

The Effectiveness of Implementing Environmental Management System - ISO 14001 in Food Manufacturing Companies: A Case Study of a Sri Lankan Food Manufacturing Company

K. M. S. C. Kumara

Systems Certification Division, Sri Lanka Standards Institution

Elvitigala Mawatha, Colombo 08, Sri Lanka

E-mail: konarasus@gmail.com

T. K. Weerasinghe

Centre for Environmental Studies and Sustainable Development

The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

E-mail: tkwee@ou.ac.lk

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Abstract

This paper aims to explore how an Environmental Management System (EMS) based on ISO 14001 would assist to enhance the performance of a Food Manufacturing Company. The research objectives were to assess the current environmental aspects and related impact and define mitigation measures to minimize such aspects while focusing on the applicable legislative requirements for the industry and the existing mitigation measures. Different types of waste generated during the processes were identified based on United Nations Environmental Plan (UNEP) cleaner production methodology and baseline data related to waste generation were analysed using Pareto charts. An Environmental Aspect Impact Register was prepared for each division to identify environmental hazards based on risk assessment criteria given in ISO 31010 Standard and the results compared before and after risk levels using the T- test.

Analysis of the environmental aspect impact register results concluded that implemented

mitigation measures were effective on particular causes at 95% confidence level and adopting Environmental Management Systems (EMS) in this company had made a positive impact on the identified performance indicators including environmental performance indicators and financial indicators. It further recognized that there was more positive impact on water saving as the quantity of water used in the manufacturing processes had already reduced.

Keywords: Environment Management System, Food Manufacturing Company, Environmental Performances

1. Introduction

Environmental issues have become a global concern in the recent decades. Most of the environmental issues and challenges are related to continuous consumption of materials, energy and water by companies, resulting in the depletion of these resources. In addition, uncontrolled emission of toxic gases, wastes and effluents into soil, water and air by the companies also has adverse effects on the environment. Climate change, global warming, ozone depletion and nitrifications, are some of the well-known consequences of these negative environmental impacts of activities of manufacturing industries on the environment.

The Environmental impacts by companies are now attracting serious concerns from the public, government, business, media and other stakeholders. The need for changes in environmental legislation and standards has begun to gain greater acceptance more prominence in public debates. Many environmental pressure groups have gradually emerged calling for a healthier environment (Bohdanowicz, 2003).

There has been a growing trend for companies to become certified with a formal Environmental Management System (EMS). Much research has been carried out on the benefits of environmental management systems which have typically been on companies either manufacturing or having an industrial background (Biondi *et al.*, 2000). However, Howes *et al.*, (2006) argues that an ISO certified company delivers real environmental improvements, usually as a byproduct of the attention that it focuses on material use and waste management. In order to address the skepticism surrounding the effectiveness of the standard as a tool to enhance sustainable environmental management, research was carried out at USEA in Zimbabwe. Moreover, Yarnell (1993) argued that employee training and awareness were key strategies in the implementation of an integrated EMS and ultimately an improved corporate environmental performance. The ISO 14001 standard defines an EMS as “a management tool enabling an organization of any size or type to control the impact of its activities, products or services on the environment”. The ISO 14001 establishes a framework for managing the environmental aspects of an organization through the development of formal processes and procedures. The standard contains 17 key elements grouped into five major areas: environmental policy, planning, implementation and operation, checking and corrective action, and management review. A unique feature of the system is that it is developed to be appropriate for any company, regardless of industry, size, location, and the level of their environmental responsibilities. The ISO 14001 is a voluntary, consensus-based, and market-driven standard (Kloepfer, 1997).

Food processing industries have a large impact on the economy and the country in general. The concentration of the industries in such a small area has aggravated the environmental stress caused by industrial activities. Some of the major problems include industrial liquid and solid waste, air and water pollution. An organization should ensure that any significant impact is appropriately controlled and/or reduced. The impacts and aspects should then be checked against a legal register to establish which items of environmental legislation are applicable to the organization when implementing an EMS.

Environmental performance should therefore be measured against the organization's control of its operations and how these are tied into and comply with any relevant environmental legislation along with the recorded reduction and minimization of overall environmental impact to enhance environmental performance while applying such mitigation measures. In theory, an adequately scoped EMS should encompass all impacts. Finally, that will evaluate the extent of compliance with the applicable legislative measures with respect to environmental pollution.

Several studies that have been conducted related to ISO 14001 and waste reduction includes a study by Rondinelli and Vastag (2000). In their study, they found that ISO 14001 certification encouraged employees to think of material recycling and to increase their commitment to sustainable management. Additionally, during the period following the achievement of ISO 14001, the amount of waste that had to be sent to landfills was reduced from 7608 tons to 4960 tons within three years and the waste cost of production per ton of aluminum dropped from \$8.33 to \$6.50. Most of the ISO 14001 studies do not focus on solid waste reduction, but on comprehensive environmental performance improvement or other aspects (Matthewe, 2011). ISO14001 and its benefits to organizations are well researched. The most immediate benefits of the approach are that its correct use will lead to more efficient use of key energy types and materials. This in turn will lead to a reduction in the waste outputs that an organization will produce and the consequent reduction of costs (Pinero and Mason,1998). Another key benefit of ISO 14001 is that it is a well-recognized international standard and the ISO itself is well respected in general. Consumers in general who are knowledgeable and have an awareness of ISO 14001 may feel assured by conformance to the standard and its ethical intentions. ISO 14001 also gives an organization the mandate to control its environmental aspects and impacts on its own processes, products, and services. It could be said that in many circumstances nobody knows their business and resulting wastes better than the organizations themselves. This allows the internal experts to control the situation not some outside body who does not understand their business and intricacies (Marsh and Perera, 2012).

1.1 Area of Investigation

In this research, Edinborough Products (Pvt) Ltd (EPPL) has been selected, as it has been manufacturing different types of food products by using natural raw material. The same company has a filling plant of bottled drinking water inside the same premises which produces large quantities of bottled water in different volumes. Further, it has an internal PET (Poly Ethylene Tetrathalate) bottle production plant which produces nearly 100,000 PET

bottles per month, two furnace oil boilers, and two diesel generators causing number of environmental impacts.

As a food processing company, Edinborough Products Pvt Ltd (EPPL) also has a significant impact on the environment on account of solid wastes, even though efforts have been made to reduce waste generation. As a legal obligation, it is imperative that the Environmental Protection License (EPL) should be obtained for the entire manufacturing plant.

Edinborough Products (Pvt) Ltd is now considering sustainability and environmental management issues to the extent of including them in the objectives and goals of the organization due to economic and non-economic incentives. The organization is now adopting Environmental Management Systems (EMS) and has already obtained the International Organization for Standardization (ISO) certification for Quality Management System (ISO 9001) and Food Safety Management System (ISO 22000) which basically covers the management aspects including policy, internal audit and the management review.

Since the EPPL has already obtained the Environmental Protection Licenses (EPLs) from the Central Environmental Authority (CEA), Sri Lanka, it has already established mitigation measures with respect to the pollution caused by wastewater and contaminated emissions due to the furnace oil boilers. They also have a well-functioning Sewage Water Treatment Plant (SWTP) and the verification of discharge quality has been done by the CEA nominated external laboratories as per the stipulated frequencies given in the annex of the EPL. Also the air emissions by the furnace oil boilers have also been monitored for particulate matter (PM), CO and SO₂ as per the regulation with external laboratory testing as requested by the CEA.

The general purpose of this paper is to study the impact of ISO 14001 and other significant factors on solid waste generation rates of organizations. The present research mainly focuses on how solid waste management and cleaner production aspects based on ISO 14001 would enhance environmental performance of a food manufacturing company so as to meet customer demand in a sustainable manner.

2. Methodology

Different types of solid waste generated were identified during company production process under two categories: organic and non-organic waste in kilo grams per month from February to August 2016. According to the UNEP cleaner production methodology, baseline data related to waste generation including the usage of water by different processes were collected and analyzed with the help of process flow diagrams. Pareto analysis was used to identify the departments which contribute 80% of solid wastes. Generated waste was categorized and prioritized using Pareto principles (that specifies an unequal relationship between inputs and outputs) to identify the main hazards which cause a significant environmental impact.

Environmental management programmes were planned and implemented after identifying the initial status of wastes with the aim of improving environmental performance. An Environmental Aspect Impact Register was prepared for each division to identify environmental hazards based on Risk Assessment criteria given in ISO 31010. All applicable legislative requirements have been reviewed and evaluated by focusing on a related

regulatory frame under the National Environmental Act (NEA) of Sri Lanka. An assessment of effectiveness of mitigation measures was done using the t-test (at 95%). A comparative Pareto analysis was also conducted to ascertain in the reduction of amount of waste generated after implementing the mitigation measures and the cost incurred due to waste and waste management activities were compared.

3. Results and Discussion

Waste production baseline data are given below in Table 1.

Table 1 - Amount of Waste Production per month

Month	Amount of waste production per month (kg)		
	Organic	Non-organic	Total
February	1004.26	159.13	1163.39
March	1277.98	202.51	1480.49
April	513.32	81.34	594.66
May	1004.87	159.23	1164.09
June	843.18	133.61	976.79
July	737.47	116.86	854.33
August	744.76	118.01	862.78

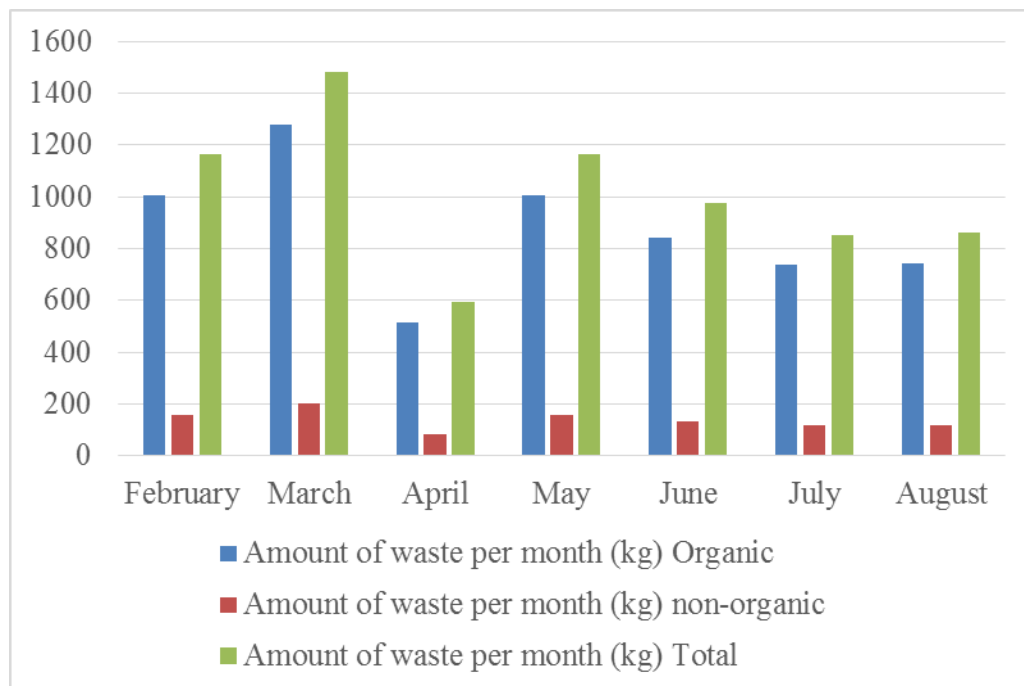


Figure 1- Amount of Waste Production per Month from February to August 2016

When analyzing the data with regard to departments' contribution to waste generated, the highest amount of waste (15342.2 kg per month) was produced by the soya department and it was nearly 66% of the total waste production of a month. Apart from that, the factory garden and the jam factory also produced a considerable amount of both organic and non-organic waste. Waste soya from the soya factory was the highest amount of organic waste produced

from factory operation. Fruit peels from the jam factory and grass cuttings from the factory garden were also in considerable amounts. From among non-organic waste amounts, High Density Polythene (HDPE) was the highest during the production process (Table 2).

Table 2 - Total weight of waste generated from each department

Responsible Department	Total weight of Waste generated (kg)
Jam Department	1821
Packing Area	26
Factory	600
Laboratory	13
Soya Factory	15342.2
Water Plant	220
Finished Goods Store	265
Kojji Room	17
Grinding Room	11.56
Vinegar Yard	57
Pet Plant	153.06
Maintenance Workshop	0
Kitchen & Canteen	447
Store No 1	140
Store No 2	12
Main Office	23.2
Factory Garden Waste	4120

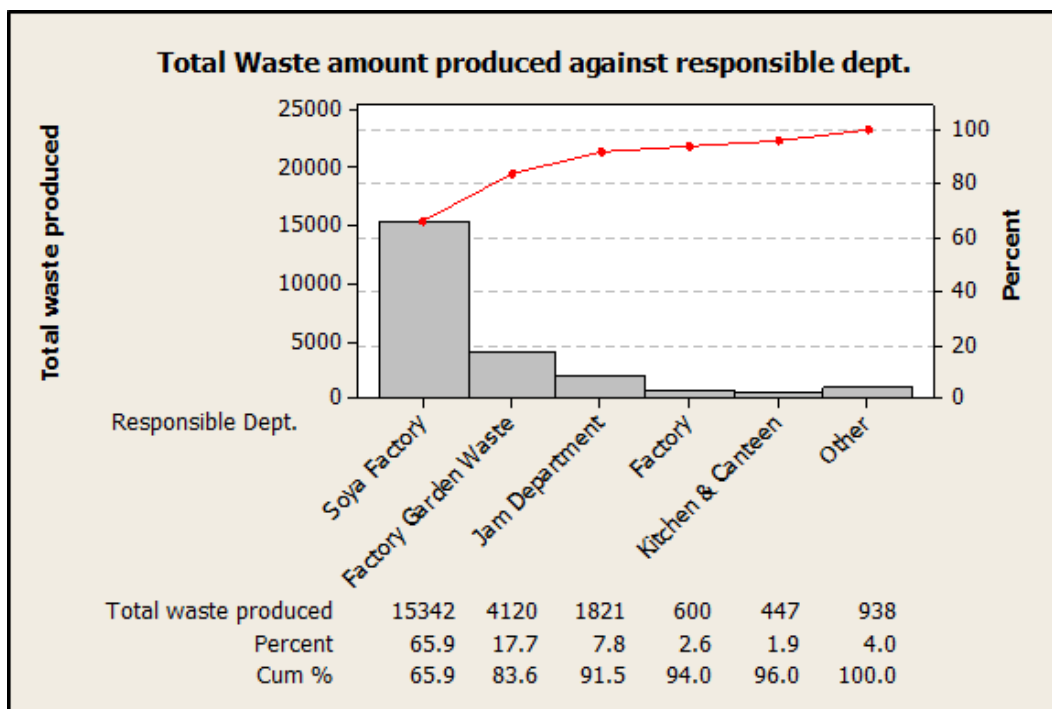


Figure 2. Pareto Chart for total weight of waste generated per month from different departments

After analyzing the baseline data according to UNEP cleaner production methodology and using Pareto analysis, the main departments which cause a significant impact on the environment were identified. The soya factory and the factory garden generated the highest amount of waste representing 80%. Therefore, it is clear from the data that the cumulative percentage of waste has reached 83.6% thus indicating significant environmental impact due to those two departments with respect to solid waste generation (Fig. 2).

From the total waste produced from the factory, more than 80% was organic or degradable waste (Fig. 1). Composting of that waste is an acceptable mitigation measure to improve environmental performance and the compost produced could be used for organic farming within the same premises.

A newly constructed containment tank for furnace oil storage is another mitigation measure for oil waste management. Further, awareness programmes for factory workers could also be conducted to minimize waste generation and promote effective waste recycling. In addition, segregation mechanisms have also been implemented as the most significant mitigation measure for waste management.

Other than waste generation, the total water usage has also been taken into account as it is a very important environmental factor. Water which was mostly used for washing and cleaning purposes sometimes mixed with detergents, may become a major source of impact on the environment. To minimize such an environmental impact, the quantity of detergents used for cleaning purposes was revalidated and sent to a wastewater treatment plant for clean up before discharging to the environment.

Further, in order to achieve the target for water usage, several programmes have been conducted and process improvements have been implemented. Special awareness has been generated with posters displayed at relevant places highlighting the proper usage of water in an effective manner.

Flow meters were also installed for each of the production processes in order to monitor their water usage. Spray guns were provided instead of normal hoses to achieve minimal usage of water for internal processes resulting in a significant reduction of water usage. Further, it enhanced the Sewage Water Treatment Plant life time as well.

When preparing the Environmental Aspect Impact Register, the guidance given in the ISO 14001 was used and risk assessments were carried out as per the guidance given in the ISO 31010. When analyzing these aspects, it is clear that the implemented control measures such as composting of organic solid waste significantly reduced the risk value from 10 to 5 having a t value of 0.000 at 95% confidence level. This result clearly indicated that implemented mitigation measures were effective.

The effectiveness of the EMS has been studied throughout the world by different researchers; by analyzing environmental aspects and impact. A study observed that electronic firms that adopted ISO 14001 were able to improve up to the industry best practices (Russo, 2000).

Another study conducted in the auto-motive supply sector before Ford and General Motors

required their suppliers to be ISO certified and found minimal reductions after ISO 14001 adoption. In terms of toxic releases and compliance with regulatory requirements, environmental performance was about the same in facilities that had adopted EMSs under ISO 14001 and those that had not (Matthews, 2001).

Eleven large companies in Guadalajara, Mexico, signed a voluntary agreement with Mexico's Ministry of Environment and Natural Resources to mentor small suppliers in implementing EMSs. Within three months of completing the formal EMS training based on the ISO 14001 model, over 80% of the participating companies in the study had reduced their environmental releases, nearly 70% had improved their work environment, and over 50% had improved their economic performance (Successful Practices of EMS in SMEs- North American Perspectives, Commission of Environmental Cooperation, 2005).

The project report noted that the vast majority of the "root causes" of significant environmental problems identified by the firms could be addressed through changes in management practices such as improved maintenance, improved procedures and better training. Relatively few of the solutions, according to the report, required significant capital expenditures (Lexington Group, 2002).

Therefore, it is clear that implementing effective mitigation measures after analyzing the impact and related aspects could achieve a successful output.

4. Conclusion

When analyzing the risk factor mark allocation in the environmental aspect impact register , it is clear that the risk marks allocated for each environmental aspect before implementing defined control measures are always higher than those after implementing. This finding basically concludes that the mitigation actions implemented by the organization show an effective reduction of environmental impact. Based on the t value, it is clear that the reduction is significant.

This study further highlighted that the control measures taken such as the establishment of containment oil tanks for furnace oil storage have improved environmental performance as the ISO 14001 management tool allows an organization of any size and type to control the impact of its activities, products or services on the environment.

A considerable financial benefit has also been achieved by EPPL after implementing ISO 14001. After safe categorization and composting of solid waste, the company has stopped the outsource operation and has gained financial outcome of nearly Sri Lankan Rs. 1.2 million. Furthermore, Edinborough Products Pvt. Ltd has gained third-party recognition as well as ensured environmental sustainability while improving performance.

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