



Uncovering industrial symbiosis potentials in a small island developing state: The case study of Mauritius



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ABSTRACT

Small island developing states (SIDS) face a serious issue of sustainability as far as waste management within the industrial sector is concerned. This paper makes an attempt at addressing the eventual practice of industrial ecology in SIDS with Mauritius as a case study. Three major polluting industries namely the slaughterhouse, edible oil refinery and the scrap metal recycling plant have been considered with a particular focus on the recycling of electric arc furnace slag as concrete aggregates. Along with the potential areas of applications for the different waste materials, this research has also addressed the benefits, barriers and factors for implementing industrial symbiosis projects within SIDS. The most striking benefits are the preservation of the fauna and flora of the island and reduced dependency on developed countries for the importation of raw materials while the absence of a landfill disposal fee for non-hazardous wastes and lack of awareness of industrial symbiosis projects have been identified as the main barriers. To overcome these barriers, a shift from manufacture-consume-dispose to manufacture-consume-recycle-manufacture is recommended. This study concludes that if a sustainable island is anticipated in the future, a combination of recycling options along with all necessary factors such as technology, funding from international organisations, regulatory framework and involvement of stakeholders, general public and non-governmental organisations is required. Ultimately, this would result in the establishment of networks among source and sink industries, thus being in harmony with the environment.

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1. Introduction

Small island developing states (SIDS) are countries characterised by their small size, remoteness and insularity, disaster proneness and environmental fragility (Briguglio, 1995) with the tourism industry playing a 'catalytic role' in these islands (Hampton and Jeyacheya, 2014). With respect to their geographical locations, the 39 SIDS are categorised into three groups namely Caribbean SIDS, Pacific SIDS and Atlantic (or Africa), Indian Ocean, Mediterranean and South China (AIMS) SIDS (UN-DESA, 2016). Due to their high dependence on developed nations for the importation of resources, land scarcity with respect to the construction of sanitary landfill and lack of appropriate know-how and technologies for efficient waste management, SIDS face a serious issue of sustainability as far as waste management within the industrial sector is concerned. One of the solutions to these problems would be initiating industrial symbiosis projects by involving in waste exchanges. Industrial

symbiosis seeks to encourage cooperation among firms such that resource flows and environmental performances are improved (Chertow et al., 2008).

Industrial symbiosis projects have been quite scanty in SIDS. However, growing interests are now being shown to its implementation. Several international organisations are currently funding industrial symbiosis projects under the 'Switch Africa Green Project' in African countries namely Burkina Faso, Ghana, Mauritius, Kenya, South Africa and Uganda (UNEP, 2013a). While there are a myriad of studies focussing on different concepts and case studies of industrial ecology; there are surprisingly only very few studies conducted in SIDS. Owing to its dense pharmaceutical firms, Puerto Rico has been the focus of the majority of studies (Ashton, 2008; Chertow et al., 2008; Deschenes and Chertow, 2004). There is also a study aimed at giving a SIDS perspective to industrial ecology within the edible oil refinery sector in Mauritius (Mauthoor et al., 2015). In Fiji, a successful integrated biosystem has been implemented around the vegetables production, farming and sugar processing industries (Klee,

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1999) while other studies undertaken in Singapore (Chertow et al., 2012) and Hawaii (Eckelman and Chertow, 2009) only used material flow analysis to assess an industrial ecology approach.

Previous works of the author concentrated mainly on the recycling opportunities of wastes from a particular industry while this current study would be addressing the potential of establishing industrial symbiosis at three major polluting industries in an AIMS SIDS with Mauritius as a case study. However, even though symbiosis transactions involve by-product exchanges, utility/infrastructure sharing and joint provision of services (Chertow et al., 2008), the focus of this paper would be the trade of by-products in order to alleviate the waste load on the unique landfill in Mauritius, which is reaching saturation. At present, there are several oppositions with respect to waste-to-energy plants in Mauritius with the promoters unable to guarantee proper pollution control measures. Besides, the national composting plant which processes unsorted municipal solid wastes, is able to handle only around 15% of waste collected (Mohee et al., 2012; Statistics Mauritius, 2014a). There is also the fact that green practices within the industrial sector are now gaining increasing interest across the globe. Hence, there is really an urgent need to find industrial waste management options appropriate within a SIDS context since the current options are not sustainable. Therefore, this paper is investigating the potential of adopting industrial symbiosis as a solution to the mounting waste problems in Mauritius by diverting wastes from one process as raw materials to another unit operation.

This study would allow academics, consultants and interested parties to think within the boundary of a SIDS; that is without seeking foreign technology and expertise which are rather costly. By determining the characteristics of wastes/by-products and knowing the physical and chemical requirements of raw materials used locally, these people would be able to propose the diversion of particular wastes/by-products to end-industries instead of practising landfilling. On a practical point of view, this would result in several benefits discussed in Section 3.4.

2. Methodology

Desk analysis was first carried out to have an overview of waste management in Mauritius and industrial symbiosis practices in SIDS. Consequently, with reference to three criteria namely industrial waste audit reports, hazardous waste inventory and national issues (Mauthoor et al., 2014), three major polluting industries were identified whereby the feasibility of using wastes from these industries as resources in other industries were assessed. Recyclers, officers at the Ministry of Environment, Sustainable Development, Disaster and Beach Management and environmental officers at these major polluting companies were interviewed to discuss on aspects associated with the implementation of industrial symbiosis. The main aspects covered were how to share data and information, a platform to gather stakeholders, the government/private sectors/non-governmental organisations/public involvement, why the need for industrial symbiosis and factors which might hinder the implementation of industrial symbiosis. With respect to the industrial infrastructure present in a developing island, discussions from the stakeholders were categorised into the benefits, barriers and factors for enabling the practice of industrial symbiosis. Finally, from these analyses, a framework for adopting industrial symbiosis in the SIDS of Mauritius was put forward.

3. Results and discussions

3.1. Area description

The Republic of Mauritius is a group of islands located in the South-West of the Indian Ocean and consists mainly of Mauritius and Rodrigues along with several other small outer islands. Mauritius had a population of 1,219,265 as at 1st July 2014 (Statistics Mauritius, 2016) and its area is 1865 km² with 43% allocated to agriculture, 25% to buildings, 25% to forests and the remaining comprising of roads, reservoirs and abandoned cane fields (Statistics Mauritius, 2014b). The manufacturing sector is the predominant industrial group in the Mauritian economy, representing 16.9% of the gross domestic product in 2013 and experiencing a growth of 4.5% compared to the previous year (Statistics Mauritius, 2014c). With the main pillars of the economy being the sugar, textile, tourism and the financial services (AfDB et al., 2012), the country has undergone an expansion in its industrial activities. This is evidenced from the index of industrial production which stood at 115.9 in 2013, representing a rise of 4.1% with reference to the year 2012 (Statistics Mauritius, 2014c).

3.2. Industrial waste management in Mauritius

Over the last decades, an increase in industrialisation has consequently resulted in a rise in the amount of industrial wastes. The per capita waste landfilled was 0.23 tons for the year 2000 and rose to 0.33 tons in 2014 (Statistics Mauritius, 2015a, 2014b, 2001). The industrial waste audit forms/reports which came into operation as at April 2009 (Ministry of Environment and Sustainable Development, 2013) serve as the only tool for managing industrial wastes since there is no database for regulating the inflow and outflow of industrial wastes within the developing island of Mauritius. Industrial wastes are generated from manufacturing units as represented in Fig. 1. They undergo little processing (For instance, waste paper is shredded before being collected) and segregation (For example, waste paper/plastic/aluminium cans are stored in appropriate bins) prior to recycling or ultimate disposal.

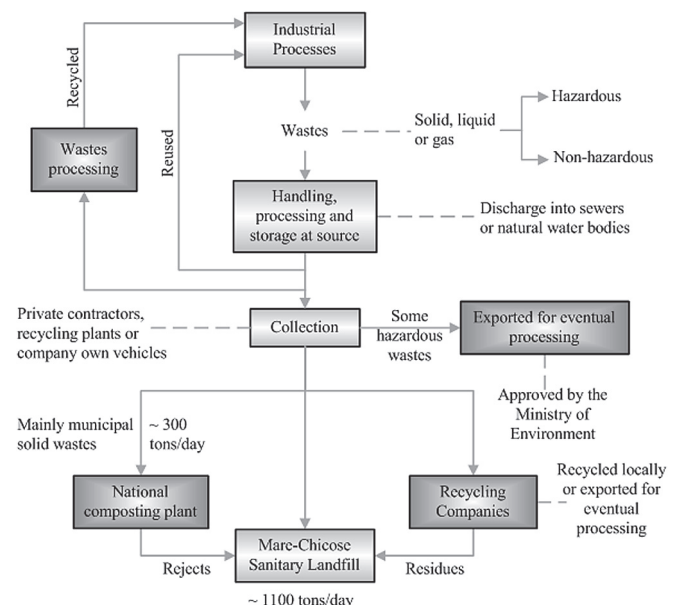


Fig. 1. Industrial waste management system in Mauritius.

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