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Faculty of Graduate Studies

35/30, Prof. Stanley Wijesundara Mawatha, Colombo 07, Sri Lanka

Tel: (+94) 011 205 56 56, (+94) 0112502127

(+94) 011 205 58 60, (+94) 011 205 58 61

Fax: (+94) 011 25 91 395

E-mail: office@fgs.cmb.ac.lk

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Adoption of Green Practices in Manufacturing SMEs: Some Lessons from Kochi, Kerala, India

Kumudinei Dissanayake

Nayani Melegoda

S. P. Premaratne

Sudheera Ranwala

2019

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Adaptation of Green Practices in Manufacturing SMEs: Some Lessons from Kochi, Kerala, India

Kumudinei Dissanayake

Department of Management & Organization Studies, University of Colombo, Sri Lanka

Nayani Melegoda

Faculty of Graduate Studies University of Colombo, Sri Lanka

S. P. Premaratne

Department of Economics University of Colombo, Sri Lanka

Sudheera Ranwala

Department of Plant Science University of Colombo, Sri Lanka

Abstract

Adopting green practices in the manufacturing sector has become a requirement for achieving sustainability goals. Even though manufacturing small and medium scale enterprises (SMEs) play a major role in the industrial sector in Sri Lanka, their contribution towards reaching a green economy is not well identified. This kind of identification needs a thorough prior knowledge of possible green manufacturing practices in the local context. This paper aims to examine the green practices, challenges and strategies, and the required institutional support for implementing and sustaining such practices in manufacturing SMEs. It examines the said phenomena in an area similar to local context, that is Kochi city in India, while approaching a set of stakeholders. The study takes a deductive approach, deriving its analytical framework from the review of literature. A set of green practices, the challenges to be anticipated and the institutional and policy support required in implementing and sustaining green practices in manufacturing SMEs are identified as lessons to be learned. It concludes that the successful implementation and sustaining of green practices in manufacturing SMEs need the own will and drive of owners and employees for greening efforts, supported by the government intervention for promoting and ensuring sustainable green practices.

Keywords: Challenges, Green practices, India, Kochi, Lessons, Manufacturing SMEs

1. Introduction

Green manufacturing has been a keyword in manufacturing entities in recent times due to its emphasize on the concepts of ‘sustainability’ and ‘safe environment’ which encapsulate a wide range of stakeholders, including future generations. As such, ‘greening’ of the manufacturing entities may lead to create a green economy which could beget benefits to the entire society. Thus, irrespective of their stage of development, many countries in the globe are adapting green practices in manufacturing towards the achievement of sustainability goals. There are evidences that India and Sri Lanka are among them (Dayaratne & Gunawardana, 2014; Sajan, Shalij, Ramesh, & Biju, 2017; Thanki & Thakkar, 2014).

SMEs which contribute to a huge portion of the gross domestic product (GDP) of developed and developing countries can claim no escape from their contribution to a green economy. Previous studies have particularly highlighted why SMEs should adopt green practices or green manufacturing, based on variety of reasons. There are numerous pull factors as well as push factors (Stopper, Kossik & Gastermann, 2016) and positive stands and negative stands, among these reasons subsequently. SMEs, when compared to large organizations, are more prone to legislator requirements and stakeholders pressures (Esty & Winston, 2006), thus pulling them towards the adoption of green practices. At the same time, SMEs are significant contributors to the overall emissions and releases which are negatively affecting the environment (Parker et al., 2009; Yacob et al., 2013), thus resultantly they are pushed towards adoption of green practices.

Some scholars stand on a positive view when justifying the SMEs’ need of ‘going green’, arguing that “consumer demand for environmentally friendly goods and services as well as the escalating costs of waste disposal have triggered environment-related business opportunities for the SMEs” (Yacob, Wong, & Khor, 2019, p. 6). Yacob et al. maintain that those SMEs which are successfully responding to market forces and are innovative enough to reduce waste generation and environmental cost will gain a competitive advantage. Thus, the unique nature and character of SMEs (flexibility and innovation) have placed them in a better position to implement green practices (Esty & Winston, 2006). However, SMEs’ negligence of green efforts is also highlighted by researchers on the grounds that they perceive that the responsibility of protecting the environment is completely at the hands of local authority and planners, rather than at their own (Vernon et al., 2003).

In addition to these, the existing knowledge indicates that the aspirations of SMEs towards ‘being green’ and their real actions towards the same are not aligned due to some important

factors such as lack of education and training (Williams & Schaefer, 2013). Further, the complicated nature of balancing both operational or financial performances and sustainability performance of SMEs (Sajan, Shalij, Ramesh, & Biju, 2017) and the lack of adequate knowledge and tools required to implement green practices in their operations (Burke & Gaughran, 2007) have been greater constraints those leading SMEs neglecting or stepping down from adopting green practices in their operations.

2. SMEs in Sri Lanka

The study found that SMEs have dominated Sri Lankan industrialization during the past decades. In 1983, SMEs industrial establishment accounted for 98%, while in 2003/04 such establishments were 90.8%. Economic Censes in 2013/14 indicated that SMEs play a significant role in Sri Lankan industrialization accounting for 98.5% of industrial establishments. As numbers, SME establishments became double during 2004 to 2014 time period, while the number of large establishment decreased from 1402 in 2004 to 720 in 2014¹. In 1983, the number of employments in SMEs was 29 % of the total employment of industrial sector. It improved to 45.7 % in 2013/14 showing a significant increase. Employment in SMEs in 2014 was 633,933 which is 50% higher than the number of SMEs' employment in 2004. SMEs value additions to the economy in 2004 and 2014 are 31.6% and 31.1% respectively.

Table 2.1- Distribution of Establishment and person engaged (non-agricultural Economic Activities) - 2013/2014

	No of establishment (all) (raw %)				No of persons engaged (raw %)			
	Total	Industry	Trade	Service	Total	Industry	Trade	Service
Micro	935736 (91.7)	236741 (25.3)	393009 (42.0)	305986 (32.7)	1338064 (44.6)	362615 (27.1)	523183 (39.1)	452266 (33.8)
SMEs	81531 (7.9)	24785 (30.4)	20709 (25.4)	36037 (44.2)	917107 (30.5)	457636 (49.9)	190758 (20.8)	268712 (29.3)
Large	2414 (0.2)	763 (31.6)	891 (36.9)	760 (31.5)	747948 (24.9)	483174 (64.6)	73299 (9.8)	192223 (25.7)
Total	1019681	261038	419089	340574	3003119	1221068	768799	1015054

¹ However, this trend can be observed everywhere in the world since industrial organizations were changed 'hierarchy to 'market' and then market to further 'network'

	(100)	(25.6)	(41.1)	(33.4)	(100)	(40.6)	(25.6)	(33.8)
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DCS, 2015

About 8% of non-agricultural economic activities come under SMEs (table 01). SMEs generate about 30.5 % of total non-agricultural employments. Among the 30.5% of total SME employments (917107), about 50% employment is generated in industrial sector. The other two sectors, trade and service, generate 20.8% and 29.3% employment opportunities respectively. Overall, 25.6% of the total non-agricultural economic establishment are in industrial sector, 41.1 % are in trade sector and 33.4 % in service sector. Meanwhile, only 30.4% of non-agricultural SMEs are in industrial sector. The highest numbers of SMEs are in service sector, representing 44.2% of total SMEs.

According to DCS (2017), SME formal establishments are only 37% of the total industrial establishments (Table 2). SMEs sector contributes to employment generation only 3.3%. SMEs are more labour intensive than large firms but they do not provide ‘decent and attractive’ jobs particularly for educated and skilled labour force.

Out of total outputs generated in the industrial section, SMEs share is only 2.2%. Though it is claimed that SMEs contrite value addition, the results show that SMEs contribute only 2.7 % of total industrial sector value addition. When a worker in a large firm generates Rs 100 value addition, a worker in SMEs generates only Rs 80.10. Productivity of the SME sector is also low in comparison with that of large firms.

Table 2.2 - Size of SME (formal establishments)

	All	SME*	%**
No of establishments	5616	2083	37.1
Persons engaged	916168	30645	3.3
Employees	907974	27388	3.0
Salaries & wages (Rs)	290164302992	7775270859	2.7
Value of outputs (Rs)	3756789324119	84101875391	2.2
Value added (Rs)	1612553572452	43822415705	2.7
Salaries per person (Rs)	316715.17	253720.70	80.1
Value of output per persons (Rs)	4100546.32	2744391.43	66.9
Value added per person (Rs)	1760106.85	1430002.14	81.2

*less than 25 persons engaged, ** % out of total formal establishments.

Source: DCS 2017

Table 2.3 shows per person contribution of large and that of small firms. For examples, when a person in a large firm earns Rs 100, a person in a small firms gets only Rs 0.79. In terms of value of output per person, the ratio is 1: 0.662 while the ratio for value added is 1: 0.807. These figures clearly indicate that the productivity as well as the contributions of small firms to outputs and value added are far below to the contributions of large firms.

Table 2.3- Comparison between large and small business firms

Indicators	Firms 25 or more persons engaged	Small firms*	Ratio**
Salaries per person (Rs)	318895.20	253720.70	0.796
Value of output per persons (Rs)	4147478.33	2744391.43	0.662
Value added per person (Rs)	1771530.68	1430002.14	0.807

*less than 25 persons engaged, ** Ratio large to small.

Source: DCS 2017

A large proportion of these establishments and employments is found to be concentrated in three groups of industries: a) food, beverages and tobacco, b) textile, apparel and leather products, and c) non-metallic mineral products. More than 70 percent of small enterprises were to be found in these sectors in 2013 accounting similar percentage of employment. This pattern is almost identical to what prevailed in 1983, which shows that SMEs in Sri Lanka has experienced limited diversification in the past three decades.

Another important feature of the role of SMEs is its geographical concentration. Majority of SMEs in Sri Lanka dispersed in the Western Province. SMEs in North Western Province have developed significantly compelling the second important province that dispersed SMEs placing the Southern Province into third province in 2013/14. However, SMEs have developed only four provinces (Western, North Western, Southern and Central) while the rest of six provinces have contributed in low percentages.

In Sri Lanka, some categorize SMEs under conventional and non-conventional sectors. The contribution to GDP from conventional sector is very low. It is represented by the industries such as mining, pottery, handloom industry, brass making and spice industry. Majority of GDP is contributed by non-conventional SMEs having high profit margins. It is represented by information technology related appliances, apparel industry, making ornaments, flower nurseries,

restaurants etc. However, SMEs in Sri Lanka are still far behind the SMEs of the 4th Industrial revolution and of global production networks. Sri Lankan SMEs are not characterized by high efficiency, high tenacity like SMEs in Taiwan or South Korea, which are the advantages of economic development in these countries.

Overall, SMEs in Sri Lanka have performed poorly. Scholars have studied the reasons for the poor performance of SMEs in Sri Lanka in different perspectives. Considering the existing literature, Levy (1993) studied some constraints which are categorized as financial constraints, regulatory constraints and cost related constraints. The White Paper (2002) prepared by Task Force for Small and Medium Enterprise Sector Development Programme has identified the major constraints that are critical for the SME development in Sri Lanka. In addition, Aberatne (2005); Lakshmen et al. (1994); Lakshmen and Abeyratne (1998); Priyanath and Premaratne (2014); Wickremasinghe (2011) discussed both policy level and industry level constraints including adverse economic policies, inadequate market demand, problems of access to credit, problems of raw material supply, rigid and unfavourable regulations, lack of infrastructure and utilities, lack of business development services, lack of information.

Thus, SMEs need to comply with green practices on the one hand to counter the voices raised by internal stakeholders for waste reduction, elimination of inefficiencies, and employee health and safety measures, and the other hand in response to the institutional pressures flowing from the government compliances, consumer reactions, and general public concerns (Wadhwa, 2014). In addition to this, Manufacturing Matters (2011) reports that “greening of manufacturing is essential to any effort to decouple environmental pressure from economic growth” (p. 6). SMEs operating in Sri Lanka also experience pressures from numerous stakeholder groups for adopting green practices in their manufacturing systems and processes. However, the greening efforts of the SMEs in Sri Lanka, their failures or success stories, and the problems and issues associated with green manufacturing etc. are yet to be examined comprehensively at individual and national level in the country.

A comprehensive base knowledge on the green initiatives, green practices, challenges and strategies in implementing and sustaining them in SMEs, gained from the perspective of diverse stakeholders, is required for understanding the ground realities of the same at the local context. Thus, present research aims to study this phenomena in a research context which is similar to the locale, and still rich with manufacturing SMEs those well initiated and adopted green practices during the past. Consequently, Kochi city, in Kerala, India is selected as the research site of the present study.

There are ample studies, conducted all over the world, reporting important aspects of green practices and green manufacturing in SMEs. Some of the highlights are as follows. Links between lean and green manufacturing have been examined through empirical as well as review studies (Hartinia, & Ciptomulyonob, 2015; Miller et al., 2010; Sawhney et al., 2007; Wadhwa, 2014). The implementation phase of green manufacturing has gained research attention in developing and developed contexts (Ajin et al., 2015; Arun & Noble, 2017; Matt & Rauch, 2013). Green initiatives, lean manufacturing and environmental sustainability has also been researched extensively (Sajan et al., 2017; Stopper et al., 2016; Tiwari & Tiwari, 2016; Yacob et al., 2019). Moreover, green supply chain management activities and performance (Dubey, Bag & Ali, 2014; Dües et al., 2013; Mafini. & Loury-Okoumba, 2018) also can be noted as a well-attended research agenda of contemporary times. One observation made in the literature review is that the implementation phase of green practices or green manufacturing in SMEs has been devoted more attention in the existing literature, rather than looking into the sustaining of the already adopted green practices in such enterprises. At this juncture, present study focuses attention on both adoption and sustaining of green practices in SMEs. Further, survey has been the method of enquiry, combined with quantitative analysis in most of the past research into manufacturing SMEs, rather than deploying on-site exploratory visits for gaining deeper understanding of the ground realities in the green operations of SMEs (e.g., Mafini. & Loury-Okoumba, 2018; Sajan et al., 2017; Yacob et al., 2019). However, a qualitative approach into several case firms is considerably imperative and promising in an ‘applied research’ project of an exploratory nature.

On these grounds, the research questions raised to answer in the present study are as follows: (a) how the green practices have been adapted by the manufacturing SMEs in Kochi, (b) what are the challenges encountered in adapting green practices by manufacturing SMEs in Kochi, and how they have strategized to overcome them, and (c) what are the lessons can be learnt through above answers. Thus, the objectives of this study are three-fold: (a) to explore the green practices adopted by manufacturing SMEs in Kochi, (b) to examine the challenges encountered and strategies used/ designed to overcome such challenges at individual and institutional level in Kochi, and (c) to draw lessons for green adaptation in manufacturing SMEs in Sri Lanka (or similar other contexts).

The paper is structured as follows. Followed by this introduction, a review of literature covering the basic existing knowledge on green manufacturing and green practices will be presented. Then, followed by an elaboration of the methods adapted for facilitating the replication of the study, a brief introduction to the research context will be provided. Presenting the detailed findings with a

discussion in line with green practices, challenges and strategies and institutional support systems available/ or recommended, the lessons for Sri Lanka (and for similar other contexts) will be drawn with policy implications and directions for further studies.

3. Review of Literature

3.1 Green SMEs

Green SMEs have been defined as “SMEs those which embrace green processes and/or produce green products/services using green production inputs (Ramessur, 2018, p.35). According to Ramessur, green SMEs, different to traditional SMEs, focus more on social and environmental requirements, combined with economic desires. Some examples of the application of greening in SMEs include production by using solar energy, recycling waste, and smart metering. These SMEs can be benefitted with higher prices for green products, possibility of obtaining raw materials for a low cost, opportunity for developing competitive advantage, implementation of innovative solutions and creation of new market niches (Ramessur, 2018, p.35).

3.2. Green manufacturing

Green manufacturing (sustainable or environmentally-safe manufacturing) refers to transforming materials into products without giving rise to emission of greenhouse gases, use of non-renewable or toxic materials or generation of waste (Allwood, 2009). Thus, the aim of green manufacturing is to optimize the industrial production (Dornfeld, 2012) and to reduce or minimize the negative effects of production processes on the ecosystem (Mafini & Loury-Okoumba, 2018) by reducing the negative externalities associated with waste and pollution (Manufacturing Matters, 2011, p. 7). It is an effort of “harmonizing the pursuit of economic benefits” (Baines et al. 2012, p. 61). As elaborated by Baines et al. (2012), green production is achieved through the actions such as producing from greener materials and by greener operations and processes, delivering greener outcomes, and being greener to dispose of at the end of their life” (p. 67). As reported in the Manufacturing Matters (2011), the ‘successful implementation of green manufacturing requires going beyond small standalone initiatives, and adopting an integrated framework’ (p. 7). Thus, recognizing ‘planning for greening’ as an essential part of the business strategy, executing green initiatives across the value chain, and communicating and promoting green initiatives and their benefits to all stakeholders are noted as requirements for such an integrated framework.

Collaborations with all stakeholders of the company is essential for implementing and sustaining green manufacturing even in SMEs. As per Baines et al. (2012), “sustainability includes considering an extended set of stakeholders, including the environment, as well as the global community and future generations” (p. 64). Thus, environmental collaborations with suppliers and environmental friendly purchasing practices, environmental collaboration with customers, training for employees and support from employees for green manufacturing are noteworthy in mentioning (Arun & Patrick, 2017). These need to be supported by the internal systems of the organization which may include an eco-design, controls on pollution, continuous checking, standardizations, and adoption of ISO 14001 certification etc. (Arun & Patrick, 2017, p. 1946-7).

There are several important areas need to be considered in green manufacturing, such as environmental impact of product(s) on offering, location of manufacturing plant, manufacturing process, manufacturing system, material utilization within materials requirements planning, capacity and inventory planning and control, supply chain management, quality control: cost or rework, scrap disposal, total quality management systems and failure prevention and recovery (Sainidis & Robson, 2017). Moreover, as elaborated by Hartinia and Ciptomulyonob (2015), a green operations system incorporates a number of elements such as product redesign, process redesign, disassembly, substitution, recycling, remanufacturing, consume internally, prolong use, returnable packaging, spreading risks, creating markets, waste segregation, and alliances (p. 40).

3.3 Green practices in manufacturing

Dornfled's (2014) work on green and sustainable manufacturing sheds light on some important and initial parameters for greening the manufacturing SMEs. According to him, enterprises need to practice the reduction of weight and increase of the yield of manufacturing goods while increasing the product lifespan. In a more broader sense, Arun and Patrick (2017) introduces green practices to be adapted in line with five parameters, such as internal environment management, technology integration, logistic management, customer focus, and supplier focus.

Thus, past studies have highlighted green practices adapted in the manufacturing sector in different lines. They have accorded attention under the themes; usage of resources, energy consumption, handling of wastes, handling of pollution, recycling, product life cycle management, water reservation, and labor force protection too. Efficient use of resources is a green practice in which ‘avoiding the use of resource in the first place’ and ‘reducing the environmental footprint of a resource’ have been emphasized (Dornfled, 2014) in manufacturing entities. Thus, reducing and/ or leveraging the use of recourses (Dornfled, 2014) and

enhancement of the use of materials consumed (Li & Huang, 2012) have been noted as the green practices of manufacturing entities.

Energy management (Yacob, Wong & Khor, 2019) and reducing energy consumption (Lin & Huang, 2012) are noted as green practices. A study of the UK-based manufacturing SMEs reveals that the adaption of automated lighting and electricity generating solar panels and searching for alternative manufacturing energy sources (e.g. changeover from electricity to gas) can be used as green practices in SMEs (Sainidis & Robson, 2017). Proper recycling of wastes (Sezen & Cankaya, 2013) and reducing the cost of recycling (Dornfled, 2014) are also noted as attempts towards greening the manufacturing. According to Sainidis and Robson (2017), designing recycling policies for manufacturing waste by-products or supply packaging is another important green practice in manufacturing. Waste management (Yacob, Wong, & Khor, 2019) and efficient disposal of hazardous products (Sezen & Cankaya, 2013) in general, and the activities for reducing waste generation and minimizing the by-products of wastes in particular, help in greening attempts (Lin & Huang, 2012).

As noted by Yacob et al. (2019), adaption of pollution prevention approaches (aiming at both compliance and competitive advantage) and using pollution control measures are some of the initiatives taken by manufacturing SMEs for assuring environmental sustainability (p. 6). Sainidis and Robson (2017) show some avenues for handling environmental pollution by maintaining low emissions and chemical outputs and through installation of systems for cleaning and extraction in manufacturing entities.

Product life cycle management is also an important aspect in greening efforts where certain practices such as reducing the product weight and increasing the product life span have been noted (Dornfled, 2014). Green practices have not been limited to products, resources and waste handling, but encapsulate labor and working conditions too. Thus, Lin and Huang (2012) views the actions for reducing occupational health and safety hazards and for improving general workplace safety are significant in greening efforts. Protection of the labor force from environmental hazards and providing a conducive working environment are some of the strategies used in green manufacturing (Sezen & Cankaya, 2013).

3.4 Challenges encountered by SMEs in greening

The implementation and sustaining of greening efforts made by SMEs have been impeded by several practical issues visible in their internal and external environments. Thus, 'cost factor' has been significant due to financial and investment constraints encountered by SMEs (Dornfeld, 2012), especially in developing economies. Ramessur (2018) notes that SMEs' lack of access to finance due to reluctance from financial institutions to finance risky "green" projects and the scarcity or absence of expert staff to assess such projects is a challenge for greening SMEs. Consequent to this cost factor, physical infrastructural blockages (Manufacturing Matters, 2011) have also affected greening in SMEs. The 1st Green Manufacturing Summit held in India in 2011 revealed that outdated labor laws and cascading taxes restrict SMEs in adopting green practices (Manufacturing Matters, 2011). In the same line of views, existing literature finds that 'technology barrier' has played a role in limiting greening efforts of SMEs (Dornfeld, 2012). Lack of new technology, materials and processes, complexity to design, reuse/recycle products, lack of technical expertise have been highlighted as the barriers in the implementation of green supply chain management in the Indian context (Govindan, Kaliyan, Kannan, & Haq, 2014).

Further to the above, lack of knowledge and awareness on green practices have been another significant challenge for the manufacturing SMEs. Lack of environmental knowledge (Ghazilla et al. 2015) and the managers' scarce environmental training and short term orientation, and the staff's scarce environmental awareness and training (del Brío & Junquera, 2003) have challenged the adaption of green practices in SMEs. Lack of environmental consciousness by the firms (Min & Galle, 2001) is also contributes to this challenge. As noted by Govindan et al. (2014), lack of professionals exposed to green systems, lack of environmental knowledge, perception of "out-of-responsibility" zone, disbelief about environmental benefits, lack of awareness about reverse logistics have created barriers on successful implementation of green practices. In addition to these, lack of training courses/ consultancy/ institutions to train, monitor and mentor progress specific to each industry are also noted by Govindan et al. (2014). Ramessur (2018) adds to this in his revelation that unawareness of available opportunities for green venturing (due to information asymmetry), deficiency of needy skills and expertise to capitalize on available green opportunities, lack of reliable partners to share risks and lack of proper regulatory framework and conducive environment to support SMEs in their green initiatives have altogether challenged green initiatives in SMEs.

Dornfeld (2012) iterates that lack of suitable measurements, control and management tools in SMEs have restricted their adaption and sustaining of green efforts. Further, lack of

environmental standards and auditing programs (Min & Galle, 2001) and the scarce influence of manufacturing process flexibility (del Brío & Junquera, 2003) have been highlighted as barriers for greening the manufacturing enterprises. The SMEs' lower ability to obtain highly radical innovations and their lack of relation ability with external stakeholders (del Brío & Junquera, 2003) also noted as challenging the greening efforts. According to Ghazilla et al. (2015), several issues related to the internal organization, business environment, social influence, financial and supplier matters have hindered the adaption of green practices in SMEs in Malaysian context. Govindan et al. (2014) reports that lack of government support to adopt environmental friendly policies also contributes to such challenges in the Indian context.

3.5 Regulatory and other institutional policy instruments helpful for greening

Two key policy priorities for greening manufacturing have been recommended by the United Nations Environment Programme (UNEP) 2011. They are: (a) promoting closed-cycle manufacturing and related life cycle approaches with supportive recovery and recycling infrastructure, and (b) regulatory reform to enable factor efficiency improvements in energy use (e.g. through the introduction of co-generation and combined heat and power technologies) (Manufacturing Matters, 2011, p. 9) in manufacturing settings. In addition to these, UNEP highlights several instruments that government institutions may use to support the greening of industry and manufacturing. They include: (a) regulatory and control mechanisms, (b) economic or market-based instruments, (c) fiscal instruments and incentives, and (d) voluntary actions, information and capacity building. The regulatory and control actions that could be taken by government institutions are noted as building cleaner technology standards and performance standards, creating markets for green products, and encouraging industries to use natural resources more efficiently. The Manufacturing Matters further elaborates the economic and market based instruments suggested by UNEP (2011) in terms of introducing charges and fees for non-compliance, liability payments, tradable permit systems targeting air pollution, water quality and land management, instruments regulating the price, and charges targeting emissions and products (at the level of manufacturing, use or disposal), as well as byproducts such as packaging and batteries. The fiscal instruments and incentives suggested by UNEP include: fiscal policy (comprising public expenditure, subsidies and taxation), tax exemptions to be made for specific products or industry sectors, and tax revenues to be earmarked for a specific purposes. Finally, voluntary actions and capacity building can be performed through the supply of instruments and provision of information instruments (such as product information, labeling and reporting) (p.9).

4. Methods

4.1 Sources of data and data collection

The present study adopted a qualitative enquiry to answer the research questions. The data requirements of the study were identified as (a) the hands-on experiences of manufacturing SMEs in adopting green practices, (b) the ground realities of challenges encountered by manufacturing SME in greening their systems and processes, and (c) the institutional facilitation for supporting the greening efforts. Thus, data gathering took place by means of (a) discussions with the SME owners and relevant stakeholders in the business, (b) discussions with the academic experts in the subject area, and (c) observations at the research site.

The site for the research study was Kochi city in Kerala, India. Two case organizations, representing the clothing industry and the essential oil industry each from among manufacturing SMEs in the research site, were selected for the study. These two industries were common in the industrial sector of the research site. The selection of the two organizations was made on the nature of their environment-friendly manufacturing. The selection of two case organizations was assisted by the experts in the local area. The interviews were conducted with the owners of the two selected enterprises for gathering data on their hands-on experiences on green practices and the challenges encountered. Five experts representing both the industrial sector and the academia were involved in the intellectual discussion on this subject, on invitation. The data collection was conducted in January 2019 by the team of researchers. Transcribing and analyzing data were conducted by the same team. Content analysis was used in deriving the findings.

4.2 Analytical framework

The green manufacturing practices, challenges encountered by manufacturing SMEs when adapting such practices, and the institutional support or policy instruments were analyzed by using the following framework, as informed by the review of literature.

Table 4.1: Analytical framework of the study

Green Manufacturing Practices (GMPs)	Challenges Encountered	Institutional Support/ Policy Instruments
Usage of resources	Capital investment and financing	Regulatory and control mechanisms
Energy consumption	Technology	Economic or market-based instruments
Handling of wastes	Knowledge and awareness	Fiscal instruments and incentives
Handling of pollution	Measures and tools	Information provision and capacity building
Recycling	Internal organizational support	
Product life cycle management	Human resource competencies	
Reservation of resources	Regulations and other controls	
Labor force protection	Social influence	
Handling health and safety	Attitudinal issues	

The strategies used for mitigating the challenges were analyzed in line with the themes emerged through data.

4.3 Ethical considerations

The research team has been fully sensitive to the ethical considerations relevant to the study. Accordingly, anonymity and privacy of all respondents were regarded highly, and the confidentiality of the individual and enterprise information was maintained. In addition, voluntary participation of respondents, informed consent, and protection from harm and victimization were also followed in principal.

4.4. Research Site

The research site selected for the present study is Kochi city in the Ernakulam district of Kerala, India. The reason for selecting this location was backed by the matter that Kerala is well known for adaption of green practices in manufacturing sector (as well as in the service sector) and the gathering of SMEs in the Kochi city in the Ernakulam district.

Kochi (previously known as Cochin) is located on the southwest coast of India, in the southern state of Kerala, while being the largest city in Kerala and the economic capital of the state (About Kochi, 2018). It is globally known for locating the world's first international airport operated solely by natural energy (solar power). Currently, the City is taking numerous actions towards green growth. The priority sectors for green growth of the city are; land-use and density, ecosystem and biodiversity, water and sanitation and housing and buildings (Abbu et al., 2015). The location of Kochi city is depicted in the following map.

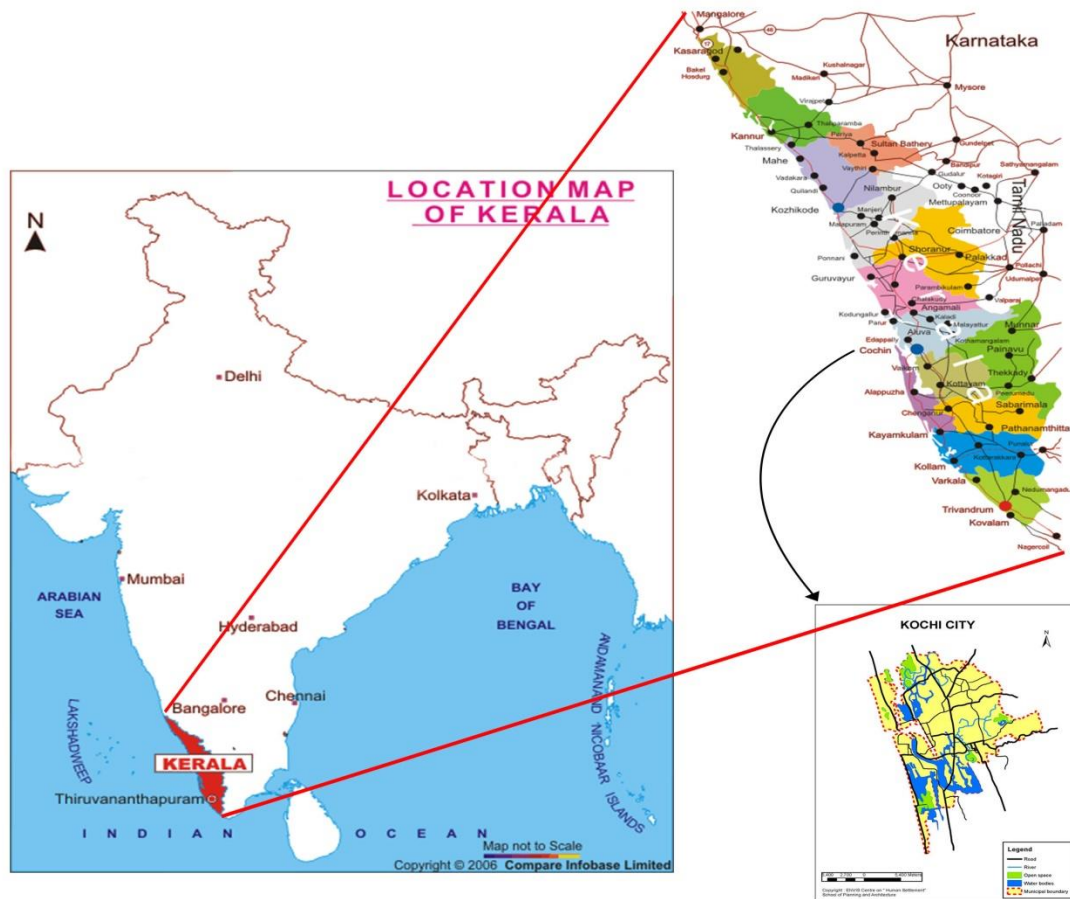


Figure 4.1: The location of the research site

Source: Google Maps (2019)

State of Kerala is well known for locating industries in the micro, medium and small enterprise (MSME) sector. The industries coming under the MSME sector in the Kerala area include handicrafts, handloom, Khadi, food processing, garment, textile, and industries related to coir, wood, bamboo, plastic, rubber, leather, clay, and electronic/electric components. The institutions facilitating the MSME sector in the area include the Directorate of Industries and Commerce of Government of Kerala, the Directorates of Handloom & Textiles, the Directorate of Coir and

Khadi, and Village Industries Board (Economic Review, 2016). The prominence of manufacturing MSMEs in Kerala is shown in the following two figures by illustrating the numbers and the production, employment and investment in the MSME sector for past few years.

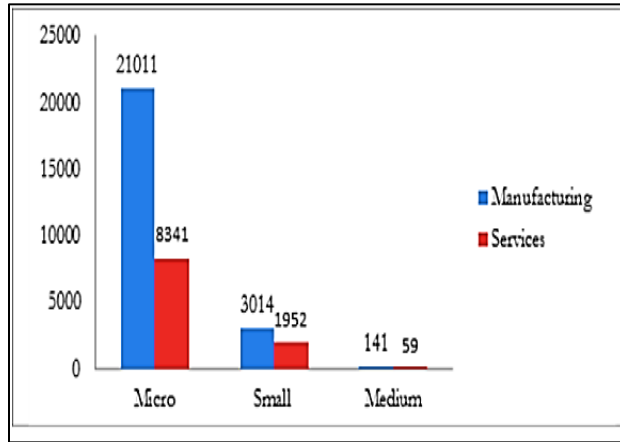


Figure 4.2: Number of micro, small and medium units registered under manufacturing and services sector in Kerala, 2016-17

Source: Economic Review (2016)

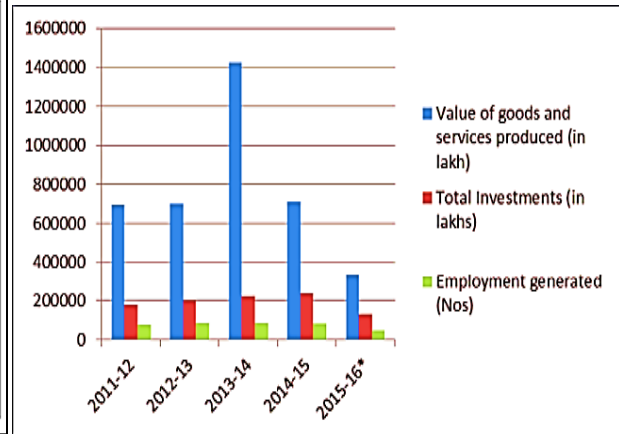


Figure 4.3: Production, investment and employment in MSME sector in Kerala from 2011-12 to 2015-16

Source: Economic Review (2016)

5. Findings and discussion

5.1 Green manufacturing practices

Our discussions with the SME owners of the case organizations revealed a number of green practices adapted by them in their manufacturing enterprises. The findings can be outlined as follows:

a. Manufacturing with zero waste

Manufacturing SMEs usually encounter the problem of waste disposal, especially when they are located in urban areas with lack of waste disposal facilities, thus restraining them from adapting green practices. However, present study found that one case organization (in the essential oil production) deal with bio-degradable wastes. Thus, they have taken actions to proceed with zero

wastes by converting their 'waste' into 'by-products' which can claim a competitive advantage in the B2B market.

b. Seasonal manufacturing

It is noted that one case organization adapt the practice of producing goods at the season in which the raw materials are readily available, thus avoiding operations in the manufacturing plant for all products throughout the year. This practice has enabled efficient handling of plant capacity as well as efficient purchasing of raw materials. Contract farming also has helped in uninterrupted manufacturing.

c. Using natural materials as raw materials/ supplementary

Further, one of our case organizations evidenced that they use only pure water (natural water) for their manufacturing purpose. The owner of the enterprise particularly mentioned that he uses 'well water' in the production process. He emphasized the importance of using pure water in his enterprise by stating; "We use good water; that is well water. It is very important for us to maintain the quality of our products by using good raw materials. That is why we use natural water". The manufacturer in the clothing industry revealed that one aspect of the 'eco-friendliness' is maintained in their enterprise by using only natural materials for their raw materials. Thus, their raw materials have been limited to organic materials (cotton), and further, the supplementary material that is used in the production process (i.e. dyes for coloring) is also been limited to organic materials. With this, they have been able to avoid the use of chemicals in their manufacturing process.

d. Avoiding machine production and using labor alternatively

Clothing industry has the option of using machinery or labor in their production processes. Machine production in the textile industry consumes energy, occupies large areas for the plant, and needs repairing and expensive parts when breakdown. However, economized labor in India still seeks hands for work despite its prevailing industrialization (Joseph, 2010). Proving this fact, it was noticed that the case organization in the clothing industry has gone green by sticking to the use of labor instead of using machines in cloth manufacturing.

e. Recycling of water

Manufacturing enterprises consume water as a resource or a material for production. Similarly, wastewater can be a by-product or a complete waste in a manufacturing enterprise. Present study found the practice of recycling and reusing of water, once used in their-own production processes, adapted by the essential oil manufacturer. The owner of this enterprise stated “We recycle water. We have that system established in the plant. Water is treated once in every six months”. The research team was able to observe the water recycling system of this enterprise.

f. Educating employees on green practices

The two case organizations revealed that the employees are well educated on the green practices they should follow, and the staff is provided with residential facilities so that they may well get into the work with full attention. They have adapted shift basis, and the staff was well trained for the work.

g. Energy saving mechanisms at small and large scales

The medium-scale entrepreneur who engaged in the manufacturing of essential oils stated “Ninety percent of our manufacturing has been greened now. The remaining ten percent will be completed soon”. The ‘*greening*’ that he mentioned was partly the use of solar power as energy in the manufacturing process. In addition, he mentioned that a part of the plant will start using ‘clean energy’ (gas) in their manufacturing process very soon. This effort was focusing on the elimination of the use of sawdust and coconut shells as materials for generating energy, which gives rise to an unavoidable release of carbon dioxide in its manufacturing process. In addition to these, there is a remarkable mass scale project of energy saving (use of solar power) in Kerala. That is the Cochin International Airport Limited (CIAL) which has been the first fully solar-powered airport in the world (Thomas, 2018), thus setting one of the best examples for energy serving projects at mass scale.

h. Popularizing green initiatives and products

It was noticed that the manufacturing SME owners that we interviewed have taken the initiative of helping local communities (societies and small scale co-operatives) for been green and manufacturing green products as well as promoting the use of green products (which are recycled, pure, organic, handcrafted and ecofriendly) through their enterprises.

5.2 Challenges encountered and strategies used/ recommended

Interviews conducted in the study revealed some of the challenges the SME owners face when going green in their manufacturing processes. One SME owner noted that securing natural (supplementary) materials for the uninterrupted production is a challenge as the materials are imported from overseas or from a far distant local area. This can be identified as ‘resource dependency’ (Pfeffer & Salancik, 1978) occurred when depending on natural resources for the green manufacturing. However, the other case organization had used the strategy of contract farming and seasonal production for enabling smooth and uninterrupted production.

Shifting from the use of non-renewable energy to the use of renewable energy in the manufacturing process has required a huge capital investment for SMEs as initial installation costs (example: establishment of biogas plants, solar power systems etc.). However, one of the case enterprises has introduced the use of solar power in a gradual process thus, stage by stage, in order to overcome this burden. One industry expert highlighted that the adaption of solar power energy in a service sector organization at mass scale was initiated in order to face the challenge of increased electricity prices in the Kerala state. This indicates that some challenges have brought positive results in greening efforts.

There are several case studies conducted in the Kochi city in Kerala in order to identifying the issues and proposing strategies for managing solid waste, reducing waste footprint and managing sustainable watershed in its residential areas (e.g., Ravi & Vishnudas, 2017(a); 2017(b); Vishnudas, Saveniji & Zaag, 2005). Discussions with the academic experts in the subject matter in this local area, supported by their publications based on the case studies revealed a number of challenges encountered in implementing and sustaining green practices by the manufacturing SMEs. A considerable attention was accorded on the difficulty in investing in the initial capital needs for the installation of new technological systems such as biogas technology (Ravi & Vishnudas, 2017(a)). In addition to this, Ravi and Vishnudas (2017(a)) pointed out the lack of knowledge and awareness of standards, design and construction of the plants for adapting such systems by the manufacturing enterprises (p. 1918). In line with this, an expert shared her view on the matter stating, “It needs to educate the people at the grassroot level, so, SME owners need awareness on waste reduction, re-use and recycle too”. She further added,

“Educational and awareness programmes for SME owners need to focus on short term practices and then they should be continued gradually in the long-run.

For an example, we have to start with simple sign board displays such as eco-labeling on “how to use”, and then proceed up to education of ‘how to be energy efficient’”.

A huge challenge faced by Indian MSMEs when shifting into more cleaner and efficient production systems has been the obsolete technologies that impede such transitions (Gopichandran, Shah, Patel & Harinarayana, 2013). Gopichandran et al. note that the Indian government has designed the strategy called ‘Credit Linked Capital Subsidy Scheme’ to help upgrade technologies (2013, p. 217) in order to overcome this challenge.

Another challenge in the green efforts is that people have developed unfavorable attitudes towards the technology on renewable energies due to their experiences in the failure of the plants generating such energies. Thus, Ravi and Vishnudas (2017) iterates the need of publicizing such technologies and making awareness programmes in the urban residential areas of Kochi city. They recommend motivational programmes to be conducted through governmental and non-governmental officials, community leaders and other influential persons and the provision of subsidies for installing renewable energy plants as strategies to address this issue (p. 1918). Further to this, the field investigations conducted in the Kochi city area have revealed that people are unaware of the effective handling, application, composting and proper use of certain waste items. Accordingly, training on such applications for the people who are handling them has been recommended in this area (Ravi & Vishnudas, 2017).

5.3 Institutional support and policy instruments

The government of India has designed policy guidelines to facilitate SME sector. One such policy guideline has been outlined in the Small Industries Development Bank of India in its Annual Report 2010–2011 (SIDBI, 2011) which refers to the Prime Minister’s Task Force for developing policy guidelines to support SMEs (Gopichandran et al. 2013, p. 216). According to Gopichandran et al. (2013), India has used some development assistances from overseas too for improving energy efficiency and facilitating cleaner production in SMEs. Improving efficiency in SMEs has been backed by green loan schemes, green rating projects and programmatic clean development mechanism (p. 217). Further, there are community services established for supporting green efforts. The Green Environment Services Cooperative Society (a forum for collective environmental actions) is one of the examples of this kind.

5.4. Lessons to be learnt on green manufacturing practices and institutional support systems

Based on the findings of the exploratory study conducted in the Kochi city, supported by the expert opinions, and relevant literature, the following can be drawn as the lessons to be learnt on the green manufacturing practices and institutional support systems to be adapted in manufacturing SM

Table 5.1: Lessons on green practices

Proposed Green Manufacturing Practice (GMP)	Operationalization
Usage of resources	• Using natural/ indigenous raw materials for production as much as possible • Using organic materials as raw materials • Avoiding the use of chemicals as much as possible and replace them with alternative natural materials
Energy consumption	• Using solar power as the major source of energy
Handling of wastes and pollution	• Recycling of waste and reusing them as by-products, without releasing them to environment
Recycling	• Recycling of water and reusing it without releasing waste water to canals/ residential areas
Product life cycle management	• Planning product life cycle in line with seasonal availability of raw materials
Reservation of resources	• Reusing the existing buildings
Labor force protection and handling health and safety	• Educating employees on green practices by SMEs themselves • Providing on-the-job training on green practices • Making the workforce committed to green practices
Manufacturing techniques	• Using labor/ converting production process into labor intensive processes in order to avoid/ reduce the use of non-green materials and facilities
Other	• Promoting green products • Helping peer groups to adapt green practices

Further, the following can be noted as the lessons (or recommendations) on institutional support systems to be provided for promoting green practices in manufacturing SMEs.

Table 5.2: Lessons on institutional support systems

Institutional Support/ Policy Instruments	Operationalization
Regulatory and control mechanisms	• Define standards for green manufacturing • Regulate the use of renewable energy in manufacturing • Create a legal framework to facilitate the adoption of innovative green practices and processes of manufacturing SMEs • Recognize and appreciate successful green initiatives of manufacturing SMEs
Economic or market-based instruments	• Popularize more green products among local customers
Fiscal instruments and incentives	• Provision of tax incentives for using renewable energies • Provision of incentives for adapting green practices • Tax benefits to encourage adaption of green practices and green technologies
Information provision and capacity building	• Cultivate opportunities for green manufacturing • Encourage manufacturing SMEs to adapt green practices, processes, methods and technology • Create awareness among manufacturing SMEs on green practices
Research and development initiatives	• Encourage more research and development on green systems and practices
Other supports	• provision of biogas plants/ solar power systems and other relevant technologies at low cost or with subsidies

6. Conclusion

Successful implementation and sustaining of green practices in manufacturing SMEs strongly need the own will and drive of owners and employees for greening efforts. However, there exist certain macro level initiatives to be taken by the regulatory bodies at the apex level as well as local government level. Government intervention will be essential in promoting and ensuring sustainable green practices in manufacturing SMEs, especially in countries like Sri Lanka due to the reason that ‘going green’ has still not fully internalized in the actions of local manufacturers or customers. Thus, popularizing green products, green manufacturing and green purchasing in the local community would be beneficial for all stakeholders involved in the greening process. Manufacturing SMEs themselves need to take actions for disseminating the green practices among peer entrepreneurs.

Even though the present study captured only two case organizations of manufacturing SMEs in its exploration, it would be more insightful to extend a similar kind of study with the use of more case organizations by using focus groups which put together many relevant stakeholders in the same discussion.

Acknowledgement: *This research was supported by the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education funded by the World Bank. The authors further acknowledge the generous financial support extended by the Faculty of Graduate Studies, University of Colombo, Sri Lanka through its generated funds for the visit to the research site; Kochi, Kerala, India for collecting data for the present study.*

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