its development grew out of ISO's commitment to support the objective of "sustainable development" as discussed at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. ISO defines an Environmental Management System as

"*…the part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining …environmental policy"*

If management is committed to a philosophy of sustainable development and is prepared to be proactive in implementing appropriate programs in an era that promotes the environment as a value, an EMS should be

helpful to influence stakeholders thinking towards the adoption of a "triple bottom line" of economical, environmental and social sustainability. The whole concept of ISO 14001 can be condensed into one sentence. One can say that fundamentally the Standard requires an organization to "*Control and reduce its impact on the environment*".

Organizations deplete energy sources as well as raw materials and generate products and waste materials. These changes are referred to as environmental impacts. Identifying and assessing the significance of these impacts, is an important stage in an organisation's preparatory stages for ISO 14001. The Standard requires management, by forethought and action, to use less scarce resources by better planning, use of recycled materials and perhaps operate the process differently.

Control required by the standard will be dictated by the demands of legislation. Thus, to keep within the law, the organization will wish to ensure that all regulatory and legislative requirements concerning the environmental performance are satisfied.

2.2 ISO 14001 Continuous Improvement Cycle

ISO 14001 is based upon the concept "Plan-Do-Check-Act" Cycle (Figure 1). One additional concept "continuous improvement" is highlighted with ISO 14001. This concept is aimed at improving on a regular basis the overall EMS. ISO 14001 requires the evaluation of the organisation's impacts with the environment. Following this, each impact is ranked based upon its significance. The most significant impacts are then addressed within the frame of the EMS for that cycle. Under the "continual improvement" concept, the organization thus attempts to continually reduce its impact upon the environment.

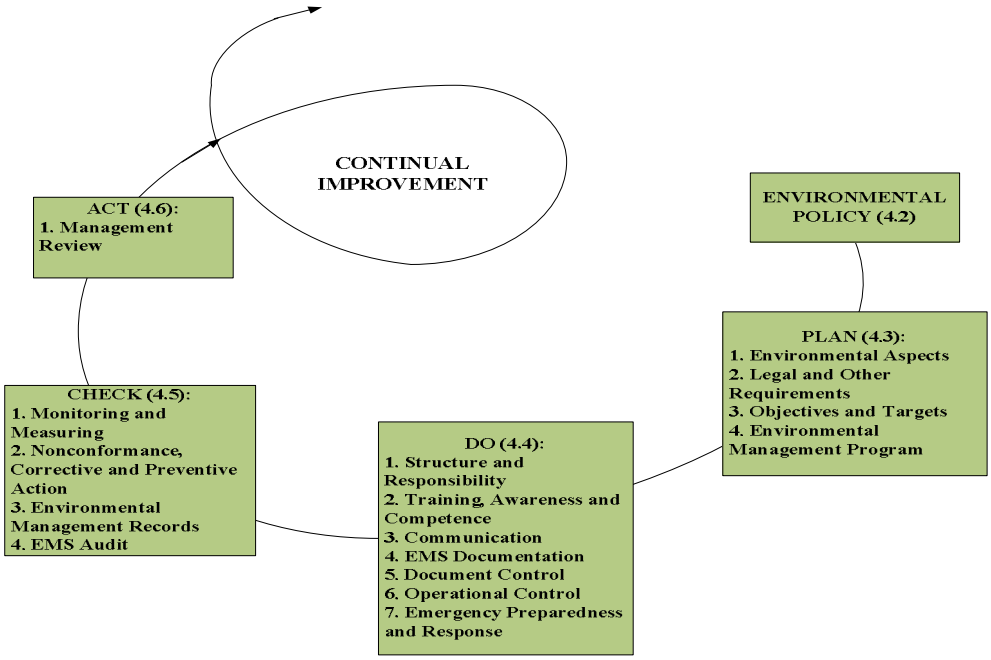


Figure 1: ISO 14001 PDCA continuous improvement Model

Therefore, the idea of sustainable development grew from numerous environmental movements in earlier decades. The concept of sustainability means many different things to different people. Sustainable Development (SD) is a contested concept with a wide range of meanings. It is embraced by big business, governments, social reformers and environmental activists. Sustainable development is maintaining a delicate balance between the human need to improve lifestyles and feeling the well-being on one hand, and preserving natural resources and ecosystems, on which we and the future generations depend.

The most commonly used definition of sustainable development is provided by the World Commission on Environment and Development in its report published in **1987** – Our Common Future (also referred to as the ***Brundtland Report***) describing it as:

"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs"

The essence of this form of development is a stable relationship between human activities and the natural world, which does not diminish the

prospects for future generations to enjoy a quality of life at least as good as our own.

2.3 Dimensions of Sustainable Development

The core mainstream of sustainable development thinking has become the idea of three dimensions, environmental, social and economic sustainability. Environmental sustainability is the ability to maintain qualities that are valued in the physical environment. This dimension focuses on an organization's impact on living and non-living natural systems including ecosystems, land, air and water. The economic dimension concerns the organisation's impact on the economic conditions of its stakeholders and on economic systems at local, national and global levels. It refers to financial viability and encompasses issues of competitiveness and long-term profitability the social dimension centers on the impact of the organization on the social systems within which it operates, the expectations of diverse groups of stakeholders as well as interested parties comprising society are genuinely considered and skillfully balanced. The social bottom line incorporates issues of community, public health, skills and education, social justice, workplace safety, working conditions, human and labor rights and equal opportunity.

2.4 The Need for Indicators

Indicators are useful tools to gain insight regarding the progress made in achieving sustainable development. The 1992 Earth Summit recognized the importance role that indicators can play in helping countries to make informed decisions concerning sustainable development. Agenda 21 specifically calls for the harmonization of efforts to develop sustainable development indicators at the national, regional and global levels.

Canada's National Round Table on the Environment and the Economy (NRTEE) has developed rules and definitions for energy, waste and water intensity indicators. The NRTEE's work builds on a framework for eco-efficiency indicators undertaken by World Business Council for Sustainable Development (WBCSD). The use of energy, waste and water intensity can help business enhance competitiveness while reducing environmental burdens.

2.5 Environmental Indicators for Mauritius

The Ministry of Environment (MOE) and National Development Unit initiated the development of an Environmental Information System (EIS) project in Mauritius. The project's objective is to ensure availability of up-to-date environmental information for decision making by policy makers,

resource managers and the public. The identification and selection of a core set of 32 environmental indicators under six broad themes were adopted.(Thaunoo-Chadee, P., 2007). Organization could adopt various tools in order to move towards sustainable development in order to balance their business. Some of the main tools are presented in Figure 2 below.

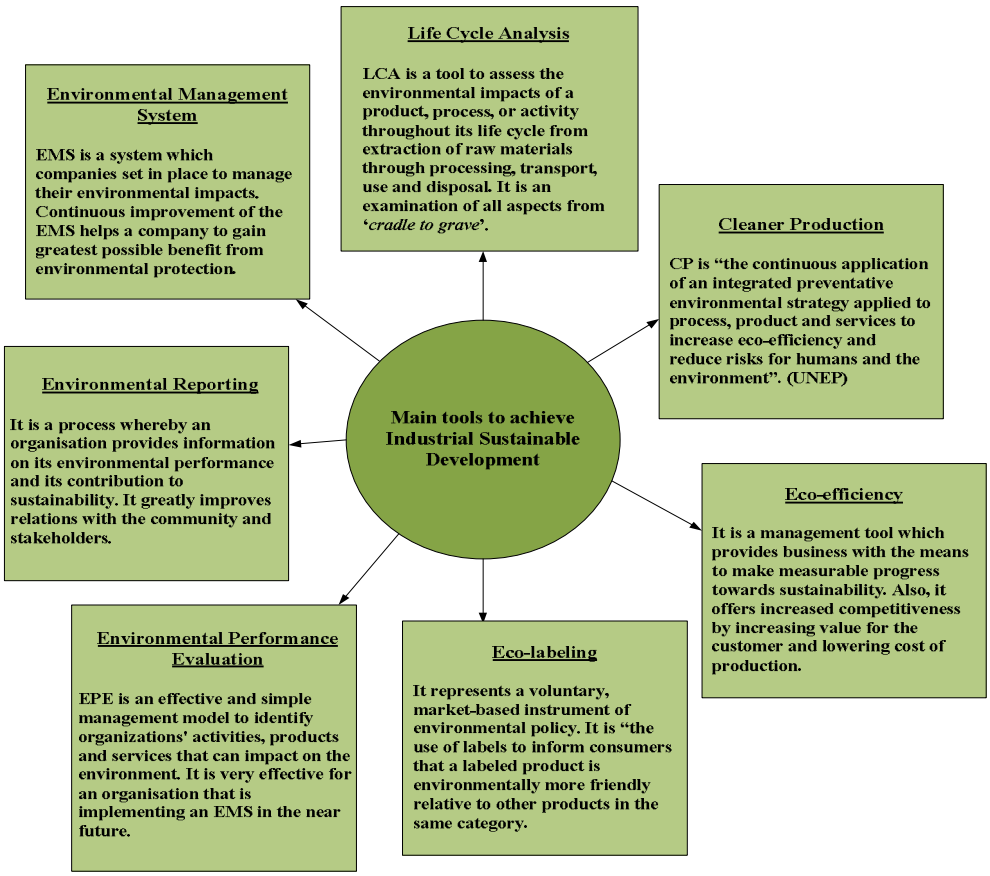


Figure 2: Tools for Industrial Sustainable Development

2.6 Sustainable Industrial Development in Mauritius

The Government of Mauritius is implementing a programme aimed at promoting sustainable industrial growth and enhancing the technological capability of the manufacturing sector, improving productivity along with, promoting manpower training. The Ministry of Industry and Commerce and the support institutions namely MIDA (Mauritius Investment Development Authority), MSB (Mauritius Standard Bureau) and SMIDO (Small and Medium Industries Development Organization) are playing a critical role in this process. The manufacturing sector has entered a

crucial phase of development that of being competitive on the world market while remaining environmentally friendly. It should be highlighted that big firms have the capacity to adapt to changes, that is, they can implement plans geared towards minimization of the impact on the environment.

A National Solid Waste Management Plan has also been prepared in Mauritius. Composting is part of the national strategy for waste minimization. The Government has also developed 'product responsibility' in the bottlers for the proper management of the bottles after they have been sold. Only one company is involved in the paper recycling in Mauritius. The major problem in increasing the capacity of paper recycling is the collection of the paper waste. A Technical Advisory Committee was set up to make recommendations on the storage, collection, transportation, recycling and disposal of used oil. Two companies have already been granted Environmental Impact Assessment (EIA) licenses for the collection and treatment of used oil in Mauritius. Materials recycled are organic waste, scrap metal, glass, paper, demolition waste, used oil and plastics. In general, waste such as lead-acid batteries, textile waste, aluminum cans are exported for recycling. Recycling rates are still very low, which is not slowing the rate of waste for final disposal. It is estimated that less than 10% of waste generated in Mauritius enters the recycling stream. Only about 9% paper, 3% plastic and 31% textiles are recycled. (Scoping Report, 2007)

3.0 AIMS OF STUDY

The aims of the study were to:

- Examine whether the organizational change in implementing the environmental quality standard ISO 14001 can act as a driving force for sustainable development.

- Identify a set of indicators for sustainable development to evaluate the environmental, social and economical performance of Mauritian industries.

- Reveal whether the introduction of ISO 14001 in an organization can be used as an active tool for promoting sustainable development.

4.0 METHODOLOGY OF STUDY

The methodology gives an overview of the method that has been adopted to carry out this project. The methodology approach consisted of five parts as follows:-

Part 1: A set of eco-efficiency indicators that is recommended by the NRTEE (National Round Table on the Environment and the Economy) has been selected at the firm level in the Mauritian context. These indicators were energy intensity indicator, water intensity indicator, water discharged indicator, waste intensity indicator and water utilization indicator.

Part 2: Two case studies were adopted for this research. The first one is an ISO 14001 certified dairy plant (referred as Plant A) and the second one is a dyeing plant (referred as Plant B) the latter is a non-certified plant with a view of going towards an EMS implementation in the near future.

Part 3: A survey questionnaire was prepared to collect data for the calculation of the eco-efficiency indicators mentioned above. Information was also acquired about the progress of these plants in managing a good environment towards sustainable business.

Part 4: The data collected from both plants are processed into indicators and the environmental progress was analyzed over the past years.

Part 5: Recommendations were made for the proper use of the eco-efficiency indicators as milestones for a sustainable environmental programme for the long term.

5.0 RESULTS

5.1 Plant A – Dairy Plant

The raw materials that are used by Plant A consist of 90% dried milk and 10% fresh milk, sugar and water. Cartons, HDPE (High Density Polyethylene) and LDPE (Low Density Polyethylene) are used as packaging. Plant A operates around 300 days per year. It has obtained its ISO 14001 certification in year 2000. The raw data collected for Plant A is first presented Table 1 followed by a sample calculation for the eco-efficiency indicators.

Table 1: Raw Data for Plant A

Parameters	Magnitude	Magnitude	Magnitude	Units
	Year 2006	Year 2007	Year 2008	
Total Production	12 000	12 600	13 200	tons
Raw Materials				
Milk	1 300	1 390	1 450	tons
Sugar	830	880	940	tons
Water	10.50	10.40	10.25	L/kg product
Energy Consumption				
Fuel-LPG	0.55	0.56	0.54	kWh/kg product
Electricity	500	510	505	
Waste Generation				
Solid Waste	[1]N/A	N/A	N/A	-
Recycled waste (paper, plastic)	N/A	N/A	N/A	-
Wastewater discharged	210	218	225	m^3/d
Effluent Parameters				
COD	1433	1450	[2]1472	mg/L
TSS	246	278	[2]314	mg/L
TKN	56	64	[2]75	mg/L
Oil & Grease	105	118	[2]127	mg/L

5.1.1 Data Analysis of Plant A for the year 2006

The raw data was analyzed for this year is as follows.

i. *Energy Intensity Indicator*

The core energy intensity for year 2006 is already calculated by plant A as follows.
Electricity intensity indicator = 500 W/kg of product
Fuel intensity (LPG) = 0.55 kWh/kg of product

[1]N/A: Not available
[2] Results for October 2008

ii. *Water Intensity Indicator*

Water Intensity = $\frac{\text{Total water taken in } [m^3]}{\text{Unit of production [ton]}}$

Water intensity indicator =

10.5 L	1000 kg	1 m^3
kg	1 ton	1000 L

= 10.5 m^3 / ton of product

iii. *Water Discharged Intensity*

Water discharged intensity = $\frac{\text{Total water discharged } [m^3]}{\text{Unit of production [ton]}}$

Water discharged intensity indicator
= 5.25 m^3 / ton of product

210 m^3	300 days	1 year
day	1 year	12000 ton

iv. *Waste Intensity Indicator*

The waste intensity for the past three years could not be determined due to lack of data on the total amount of waste generated by the plant.

v. *Waste Utilization Indicator*

The waste utilization intensity could also not be determined due to lack of data on the total amount of waste generated as and the quantity of waste that is sent to recycling plants.

vi. *COD Indicator*

COD load = 7.523 kg/ton of product

1433 mg	1000 L	1 x 10^{-6} kg	210 m^3	300 days	1 year
L	1 m^3	1 mg	day	1 year	12 000 ton

vii. *TSS Indicator*

TSS load =

246 mg	1000 L	1 x 10^{-6} kg	210 m^3	300 days	1 year
L	1 m^3	1 mg	day	1 year	12 000 ton

= 1.29 kg/ton of product

viii. *TKN Indicator*

TKN load =

56 mg	1000 L	1 x 10^{-6} kg	210 m^3	300 days	1 year
L	1 m^3	1 mg	day	1 year	12 000 ton

= 0.29 kg/ton of product

ix. *Oil and Grease Indicator*

Oil and Grease load

=

105 mg	1000 L	1 x 10^{-6} kg	210 m^3	300 days	1 year
L	1 m^3	1 mg	day	1 year	12 000 ton

= 0.55 kg/ton of product

The raw data of Plant A for the year 2007 and year 2008 were analyzed in a similar way as shown above Table 2 gives a summary of the eco-efficiency indicators' results of Plant A for the past three years.

Indicator	Result	Result	Result	Unit
	Year 2006	Year 2007	Year 2008	
Energy intensity	0.55	0.56	0.54	kWh/kg of product
Fuel-LPG	500	515	505	W/kg product
Electricity				
Water intensity	10.5	10.4	10.25	m^3/ton product
Water discharge intensity	5.25	5.19	5.11	m^3/ton product
Effluent parameters				
COD	7.523	7.526	7.527	kg/ton of product
TSS	1.29	1.44	1.61	kg/ton of product
TKN	0.29	0.33	0.38	kg/ton of product
Oil & Grease	0.55	0.61	0.65	kg/ton of product

Table 2: Eco-efficiency Indicators' Results for Plant A

6.0 DISCUSSION

This section discusses the factors of the three dimensions of sustainable development (environmental, social and economical) analyzed for both Plant A and Plant B. Firstly the environmental management performance of Plant A is discussed in relation to existing controls in place to maintain the ISO 14001 standard. Results of plant B were similarly analyzed; an analysis was carried to understand if the eco-efficiency indicators identified in this study are responding for plant B. The aim was to investigate if a company which is not yet certified to ISO 14000, can still be complying to environmental norms by monitoring its eco-efficiency indicators.

6.1 Implementation of ISO 14001 at Plant A

Plant A has an environmental management system ISO 14001 in place since 8 years. The plant continuously improves its environmental management system and in this way contributes to business progress. It has its environmental policy, which pledges to protect the environment, making optimal use of natural resources and reducing pollution from its

operation. The respective environmental goals and tasks are defined for Plant A in Table 3. In order to achieve ***Goal 1***, the wastes generated are separated for recycling which helps to create the habit of waste segregation amongst workers.

Table 3: Environmental goals and tasks of Plant A

Goal 1	TASKS
Waste management optimization	Separation of paper, plastic cardboard waste
Goal 2 Management plan to improve the environmental performance	Minimization of resources consumption
Goal 3 Improve the competitiveness of the plant	Adopting a life-cycle assessment that will allow the identification and correction of processes inefficiencies
Goal 4 Environmental education as a pre-requisite for success	Improving workers' conscience about environmental problems and what is needed to resolve them
Goal 5 Increasing environmental awareness of the workers	Training staff in the field of safety legislation and environmental protection
Goal 6 Reduction in emissions	Switching from coal-fired to gas fired boiler

The task to achieve ***goal 2*** is to reduce the raw materials, energy and water consumption. This is later elaborated when the results for eco-efficiency indicators are discussed. To improve competitiveness (***Goal 3***), a life cycle assessment is being done for the processes to be run in a more effective way. Workers are continuously educated about the environmental impacts so that they can find remedies to reduce these problems (***Goal 4***). And ***Goal 5*** is accomplished by training the staff (on environment and health safety) in order to prepare them to manage the removal of effects of environment and health damage. Finally ***Goal 6*** has been attained since the past 10 years as the plant has switched its steam production from coal to LPG to reduce air emissions that can pollute the environment.

6.2 Factors of Environmental Sustainability for Plant A

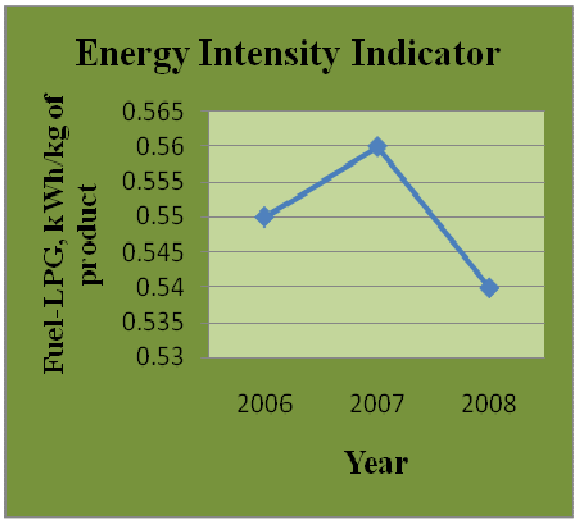
Plant A maintains records on its environmental performance. In June 2007, the company was awarded a trophee by the Minister of Environment for participating in the National Environmental Reporting Award. This is a good image for the plant towards practicing environmental reporting. The plant is connected to a sewer network and complies with the environmental regulations. Plastic and paper wastes are usually sent to

recycling plants for re-use again. This is a good motive towards conserving resources and reducing both pollution and the waste sent to landfill. Re-use of material on-site is not practiced as this is against the food and hygiene requirement as it must be ensured that the product is being protected in the same way as virgin materials. The plant's own unit carries out internal environmental auditing every 6 months to evaluate its environmental performance and to identify areas for improvement to establish compliance to the standard. Cleaner production has been implemented in Plant A to comply with the EMS, reduce levels of pollutions and risks, increase productivity and efficient use of resources. Eventually the eco-efficiency elements viewed by the Plant A are firstly, to reduce material requirement through improved waste and water management and also to reduce the energy intensity of goods.

6.3 Graphs of Indicators for Plant A

The results for the eco-efficiency indicators is analyzed graphically and discussed to have an idea how Plant A is tracking its environmental performance in question towards sustainable development. As shown in Figure 3, the energy intensity indicator (both LPG and electricity) was higher for the year 2007 compared to years 2006 and 2008.

6.3.1 Energy Intensity Indicator for Plant A



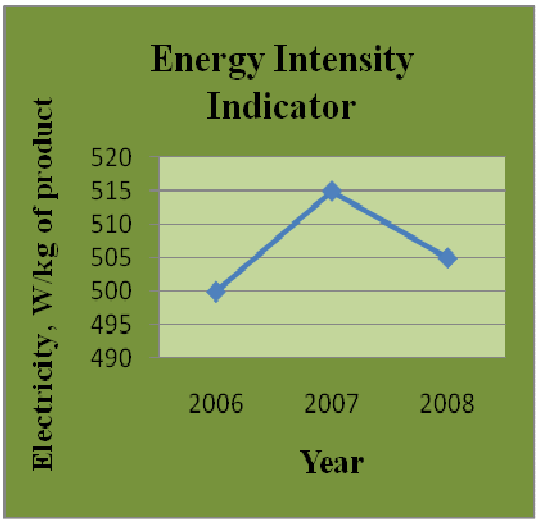


Figure 3: Graphs of energy intensity indicator (LPG & Electricity)

However for the year 2008, the value of the energy intensity has decreased while both the quantity of production and the energy consumption has increased. Thus, the energy used per unit of production has decreased for this year, indicating that Plant A is improving its energy intensity.

6.3.2 Water Intensity Indicator for Plant A

The water consumed by Plant A has increased for the past three years with an increase in the total production. The plant is trying to recycle some hot water from its condensers for other heating as well as cleansing purposes.

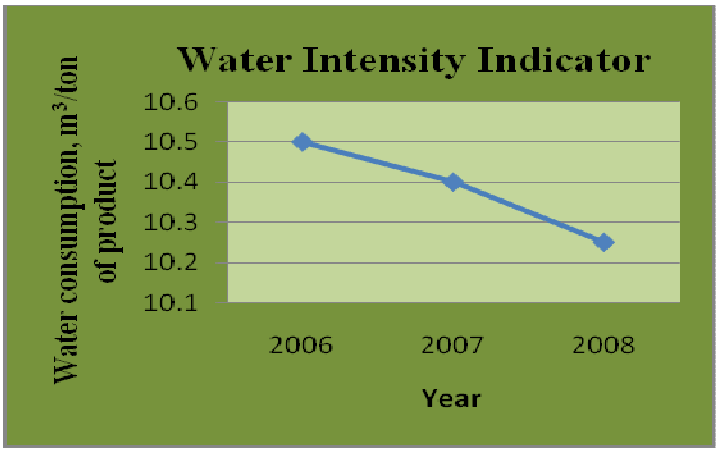


Figure 4: Graph of water intensity indicator

However, the water intensity indicator has decreased (approximately by 0.1 m^3/kg of product yearly) as shown in Figure 4. Hence this indicates that the plant is improving its water intensity indicator.

6.3.4 Water Discharged Intensity Indicator for Plant A

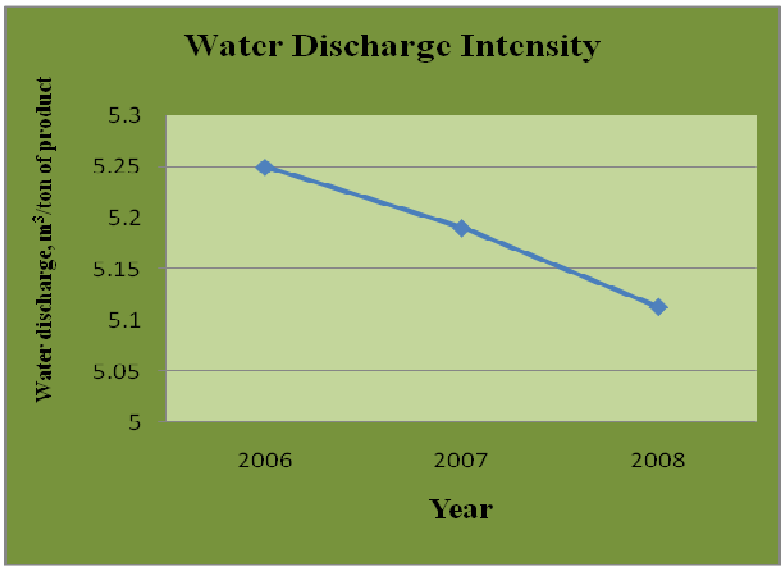
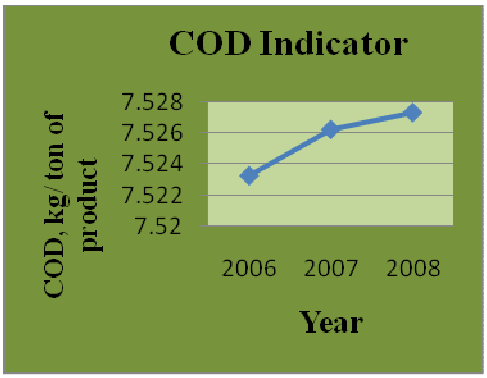
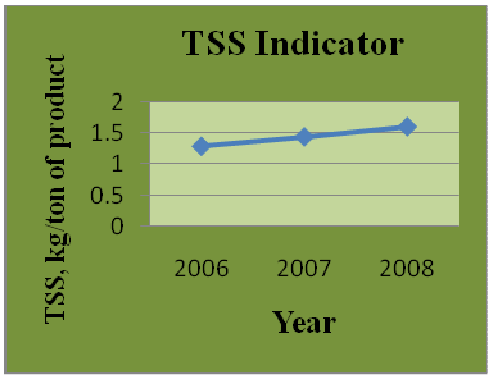


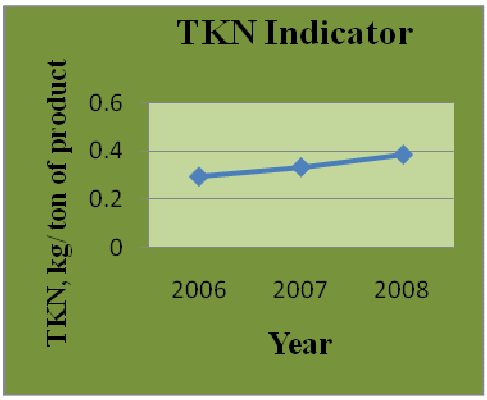
Figure 5: Graph of water discharged intensity indicator

The water discharged intensity indicator is as seen in Figure 5. There has been a considerable decrease in the amount of wastewater per kilogram of product. Water used was recycled for some processes, thus the increase in the amount of influent generated was not that extensive with the total production. This could result in a reduction cost of treatment of wastewater and hence less effluent to be discharged in the industrial wastewater system.

6.3.5 Effluent Parameters for Plant A







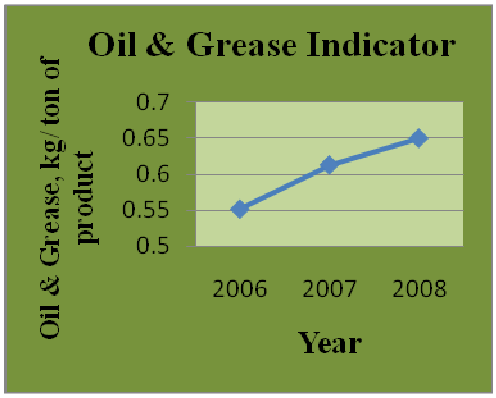


Figure 6: Graph of effluent parameters

The amount of pollutants per ton of product has increased over the past years as shown in Figure 6. This occurred due to an increased in the production raw, implying that the plant is making use of more raw materials (milk and sugar). However the plant is still complying with the sewer network regulations as explained below.

Plant A generates effluent with high loads of organic matter (average of 1450 mg/L) and TSS (average of 279 mg/L) which is typical for a dairy industry. The COD and TSS load are discharged in the sewer network, the permissible limit for both parameters being 1500 mg/L and 400 mg/L. The amount of TKN present in the effluent was around 65 mg/L and that of oil and grease; being 116 mg/L (the limits for discharged of TKN and oil & grease are 80 mg/L and 150 mg/L respectively). Compliance is achieved by Plant A for pollutants discharged in the sewer network. Therefore this shows that it is preserving the natural environment towards sustainability.

6.3.6 Factors of Social Sustainability for Plant A

Plant A holds good relations with its neighbourhood community. No complaints from the community have been received, showing that the company complies with the environmental regulations. Comprehensive training programs are offered to empower its employees to work efficiently to ensure a productive company. The plant sponsors its nearby social centre and some sport activities to maintain good relation with the inhabitants. A pre-primary school in a deprived area was helped by the plant and a cafeteria was constructed to provide lunch for poor children. The plant organizes social outings for its employees so that they are not stressed with their work load. This is a sort of encouragement for a better workforce.

6.3.7 Factors of Economical Sustainability for Plant A

For confidential reasons, the factors of economical sustainability were not available. But still the plant ascertains its profitability by certifying to the ISO 14001 environmental management system.

Plant A has already in place its own productivity efficiency indicators, which enables it to keep track of its environmental performance. The indicators are used to improve profitability, work efficiency and quality of the product and for internal reporting

6.4 Plant B – Dyeing Plant

Since Plant B is now on the move to implement the ISO 14001 Environmental Management System, the changes in the behavior of the company were studied. The sustainability factors are also discussed in the environmental, social and economical dimensions. Its policy statement was not available but still the plant ascertains that it wants the environment to be protected and least affected by its dyeing processes. The impacts on the environment are continuously being studied to reduce them and training is being given to the employees in the environmental field.

6.4.1 Factors of Environmental Sustainability for Plant B

Plant B reports that it conducts environmental audits through regular sampling and testing. The main benefit of this process is to enhance its productivity. The plant is connected to a sewer network and complies with the environmental regulations. Part of its textile wastes are sold to individuals and the rest exported abroad. The eco-efficiency elements viewed are to maximize the sustainable use of resources and to reduce the energy intensity and water intensity of its goods. For Plant B, graphs could not be plotted as only the values of the past two years were obtained. Due to lack of data, the indicators for year 2008 could not be computed. As seen from Table 4 below, the decreasing values of the energy intensity indicator (17013.12 MJ/ton of production in 2006 to 16626.43 MJ/ton of production in 2007), water intensity indicator (from 72.00 m^3/ton of product in 2006 to 70.71 m^3/ton of product in 2007) and water discharged intensity indicator (67.2 m^3/kg of product in 2006 to 66.43 m^3/ton of product in 2007) thus showing an improvement in the performance of the dyeing plant over these past two years. But on the other hand, there has been a considerable increase for the effluent parameters with an increase in production. The effluent BOD is 357 mg/L. There has been an increased in the COD values (856 mg/L in 2006 to 1145 mg/L in 2007) and TSS values (46 mg/L in 2006 to 70 mg/L in 2007) which indicates a

deterioration in the quality of the effluent being discharged to the sewer line but the plant is more or less complying with the limits of discharge (1500 mg/L for COD and 400 mg/L for TSS).

Table 4: Eco-efficiency Indicators' Results for Plant B

Indicator	Result	Result	Unit
	Year 2006	**Year 2007**	
Energy Intensity **Fuel-LPG** **Electricity**	17 013.12	16626.43	MJ/ton of production
Water intensity	72.00	70.71	m^3/ton of product
Water discharge intensity	67.20	66.43	m^3/ton of product
Effluent Parameters			
BOD	21.84	25.84	kg/ton of product
COD	57.52	76.06	kg/ton of product
TSS	3.09	4.65	kg/ton of product

6.4.2 Factors of Social Sustainability for Plant B

The plant has not received any neighborhood complaints on environmental issues to date. This is thus helping the plant to preserve its surrounding environment and its inhabitants. Seminars, picnics and football tournament are organized for its employees to feel more relaxed from work tension. Plant B sponsors community social activities and has adopted the burns unit of a hospital so that its employees and people of its locality can benefit from the services of the hospital.

6.4.3 Factors of Economical Sustainability for Plant B

The economic performance of the plant could not be tracked due to non availability of information for privacy reasons. But still, the plant informs that it has improved in its profitability leading to success. Overall, both plant A and B, did affirm that they are trying their best to preserve the natural environment. Introducing ISO 14001 has a good image on their organizations and all their workers are being trained continuously to identify environmental impacts. Hence the EMS serves as a good tool to measure their performance.

7.0 CONCLUSIONS

Environment is nowadays a key driver of innovation and of competitiveness around the world. The long term economic success of Mauritius is not possible without environmental sustainability. ISO 14000 standards provides a mechanism that links the concept of sustainable development with business practice. In most developed countries, business and industries have gone beyond mere compliance with the legislative requirements. Many are now disclosing their environmental reports publicly and promoting their CSR in response to a variety of social, environmental and economic pressures.

Sustainable production activities are mainly focused on the implementation of the environmental management system ISO 14001. Several tools are being used at the firm level to achieve ecologically sustainable development. Amongst them are the adoption of cleaner production, eco-efficiency and LCA to improve the productivity and competitiveness. Industries and businesses require indicators to measure progress.

It is believed that the case of Plant A which is an ISO 14001 certified industry has achieved success over the past years by operating in an efficient manner and preserving the environment by complying with the regulations for its wastewater disposal. The plant is having a management plan to improve its environmental performance by minimizing its resources consumption. Plant A has already implemented Cleaner Production and is now adopting life cycle assessment in order to improve its competitiveness. The workers at Plant A are continuously being trained to be kept aware about the environmental impacts. The eco-efficiency indicators' results show how Plant A has reduced its energy intensity, water intensity and water discharge intensity from the year 2007 to the year 2008. Plant A contributes to social sustainability by caring for its nearby community and its employees. The profitability of the plant is also affirmed.

Plant B also affirms that the introduction of environmental management activities following the guidelines of ISO 14001 implementation has changed the atmosphere of the company. The workers are being given environmental training. From the indicators' analysis, Plant B is also seen to have reduced its energy intensity, water intensity and water discharge intensity showing a good improvement for its performance. The plant also contributes to social sustainability and economic sustainability.

Hence this suggests a positive answer to the research question that the ISO 14001 Environmental Management System is a motivation towards

sustainable development. It would seem that the environmental management system ISO 14001 implementation and its certification process can be an effective tool for sustainable development. The EMS ISO 14001 is not only a system for environmental performance, but can also motivate manufacturing companies to adopt a sustainable society. The project also illustrates the importance of sustainability-performance measurements, whereby environmental benchmarking can be implemented as an important tool for cost reduction and quality improvement.

8.0 RECOMMENDATIONS

The authors fully recommend that the ISO 4000 tool can be a powerful tool to guide companies to improve their environmental performance. It is also recommended that fully implemented policies and procedures are not enough. To ensure compliance to environmental norms, specific indicators and targets for the short and long term must be established and monitored. Usually the monitoring of environmental aspects is ensured by the proper implementation and maintenance of well established control procedures.

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