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Adoption of Voluntary Environmental Practices: Evidence from the Textile and Apparel Industry in Sri Lanka

D. W. Kinkini Hemachandra

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D. W. Kinkini Hemachandra
University of Sri Jayewardenepura,
Sri Lanka

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Comments should be sent to

D.W. Kinkini Hemachandra
Senior Lecturer, Department of Business Economics
University of Sri Jayewardenepura, Sri Lanka
Email: kinkini2009@gmail.com

Contents

Abstract

This study examines voluntary adoption of environmental management practices in the textile and apparel sector in Sri Lanka. The textile and apparel industry contributes to 58% of total industrial export earnings and 52% of industrial employment in the country. Factories in this sector undertake different production activities and the Sri Lankan Central Environmental Authority identifies washing and dyeing factories as significant contributors to water pollution. In this study, we review existing environmental rules and regulations that apply to the textile and apparel sector and follow up with an econometric analysis of data from a factory survey and a set of detailed case studies. Our sample covers factories that are registered with the Sri Lankan Board of Investment, which primarily gathers large-scale export-oriented companies operating in the apparel sector. Study findings show that 96% of the factories surveyed voluntarily implemented at least one environmental management practice such as water recycling, material re-use and environmental audits and certification. 69% adopted more than two practices. Most of the surveyed factories had been inspected by regulators, but had never been fined. Our analyses suggest that while factories are responsive to existing regulations, market pressure from international buyers may be the dominant reason why Sri Lankan firms adopt good environmental practices. The analyses also suggest that firm's size and type of activities undertaken are the most significant factors that influence decisions to voluntarily adopt environmental management practices.

Key words

Environmental Management Practices, Apparel and Textile industry, Sri Lanka.

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1. Introduction

The textile and apparel industry represents 58% of total industrial export earnings (Central Bank of Sri Lanka, 2013) and 52% of the industrial sector labour force in Sri Lanka (Department of Census and Statistics, 2014). The major export markets for Sri Lankan garments are the USA and Europe, which buy a variety of clothing from T-shirts to cotton skirts. Many well-known brands such as Victoria's Secrets, Nike, Gap, and Pierre Cardin to sell garments produced in Sri Lanka. Sri Lanka's 2011 Survey of Industry identifies over 3500 firms in this sector, which are more or less evenly divided between textile and apparel manufacturing factories[1] (Department of Census and Statistics, 2014). Textile and apparel factories undertake different types of activities: fabric manufacturing, washing, dyeing, weaving, knitting and sewing. Washing and dyeing are the most damaging for the environment and the wastewater they generate can include high concentrations of chemicals (World Bank, 2014). The apparel manufacturing sector tends to be less environmentally polluting than other components of this industry.

In order to control and monitor industrial pollution, most countries use some form of command and control policies (Delmas and Toffel, 2003; Hart, 1995; Priyadarshani and Gupta, 2003; Dasgupta, Hettige and Wheeler, 2000). However, regulations have not always proved effective in reducing industrial pollution in the developing world (Anton et al., 2002; Blackman and Sisto, 2005; Maxwell and Lyon, 2000). On the other hand, firms[2] are also known to voluntarily adopt different environmental management practices (EMPs) to help manage the potential impacts of business strategies on the environment (Anton, 2005; Jayasinghe–Mudalige, Udugama and Ikram, 2011; Uchida and Ferraro, 2007; Florida and Davison, 2001; Pulvor, 2002).

In this paper, we study factors driving voluntary adoption of EMPs in the Sri Lankan textile and apparel sector, with a focus on large-scale export-oriented factories. We first undertake an analysis of environmental regulations in the country and compare stated rules and regulations with empirical findings. We draw on evidence from interviews with regulators and firms to compare regulations in paper with practice. We also undertake an empirical analysis of factory survey data to identify factors driving adoption of EMPs in textile and apparel manufacturers in Sri Lanka. Our analyses suggest that firm's size, export orientation, and type of activities undertaken at the factory are the most significant factors influencing factories' decision to voluntarily adopt EMPs. Some of these results are reinforced by findings from ten detailed case studies.

2. The Textile and Apparel Industry in Sri Lanka

Mahavamsa, one of Sri Lanka' oldest historical chronicles, explains that when Prince Wijaye came to Sri Lanka, Queen Kuweni was spinning threads. However, the textile and apparel industry commercially started in the 1960s when production began for local markets. The sector began attracting investors and exporting following the economic liberalization policy in the early 1970s. Low labour costs, the establishment of the Board of Investment (BOI) and subsequently of Export Processing Zones (EPZs), attracted foreign investors.

1 Factory refers to a single plant located separately. Each factory is registered at the BOI as a separate unit.
2 One firm can have more than a factory.

The textile and apparel sector recorded USD 4.5 billion income in 2013 through their export earnings.[3] This represents 43% of total export earnings and 58% of total industrial export earnings in Sri Lanka in 2013 (Central Bank of Sri Lanka, 2013). The major export markets for Sri Lankan textile and apparel producers are USA (43%) and Europe (46%) (Central Bank of Sri Lanka, 2013). These manufacturers produce: sportswear, lingerie, loungewear, bridal wear, safety worker's wear, swimwear, and children's wear. These are also classified as knitted or crocheted, not knitted and warm clothing (see Figure A1 in Appendix for recent trends in export earnings).

In the last few years, the textile and apparel industry has faced a number of challenges, including suspension from the European Union's Generalized System of Preferences (GSP +), which provided the EU tax free access for Sri Lankan's garments. Consequently, the industry has begun to specialize in high quality products and developed labels such as "Ethically Manufactured Garments", "Garments without Guilt Certification" and "Sustainable Environmental Friendly Manufacturing". The industry is aiming to build a reputation in high quality finished products and to make in-roads into niche markets.

The forthcoming empirical analysis focuses on BOI-registered establishments, which are largely large-scale export-oriented factories operating in the apparel and textile sector. The BOI is the governmental agency responsible for increasing foreign and domestic investment in the textile and apparel sector in Sri Lanka. Its main mandate is to provide advice and assistance to potential investors. The BOI is in charge of administering EPZs, which offers investors benefits such as tax holidays or preferential rates, exemption from customs duty and foreign exchange controls. The EPZs also usually benefit from modern public infrastructure such as access roads, water and sewerage facilities, security, as well as a range of business services. There are currently nine EPZs in Sri Lanka.

As of today, 326 factories operating in the textile and apparel sector are registered with the BOI, including 168 factories with more than 250 employees. 42 out of these 326 factories (13%) are located within an EPZ. Sixteen textiles and fabric manufacturing factories and nine finishing factories (representing less than 5% of all establishments) are also registered with the BOI (BOI and Central Bank of Sri Lanka, 2013). BOI-registered factories are, for the vast majority, export-oriented firms and represent 96% of total apparel export earnings in Sri Lanka. However, they represent a small share of the total number of factories engaged in textile and apparel manufacturing. A total of 1,977 establishments were recorded in category 17 (Manufacturing of textiles) and 1,553 establishments in category 18 (Manufacturing of wearing apparel) in the 2011 Survey of Industries (Department of Census and Statistics, 2014).[4,5] Thus, compared to the 3,510 factories identified in the textile and apparel sector in 2011, some 10% are registered with the BOI.

3. Environmental Regulations and Monitoring in Sri Lanka

The main objective of our study is to gain insights into whether the business practices in the textile and apparel industry in Sri Lanka are sensitive to environmental concerns and what contributes to voluntary adoption of EMPs in this sector. Thus, we first examined environmental regulations that apply to the textile and apparel industry. Next, to understand the challenges to monitoring and enforcement of these regulations, we conducted a number of interviews with both regulators and licensees during 2012 and 2013. Among the regulators interviewed were the Directors of the Environmental Pollution Control Unit and Environmental Impact Assessment Unit of the Central Environmental Authority (CEA), the Environment Unit of the BOI Zonal office (in Katunayake Export Processing Zone), and the Statistical Unit of the BOI. Three Directors of certification bodies, the Director of the System Certification Unit at the Sri Lanka Standard Institute, and the Director of the Textile Industry at the Ministry of Industry and Commerce were also interviewed.

Sri Lanka's Ministry of Environment and Renewable Energy[6] is responsible for the overall management of the environment and natural resources, while policy implementation is the responsibility of the CEA. The environmental laws of the country give the CEA authority to use two important instruments to regulate firms' /factories' behaviour:

[3] Value of GNP is SLR 8,438,960 million (64.9 USD billion). USD 1= SLR 130. Manufacturing sector- industrial manufacturing: SLR 1,402,353 million (10.8 USD billion); Textile and Apparel: SLR 259,412 million (USD 2 billion). Textile and apparel export earnings are SLR 583,046 million at current market prices (USD 4.5 billion which is out of USD 10.4 billion of total export income).
[4] Full report available at http://www.statistics.gov.lk/industry/ASI%202012%20report.pdf
[5] Among these, 61 in the textile sector and 335 in the apparel sector had more than 100 employees.
[6] Earlier it was the Ministry of Environment and Natural Resources.

the Environmental Protection License (EPL) and effluent standards. The CEA also disseminates environmentally-related information and offers laboratory testing facilities (for measurement of water quality, soil and solid waste contamination, noise level, and air pollution).[7] There are CEA offices located in each of the nine provinces and 13 district offices. In addition, the Environment Department of the BOI is given responsibility to monitor environmental pollution of industries registered at the BOI. Regulations related to pollution control are mainly described in the National Environment Act No 47 of 1980 and its subsequent amendments (see Appendix 1 Table A1).

3.1 Environment Protection License

Under Section 23A and 23B of the 1988 amendment to the National Environmental Act, any new business is required to obtain project approval from the Authority before starting any operationand an Environment Protection License (EPL). This license gives the right to emit or discharge pollutants in accordance with the standards and criteria set by the Act. Approved projects arerequired to submit an Environmental Impact Assessment (EIA) report before starting their operations describing their impact on the environment and the subsequent measures undertaken. The general public is then informed of approved projects through the media.

Industries are classified under three categories (A, B, and C) depending on their pollution potential. Category A contains 80 highly polluting industrial activities, while category B includes 33 activities generating medium level of pollution. Category C gathers 25 low polluting industrial activities.[8] All textile and apparel manufacturing firms are classified under either category A or category B. A factory is listed in category A if its operations involve bleaching, dyeing, printing, washing and sand blasting. Also included in category A are factories with more than 25 power looms or machines used for sizing activities; factories which use shared or individual wastewater treatment plants with a capacity of 10,000 cubic meters per day or more; factories that employ 200 workers or more per shift; and factories which discharge 10 cubic meters of wastewater (or more) per day or use toxic chemicals in its production process.

A factory is listed in category B if it is a batik industry where less than 10 workers are employed; a factory with less than 25 power looms; a factory with hand looms or knitting or embroider with more than 10 looms; a garment with employees 25-200 per shift; and any industry which discharge 3-10 cubic meters of industrial processing waste water per day. As mentioned earlier, an EPL is issued or renewed by either the CEA or the BOI, the two monitoring bodies. BOI-registered companies in EPZs are monitored directly by the BOI's Environmental Management Department (EMD). EPZs are also indirectly monitored by the CEA since the central authority issues an EPL for each EPZ, considering each zone as a single enterprise. After this, EPLs are issued to individual enterprise by the BOI's Environment Management Department. For a BOI-registered factory not located within an EPZ, the EPL is issued by the EMD after obtaining concurrence from the CEA based on joint inspection by CEA and BOI officers (see Appendix 2 for additional details).

Every application for an EPL needs to be accompanied with a certificate of sufficient to cover damages that may be caused to the public as a result of any activity carried out by the factory. Once granted, the license is valid for aperiod of one to three years, after which it needs tobe renewed. Section 23D of Act No 56 of 1988 describes the cases under which the license can be suspended or cancelled. Actions that may be taken by the CEA against a company violating these rules include written warning, non-renewal or cancelling of the EPL, penalty, and factory close-down. Figure A2 in Appendix 1 summarizes the procedure to be followed to obtain an EPL.

3.2 Effluent Standards

The type of waste and pollutants emitted by textile and apparel factories depend on the main activities undertaken, but water pollution remains the primary concern. Table 1 identifies the standards set by the CEA that apply to wastewater discharged into inland surface waters. In addition to the national standards, some less stringent (interim) standards apply within EPZs (see Table 1). Factories within the zone are required to maintain the interim standards set by the BOI ordinance whereas the EPZ (zone as an individual enterprise) is required to maintain national standards set by the National Environmental Act. Parameters such as pH, temperature, total suspended

[7] There are currently 29 registered laboratories and 41 registered consultants in the CEA.

[8] Amendments to the 1980 National Environmental Act published in 2000 and 2008 provide further details regarding the issuance of the EPL for different types of activities.

solids, Biochemical Oxygen Demand (BOD), colour, oil and grease, phenolic compounds (phenolic OH), Chemical Oxygen Demand (COD), sulphides, chromium total, hexavalent chromium, copper, zinc, ammoniacal nitrogen and chloride are regulated.

The environmental regulator has the power to monitor and inspect activities conducted by a licensee, to examine records, to take samples of wastes or recycled wastes, and to provide advice on waste handling (National Environment Act, Section 29, 1980). Factories are required to maintain records of waste generated and handled. Violation of standards can result in licenses being suspended or cancelled and the factory being fined. Section 31 of the Act also states that any factory manager who commits an offence is liable to imprisonment not exceeding two years, or to a fine of not less than SLR 10,000 to 100,000, or to both imprisonment and fine.

3.3 Monitoring and Enforcement

The process for monitoring and enforcement involves licensing and factory inspection of Category A and B. According to the Act No 47 of the National Environment Act (1980) every factory is required to obtain an EPL before starting their commercial operations and every factory has to renew its EPL annually (category A factories) or tri-annually (category B factories). When it comes to practice, every factory that applies to get or renew an EPL is inspected by CEA officers.

At present there are 86 Senior Environmental Officers (SEO), 150 Environmental Officers (EO) and 250 Deputy Environmental Officers (DEO) at CEA's provincial and district offices, who are responsible for monitoring and licensing industries in all sectors.[9] All these officers are graduates and most of them have a background in science. They are regularly given local as well as overseas training. There are 6 SEOs and 4 DEO and EOs at the CEA head office and they carry out inspections in factories within the Western province. In practice, a SEO goes with a DEO or EO for inspections.

CEA issues legal notices to the factories which violate regulations. The most common violation is non-renewal of licenses. In 2013, across all industrial sectors, there were 53 cases filed (39 were finalized) and 65 EPL were cancelled (none related to textiles and apparels). The time taken to finalize a case varies. Some factories are required to establish an effluent treatment plant or to change their waste handling methods, which may require a considerable time. According to the legal department at the CEA, only one textile manufacturing factory was fined for excessive water pollution during the year 2013 (this factory was not registered with the BOI).

Most of the regulators interviewed indicated that they were moderately satisfied with the overall monitoring and enforcement process in the textile and apparel sector. They identified several factors that appear to positively influence compliance in this sector. First, the dominance of apparel manufacturing (dry process) is itself a major factor since these firms are less polluting in general. Another important issue that repeatedly came up was pressure from foreign customers: major buyers, mostly from Europe and USA, put pressure on Sri Lankan factories to comply with regulations and even international standards. To cite the Deputy Director General, Environmental Pollution Control, Central Environmental Authority "*90% of Sri Lankan textile and garments goes to Europe and USA, where they are more concerned about environmental friendly production methods. If a company does not obtain EPL certificates and test reports such as noise level report, ambient air quality report, waste water treatments' reports etc., the foreign buyers will withdraw their orders from the factory.*"

The factory managers who were interviewed confirmed that they felt pressure from their international buyers. They also indicated that the foreign buyers ran their own audits, which cover employees' health and safety, production techniques, employee payments as well as environmental practices of the factory.

Regulators recognize that the public has also become cognizant about environmental issues with an active media that frequently reports on industrial pollution. For instance, one recent incident in the rubber manufacturing sector was reported by the media and the factory was closed down as a result of community unrest. Chemical wastes from this factory had contaminated local water bodies and raised severe health issues among the villages (Ratnakara, 2013; Ceylon Today, 2012).

[9] During 2013, for category A industries, after inspecting 1,192 factories across all industrial sectors, a total of 1,006 new EPL were issued; and after inspecting 2,236 factories, 2,188 EPLs were renewed. For Category B industries, 938 new EPLs were issued after completing 1,137 inspections and 793 were renewed out of 870 inspections.

Regulators also believe that the CEA staff is relatively well qualified to monitor environmental pollution. All CEA staff members are graduates and have completed some form of relevant training. However, the number of staff is not sufficient to ensure proper monitoring. Because of the small number of staff, a factory is generally inspected only when an EPL is given or renewed. EMDs in the EPZs also suffer from staff shortages. Usually there are two to three inspectors allocated to each EPZ, while each zone commonly gathers more than 50 factories. Furthermore, the laboratory facilities within the EPZs are not adequate and the environmental officers sometimes have to send samples to laboratories located outside the zone, which causes enormous delays and expense.

CEA officials point to a few other some weaknesses in the system related to penalties and legal bottlenecks. Many of the regulators opined that the level of fines charged to non-compliant factories is generally small and does not provide much incentive to factories to comply with standards. In fact, the CEA has recently requested the Attorney -General and the Legal Draftsman Division to increase the current fines.

The CEA is also not directly responsible for fines, which have to be mandated by the courts. There are specific amounts of fines for different violations.[10] In practice, CEA does not consider fines for first time violations. They follow several prior steps such as warning in writing, filing a case, hearing a case, giving chances for appeals etc. The process is as follows:

1. If CEA finds a problem through their inspections or sometimes as a result of complains made by the community, they start their legal actions.
2. CEA conducts inspections once again to collect the evidence
3. With the collected evidence CEA files a case against the company
4. Within the given ranges of fines under different violations, the final amount is set by the court.

The whole judiciary process can take time due to practical reasons such as the number of cases to be handled by the district courts in a day, shortage of officers, etc. On average, a case can take several months to years. Thus, legal delays seem to be a major deterrent to effective implementation of regulations.

4. Firm-specific Environmental Management Practices

There are different theories discussed in the literature on adoption of sound management practices. Hart (1995), for instance, discusses institutional theory, which highlights regulatory pressure as the most powerful instrument to influence firms to adopt EMPs. Khanna and Brouhle (2007) explain firm behaviour by using economic theory underlying profit maximization, which suggests that a firm's adoption decision depends on the expected profits from such actions. Arora and Cason (1995) also explain firm responses in relation to its need to maximize profits.[11]

Several authors (Jayasinghe-Mudalige, Udugama, and Ikram, 2011; Delmas and Toffel, 2003; Blackman, 2009) identify firm specific characteristics that influence adoption of EMPs among industrial operators. Firm size, export orientation and managers' leadership within the firm, are, for example, important variables that influence firm behaviour (Jayasinghe-Mudalige, Udugama, and Ikram, 2011; Delmas and Toffel, 2003; Blackman, 2009). For example, Arora and Cason (1995) examining factors affecting the adoption decision to 33/50 program in USA in 1993, found that large firms and more polluting firms voluntarily adopt this system when compared to other firms (Arora and Cason, 1995).

Another set of literature argues that market based factors and regulatory pressures explain why firms tend to adopt EMPs (Uchida and Ferraro, 2007; Anton, 2005; Potoski and Prakash, 2004). According to Anton (2005) consumer pressure has the most influence on firms' EMP decisions. In a related study, Testa et al. (2011), examining the impact of environmental regulation on firms' performances, found that economic incentives have a significant impact on corporate performances.

[10] 1) If waste water discharge exceeds the standards set by the Act - SLR 15,000 – SLR 120,000; 2) If the factory exceeds the standard level of noise pollution – SLR 15,000- 120,000; 3) An industry operating without having an EPL – SLR. 10,000 to 100,000 plus I year imprisonment or could be both; 3) In addition to the above mentioned 3 cases, there is fine on violation of EIA assessment. Maximum to SLR. 10,000; and 4). In case of air pollution, there is no specific fine stated by the act due to inability to measure air pollution from the industry.

[11] A variation on this is provided by Testa et al. (2011), who point to three different approaches for explaining the adoption decision: traditional neoclassical approach, revisionists approach based on the Porter hypothesis and, third, a resource based approach.

Institutional factors, such as inspections by the monitoring authorities and necessary licences are also found to be important in influencing firms' decisions (Potoski and Prakash, 2004; Jayasinghe and Weersink, 2004). Interestingly, some studies find that neither market based nor regulatory pressures directly impact a firm's pollution intensity (Khanna et al., 2007; Anton, Deltas and Khanna, 2002). Rather, these effects are indirect since they influence the adoption of EMS (Anton, Deltas and Khanna, 2002). In addition, Foulan, Lanoie and Laplante (2002) suggest that information disclosure strategies can have a noteworthy effect on pollution and compliance levels.

In our study, we examine factory level data to tease out the important factors the influence firms' voluntary decisions to adopt EMPs. Following Ervin et al. (2006) and Jayasinghe and Udugama (2011), our conceptual understanding is the decision maker gets utility (U) from undertaking environmental management in the firm. Accordingly, $U_i = u[V(EMP_i | I_{ji}, F_{ki})]$, where V represents gains from adopting environmental practices by the factory and EMPi represents different EMPs adopted by the factory (Jayasinghe and Udugama, 2011). These EMPs are influenced by regulatory and market based factors and factory's characteristics.

$$EMP_i = a + b_j I_{ji} + t_k F_{ki} + e_i \quad (1)$$

where I_{ji} refers to j different incentives faced by the factory i for the adoption of EMPs and F_{ki} refers to the k factory characteristics of the i^{th} factory.

5. Adoption of Environmental Practices among Factories

In this section we present descriptive statistics and graphical analyses of our data. We then undertake econometric analyses to assess which factors may be most important in influencing adoption of EMPs.

5.1 Data and Descriptive Analyses of Firm Behaviour

Our data for these analyses come from a survey of 55 BOI-registered factories in the Western Province of Sri Lanka, where a majority of textile and apparel factories are located.[12] We randomly selected 65 factories out of the 221 BOI-registered factories which operate in the Western province.[13] We emailed a questionnaire to the managers and also hand-delivered a copy to the highest officer in charge of safety and compliance. Following up with frequent telephone reminders, we were able to gather data from 55 questionnaires.[14] We focused on BOI-registered factories because the value addition from this sector to GDP and export earnings is significant.

The survey recorded information on a number of factors including location, years in operation, type of company, share of foreign exports, monthly sales, number of employees and type of activities undertaken at the factory. Managers were also interviewed about certifications received by the factory, EMPs and presence of environmental audits at the factory level.[15] In addition to factory's characteristics, we were interested in the impact of regulatory practices and external pressures. Managers were, thus, questioned about inspections by environmental officers and fines they may have received. Finally, they were asked to evaluate the level of pressure (on a scale from 1 to 5) for compliance with environmental regulations and/or adoption of EMPs, they may have received from i) the Apparel Exporters Association (AEA); ii) the Central Environmental Authority (CEA); iii) the local community; iv) the buyers, and v) the owners.[16] The full list of variables useful for our analyses and their definitions is given in Table 2. Due to multi-collinearity problems, variables only with * in Table 2 and 3 are used in the regression analysis.

Descriptive statistics shown in Table 3 indicate that around 60% of the surveyed firms are located within an EPZ and 91% are export-oriented (i.e., more than 90% of their sales are made outside the domestic market). The average factory in our data set is 17 years old and has 843 employees (ranging from 35 to 3,800). Per Sri Lanka's industry

[12] Some two-thirds (221) of all the BOI-registered factories are located in the Western province (Colombo, Gampaha and Kalutara districts), see Appendix Figure A3 for a map of the country and districts.

[13] Colombo district records the highest number of factories (163 BOI- registered factories) and the highest per capita income compared to other districts in Sri Lanka. There are 44 BOI-registered textile and apparel manufacturers and five EPZ in Gampaha district and 14 factories and one EPZ registered in Kalutara district.

[14] 25 are located in Colombo district, 23 in Gampaha, and 7 in Kalutara districts; and 33 are located within an EPZ.

[15] This information was reported by the interviewees. We visited all of the 10 case study factory sites.

[16] Owners represent owner- entrepreneurs of the factories if it is a sole proprietorship, partnership or a public limited company. If it is a public limited company the owner represents the Chairman or Managing Director. If it is a branch of the foreign company the owner represents the foreign entrepreneur.

laws, a factory is large scale if it has at least 25 employees. Thus, 100% of the factories surveyed are large factories per their number of employees. Furthermore, 90% of factories are classified either as A or B category because of more than 200 employees per shift.

Figure 1 depicts environmental management practices among the surveyed factories: 27% (15 factories) are ISO 14001-certified, 42% do water re-cycling, almost all (87%) re-use material (e.g. paper and fabric), and 37% have had environmental audits. Only two factories do not undertake any EMPs, while 18% (10 out of the 55) of factories are ISO 14001-certified, recycle water, reuse material, and have been audited on their environmental practices (Table 5). Of those factories undertaking only one EMP, the most common practice is material reuse (11 out of 15 factories), as shown in Table 5. This suggests that material re-use is one of the easiest or least-costly EMP that firms can adopt.

In Figure 2, we report the proportion of factories undertaking each of the four EMPs for factories outside an EPZ (22 observations) and factories located within an EPZ (33 observations). This graph shows that, on average, the factories that are located within an EPZ engage voluntarily more often in water recycling, are more often audited, and are more likely to have an ISO 14001 certification. Simple statistics show that factories located within an EPZ have more employees, on average, than factories located outside an EPZ but the difference is not statistically significant. In general, this Figure shows the being located in an EPZ seems to make factories more environmentally friendly.

In Figure 3, we compare factories with washing and dyeing operations (10 observations) with the group of factories not doing any washing and dyeing (45 observations). Dyeing and washing are activities that require large quantities of water and contribute the most to water pollution in the textile and apparel sector. However, contrary to this generally held view, the graph suggests that the factories that do washing and dyeing operations are more likely to voluntarily adopt the four EMPs. Thus, these firms appear to be taking on additional practices to clean an inherently more dirty set of activities.

Managers believe that they are under moderate pressure to comply with environmental regulation: pressure is around 3 on average, on a scale from 1 to 5. The strongest pressure comes from the buyers (3.96 on average) followed by the owners (3.76), while AEA and the community exert the least influence on factory managers' compliance decisions (Table 3).

5.2 Econometric Analyses of EMPs Adoption

We estimate the following Poisson model where the dependent variable is the number of EMPs undertaken at the factory:

$$Pr(EMP = y) = \frac{\theta^{-\mu}\mu^{y}}{y^{i}} \qquad y = 0,1,2,3, or\ 4 \tag{2}$$

The parameter $\mu\mu$ is called the intensity or rate parameter. The Poisson model is estimated using Maximum Likelihood.

The dependent variable in model (2) represents the number of the following EMPs adopted by the factory: 1) ISO 14001-certification,[17] 2) water recycling,[18] 3) material re-use,[19] and 4) environmental audits.[20] Hence, the variable EMP in model (2) can take five possible values: 0, 1, 2, 3 and 4, where 0 refers to no EMP, 1 indicates that only one of these four EMPs is undertaken, etc. (see Table 4).

[17] ISO 14001certification represents a voluntary action of taken by factories. This certificate ensures the factories have taken voluntary actions to set targets, implement strategies, and make necessary adjustments to minimize the environmental impacts due to their production process. There are certification bodies with international accreditation to issue ISO 14001 and 9001 standards in Sri Lanka.

[18] In the paper, water recycling means that factories have taken necessary steps to recycle the used water/ waste water before discharging it to the municipal waste or before using for some other purposes such as toilet flushing or gardening. Some factories have established their own waste water treatment plants where as others have given this as a contract to a third party.

[19] Different types of waste materials are generated such as fabric waste , cones, bulbs, water, dye, paper, cardboard, tires, food, etc. Some of these waste materials are used for the second time by factories. For example; fabric wastes are used at the canteen, factory floor, for boilers etc. Used cones are reused for the same purposes. Paper waste is used for making bags, and canteen as welfare services. Tires and plastic cans are used for gardening purposes.

[20] Environmental audits are conducted by two parties. Internal audits are carried out by compliance department, maintenance department or engineering department. They compare the energy targets, and environmental related targets with the actuals. The external audits are conducted by either certification bodies or buyers, or agents from buying office.

Based on our literature review, we hypothesize that factors such as firm size, market-orientation, type of activities undertaken, location on an export zone and pressures from different parties affect factory's behaviour. Firm size is measured through the number of factories owned by the company (variable *nofactories*). We control for market orientation of the factory using a dummy variable that takes value 1 if more than 90% of its sales are exported, and 0 otherwise (*i_foreignexp*). Type of activities undertaken on the factory premises is captured by six dummy variables that represent factories oriented towards dyeing, washing, weaving, apparel manufacturing, embroidery, and accessories *(i_dye, i_wash, i_weaving, i_apparel, i_embroid*, and *i_access*, respectively). We are not able to directly measure the role of monitoring and enforcement or regulatory pressure since none of the 55 factories has been fined (even though 54 out of 55 have been inspected). However, we create a variable (*av_pressure*) that indicates the firm's perception on overall pressure it feels from different sources (regulatory and market) to comply with environmental standards. Finally, we control if the factory is located within an EPZ or not (*i_boiepz*). The model that is presented here provides the best fit to our data. Other explanatory variables were available in the database (see Table 2) but were not used in the model to avoid multicollinearity problems.

The regression results are shown in Table 6. The Wald test indicates overall significance of the model even if the Pseudo-R2 is only 0.09. The average marginal effects indicate the expected change in the number of EMPs following a one-unit change in the corresponding explanatory variable. Our results in Table 6 show that factories belonging to larger companies (as measured by the number of factories belonging to the same company) are significantly more likely to undertake more EMPs. This suggests that there may be some economies of scale in implementing EMPs, i.e. the larger the scale or replicability of the EMP practice, the more likely there will be a corporate strategy for adopting EMPs.

As expected, a higher proportion of sales directed towards the foreign markets is associated with a significant increase in EMPs. This result, which is strongly reinforced in the next section on case studies, suggests that there is pressure from foreign customers to adopt environment-friendly production processes.

The type of activities undertaken by the factories also has a significant impact on the number of EMPs: factories that run dyeing operations, the most polluting activity, adopt 2.4 additional EMPs on average relative to factories associated with accessories (category of activity used as the reference), while washing is associated with a reduction in the number of EMPs (-0.9 on average). Factories that produce apparel are also more likely to engage voluntarily in EMPs (the marginal effect in terms of EMPs is estimated at 0.7). One possible explanation for the latter result (something discussed during the face-to-face interviews) is that apparel manufacturers directly deal with buyers whereas weaving and embroidery factories do not (they usually supply apparel manufacturers on contract basis). It is also interesting to note that, among BOI-registered firms, the most generally polluting firms, i.e. dying factories, undertake more EMPs. This suggests that even the most polluting firms can be transformed under the right circumstances.

The coefficient on ISO 9001-certification is significant and associated with 0.7 additional EMPs, which suggests that factories that get certified from external bodies adopt a higher number of EMPs. The ISO-9001 certification process is not focused on environmental issues. Yet, it seems to have a broader environmental effect on factories. It is also possible that such factories are also more open and pre-disposed to issues of sustainability and environmental management.

The coefficient of our variable on pressure from different sources is positive but not statistically significant. Finally being located in an EPZ increases the number of EMPs voluntarily adopted, which might reflect some (positive) peer or neighbouring effects (i.e. factories might be influenced by what other factories within the EPZ are doing).

6. Insights from Case Studies

As previously discussed ten case studies were undertaken to get a deeper understanding of their voluntary environmental practices. We randomly selected six factories out of 23 that were ISO 14001 certified in 2012 and four that were not certified from a list of factories registered with Sri Lanka's BOI.

Table 7 identifies the main characteristics of the chosen factories. Seven of the ten factories manufacture apparel, while three do washing and finishing. Except for one, all other factories have been in operation for more than five years, and at least two have been operating for 35 and 33 years, respectively.The number of employees in the ten factories ranged from 127 to 5,300. Thus, these factories were, on average, slightly larger in terms of employment, than the factories covered in the survey. Washing and finishing activities include spray painting, sand blasting, laser printing, and dyeing, and most of their employees are male. In all cases, employees are permanent workers. Nine out of ten factories produce exclusively for the export market with one factory producing for both the local and export markets. The monthly turnover of all ten factories is greater than SLR 5 million (USD 38,461). Except for two factories, the monthly turnover varies between SLR 15 million (USD 115,384) and SLR 50 million (USD 384,615). Only one out of the ten factories is located within an EPZ.

We were able to obtain more details on EMPs relative to what we were able to learn from the survey data. EMPs in the selected factories are identified in Table 8.They include certification, prevalence of environmental practices such as recycling, rain water harvesting, energy efficiency improvements, presence of an environmental policy and environmental management staff, dissemination of environmental policies etc. We discuss below how the case study factories fared in terms of these indicators.

Six factories out of ten have ISO 14001 certification, whereas three factories have ISO 9001 certification. Some 50% of the factories had also won awards related to the environment.Nine factories out of ten have their own environmental policy.[21] When in place, the policy is usually posted in different places inside the factory: at the entrance, in the canteen, in the lobby, in the production floor, in the toilets etc. Sixty percent of the factories had separate division of Environmental Management Systems (EMS) and qualified staff who receive frequent training. Managers' interest towards practicing EMS ranged from moderate level (five out of ten) to high level of interest (five out of ten).

Most of the factories reuse paper, fabric, and plastic cones. Fabric cuts are sold either to small scale producers who produce some by-products or to a collector who exports the fabric cuts to China for recycling purposes. Seven[22] out of ten factories had water treatment plants and reuse recycled water for gardening and toilet flushing (leading upto 25% reduction in water use in one case). One factory reported that clean water usage and wastewater generation have been significantly reduced due to new ozone machines[23] and implementation of rainwater harvesting.

All ten factories monitor energy use and use innovative methods to improve energy efficiency such as layout planning, sky lighting, solar energy, LED bulbs, and improved air conditioners and broilers. Seven factories have identified some benefits of energy use monitoring, even if the direct and indirect benefits are difficult to evaluate. Most managers agreed that the payback period of these energy-related investments is very short in general.[24] Finally, two out of ten factories sell fluorescent bulbs to one bulb manufacturer who recycles them in Sri Lanka. (Table 8)

In discussions, managers expressed interest in developing their EMS further. One factory plans to increase solar power production as well as the amount of organic food production using compost produced by the factory. Another one has plans to increase the level of day light as a natural lighting source to the production floor, to increase the use of fluorescent bulbs, and to conduct an energy survey in the factory. One factory is interested in replacing LED bulbs, introducing solar power systems, establishing a bio gas plant, and constructing absorption chillers in their factory. One factory also intends to establish a water recycling plant and to apply for ISO 14001 certificate next year. Another one is interested in establishing a power station using coal, in using groundwater from the factory premises, and in buying ozone machines. Two factories intend to construct water boilers powered by saw dust.

[21] When the factory belongs to a group, then the environmental policy of the company applies to all factories in the group.
[22] Five factories have their own water treatment plants run by the factory itself and two factories have contracted out the water treatment plant to an outside contractor.
[23] Ozone machines are improved washing machines which use less water for washing purposes and do not discharge wastewater after washing.
[24] For example cost of an improved rice steamer in the canteen can be covered within 2 and half months.

In general, the case studies reinforce the econometric results and show that large firms are very cognizant of their environmental footprint and have undertaken voluntary measures beyond what is required by law. According to the factory managers, the high level of compliance and voluntary adoption of environmental management practices is due to substantial buyers' pressure. Major companies in Europe and the USA are concerned about the environmental impact of the production process in the factories and conduct their own audits. These audits are conducted by company representatives and cover health, safety, and environmental issues. In most cases, these audits are carried out each time a purchase order is placed. Hence, factories selling to major brands have a large incentive to comply with international safety and quality standards.

Furthermore, factories located within the BOI zones have strong ties to the BOI Environmental Department. For example, factories are required to treat effluent to meet interim standards and the BOI Environment Department treats further using common waste water treatment plants to meet national standards. Factories in the zones are also closely supervised by the BOI Environment Department officers with frequent inspections and follow up procedures. In contrast, factories located outside the zones maintain their own waste water treatment plants, and have little close supervision by monitoring authorities (they are probably inspected once a year). In addition, when the factory is located outside BOI zone, it is generally small or medium sized and its commitment to adopt EMS is comparatively low.

The effect of scale on EMPs adoption is also identified through the case studies. In Sri Lanka there are few leading apparel manufacturing group of companies; such as MAS Holdings (with 30 + factories), Brandix Group (with 25 + factories), Hirdaramani Group (around 20+ factories including leased or contract based factories), Timex Garments (about 10 factories). A group has an environmental policy which is followed by all their factories. When a factory belongs to a group, financial and technological capacities are much stronger than other factories. There is an EMS department at the group level, which drives the factories to adopt EMPs, by giving targets, training etc.

Leading apparel exporters have made some strategic decisions to maintain a competitive edge in the apparel export market. Building strong relationships with major buyers, securing a niche markets such as moving to intimates and sportswear and product and process development are increasingly important to firms. Under product and process development, several firms have converted their production process using Garment without guilt concepts, lean manufacturing processes, organic fabrics and green plant processes etc. (Wijayasiri and Dissanayaka, 2008). However, interviews with factory managers did not reveal that there is a price premium for the products which are manufactured with EMPs.

7. Conclusions

The textile and apparel industry in Sri Lanka is almost equally divided between textile manufacturing and apparel manufacturing factories. Because of the relative large presence of apparel related factories, Sri Lanka's textile industry is relatively less damaging on the environment. This is probably one reason why the level of compliance to environmental regulations in the textile and apparel sector in Sri Lanka seems to be quite high. In a survey of 55 firms, we found that 96% had implemented at least one environmental management practice and that almost all had been inspected but never fined. Further, discussions with officials from the Central Environmental Authority and BOI also suggest that compliance is moderately good. Detailed case studies of firms also reinforce the notion that the textile and apparel sector in Sri Lanka is willing to develop good environmental practices.

One of the main reasons the Sri Lankan textile and apparel sector operates with high environmental standards is because international buyers from Europe and the USA put pressure on Sri Lankan manufacturers to comply with environmental regulations. Almost all the firms surveyed had gone through environmental audits conducted by representatives of the major brands. The role of international buyers was also emphasized by factory managers interviewed for the case studies.

Several factory level characteristics influence a factory's decision to adopt environmental management practices. A factory that belongs to a group of firms is more like to increase its adoption of EMPs relative to a single factory. The type of production activity a factory is involved in is clearly important for the adoption decision. Since apparel is a dry production process, most apparel producers voluntary adopt EMPs. Interestingly, in our dataset, factories

that engage in more polluting activities (such as dyeing and washing) also adopt more EMPs. This is likely because these export-oriented factories are trying to make sure that their production is clean and perceived to be clean. Factories are also likely to adopt EMPs if they are ISO 9001 certified, even though this certification is not related to the environment. It is also interesting to note that factories within export processing zones fare better than those outside in terms of their environmental practices. Buyer's pressure also has a significant influence on factory EMP adoption. This is a major finding that emerges from the econometric analyses of factory data and the detailed case studies.

The case study findings reveal that large apparel and textile manufactures do more in terms of environmental management than the regulatory requirements. Findings also indicate that there are some benefits from adopting EMPs such as savings from waste recycling, energy use monitoring and energy efficiency. Interviews with managers suggest that adoption of voluntary mechanisms increases the competitiveness of their products in the export market.

The message for the policy maker is that that the buyers' pressure and internal savings are important factors that influence voluntary environmental practices. Therefore, in their awareness raising and networking activities for the industry, policy formulating and monitoring bodies should emphasize how firms can gain in terms of accessing a broader market, improving their reputation and obtain some internal savings by adopting EMPs.

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Tables

Table 1: Tolerance limits for wastewater from textile industry being discharged into inland surface waters (national and interim standards set by the CEA)

No	Parameter	Unit type of limit	National standards	Interim standards
01	pH at ambient temperature		6.5 to 8.5	6.5 to 8.5
02	Temperature	0C, max	40 measured at site of sampling	40 measured at site of sampling
03	Total suspended solids	mg/1, max	50	500
04	Biochemical Oxygen Demand (BOD5) in five days at 200c or BOD3 in a three days at 270c	mg/1, max	60	200
05	Colour	Wavelength range: Yellow range Red range Blue range	Maximum spectral absorption coefficient: 436 nm (7m-1) 525 nm (5m-1) 620 nm (3m-1)	Maximum spectral absorption coefficient: 400- 499 nm (7m-1) 500- 599 nm (5m-1) 600- 750 nm (3m-1)
06	Oil and grease	mg/1, max	10	30
07	Phenolic compounds (Phenolic OH)	mg/1, max	1.0	5.0
08	Chemical Oxygen Demand (COD)	mg/1, max	250	600
09	Sulphides (S)	mg/1, max	2.0	2.0
10	Copper, total (Cu)	mg/1, max	3.0	3.0
11	Zinc, total (Zn)	mg/1, max	5.0	10
12	Ammoniacal nitrogen (N)	mg/1, max	60	50
13	Chloride (Cl)	mg/1, max	70	900
Source: Environmental Norms, Board Of Investment of Sri Lanka (2011) and National Environmental Act, No 47 of 1980 as per the gazette of the Democratic Socialist Republic of Sri Lanka, Extraordinary, No: 1534/18, Friday, February 1, 2008.				

Table 2: List of variables and their definitions

Variable	Definition
i_Colombo	Equal to 1 if the factory is located in Colombo district, 0 otherwise
i_Gampaha	Equal to 1 if the factory is located in Gampaha district, 0 otherwise
i_Kaluthara	Equal to 1 if the factory is located in Kaluthara district, 0 otherwise
i_boiepz*	Equal to 1 if the factory is located in a BOI or EPZ zone, 0 otherwise
Yearsestab	Number of years since establishment of the factory
i_solep	Equal to 1 if the company is in sole proprietorship, 0 otherwise
i_partner	Equal to 1 if the company is in partnership, 0 otherwise
i_ltdliab	Equal to 1 if the company is a limited liability company, 0 otherwise
i_group	Equal to 1 if the company belongs to a group of companies, 0 otherwise
i_brforeign	Equal to 1 if the company is a branch of a foreign company, 0 otherwise
nofactories*	Number of factories owned by the company
i_foreignexp*	Equal to 1 if more than 90% of sales are exported, 0 otherwise
i_salesgr15	Equal to 1 if average monthly sales are greater than 15 M SLR, 0 otherwise
totalemployees	Total number of employees in the factory
sh_managers	Proportion of managers
i_dye*	Equal to 1 if dyeing activities are done at the factory, 0 otherwise
i_wash*	Equal to 1 if washing activities are done at the factory, 0 otherwise
i_weaving*	Equal to 1 if weaving activities are done at the factory, 0 otherwise
i_apparel*	Equal to 1 if apparel is produced at the factory, 0 otherwise
i_accesso*	Equal to 1 if accessories are produced at the factory, 0 otherwise
i_embroid*	Equal to 1 if embroidery activities are done at the factory, 0 otherwise
Nostaffems	Number of staff involved in EMS

i_degree	Equal to 1 if the highest qualified person in charge of EMS has a degree, 0 otherwise
i_iso14001	Equal to 1 if the factory is ISO 14001-certified, 0 otherwise
i_iso9001*	Equal to 1 if the factory is ISO 9001-certified, 0 otherwise
i_recycle	Equal to 1 if the factory is doing some water recycling, 0 otherwise
i_reuse	Equal to 1 if the factory is reusing any material (e.g. fabric, paper, or water), 0 otherwise
i_envaudit	Equal to 1 if the factory has undertaken some environmental audit, 0 otherwise
i_fines	Equal to 1 if the factory had to pay fines due to noncompliance with environmental regulations, 0 otherwise
i_inspect	Equal to 1 if the factory has been inspected, 0 otherwise
AEApressure	Level of pressure from the Apparel Exporters Association (AEA), scale from 1 (no pressure) to 5 (highest level of pressure)
CEApressure	Level of pressure from the Central Environmental Authority (CEA), from 1 to 5
communitypressure	Level of pressure from the community, from 1 to 5
buyerpressuree	Level of pressure from the buyers, from 1 to 5
ownerpressuree	Level of pressure from the owners, from 1 to 5
av_pressure*	Average level of pressure, from AEA, CEA, community, buyers, and owners
Note: Variables that are used in the econometric analysis are shown with *.	

Table 3: Descriptive statistics (55 cases)

Variable	Mean	Min	Max	Variable	Mean	Min	Max
i_Colombo	0.45	0	1	i_apparel*	0.71	0	1
i_Gampaha	0.42	0	1	i_accesso*	0.07	0	1
i_Kaluthara	0.13	0	1	i_embroid*	0.16	0	1
i_boiepz*	0.60	0	1	nostaffems	12.29	0	240
yearsestab	16.85	2	35	i_degree	0.53	0	1
i_solep	0.15	0	1	i_iso14001	0.27	0	1
i_partner	0.11	0	1	i_iso9001*	0.38	0	1
i_ltdliab	0.33	0	1	i_recycle	0.42	0	1
i_group	0.29	0	1	i_reuse	0.87	0	1
i_brforeign	0.13	0	1	i_envaudit	0.67	0	1
nofactories*	8.49	1	40	i_fines	0.00	0	0
i_foreignexp*	0.91	0	1	i_inspect	0.98	0	1
i_salesgr15	0.78	0	1	AEApressure	2.22	1	5
totalemployees	843.20	35	3,808	CEApressure	3.44	1	5
sh_managers	0.04	0	0.23	communitypressure	2.29	1	5
i_dye*	0.25	0	1	buyerpressuree	3.96	1	5
i_wash*	0.27	0	1	ownerpressuree	3.76	1	5
i_weaving*	0.11	0	1	av_pressure*	3.13	1	5
Note: Variables that are used in the econometric analysis is shown with *.							

Table 4: Number of EMPs undertaken by factories

No of EMPs	Freq.	Cumulative Freq.	Percent	Cumulative Percent
0	2	2	4	4
1	15	17	27	31
2	16	33	29	60
3	12	45	22	82
4	10	55	18	100
Source: Factory survey				

Table 5: Type and number of EMPs undertaken by the factories (55 observations)

Type of EMPs	Number of factories
single EMP	
Water recycling only	0
Material reuse only	11
Environmental audit only	4
ISO 14001 only	0
two EMPSs	
Water recycling and material reuse	4
Water recycling and environmental audit	0
Water recycling and ISO 14001	0
Material reuse and environmental audit	12
Material reuse and ISO 14001	0
Environmental audit and ISO 14001	0
three EMPs	
Water recycling and material reuse and environmental audit	7
Water recycling and material reuse and ISO 14001	1
Water recycling and environmental audit and ISO 14001	1
Material reuse and environmental audit and ISO 14001	3
four EMPs	
Water recycling, material reuse, environmental audit and ISO 14001	10

Table 6: Poisson model, Maximum Likelihood estimation results (55 observations)

	Coef.	Robust Std. Err.	P>z		Average marginal effect	P>z
nofactories	0.011***	0.004	0.007		0.024***	0.008
i_foreignexp	0.693***	0.169	0.000		1.200***	0.003
i_access (ref.)	-	-	-		-	-
i_dye	0.853***	0.167	0.000		2.437***	0.000
i_wash	-0.450***	0.152	0.003		-0.945***	0.000
i_weaving	0.257	0.194	0.184		0.640	0.236
i_apparel	0.334**	0.147	0.023		0.717*	0.051
i_embroid	-0.159	0.139	0.252		-0.337	0.218
i_iso9001	0.287***	0.107	0.007		0.655**	0.014
av_pressure	0.021	0.071	0.762		0.048	0.761
i_boiepz	0.207*	0.108	0.055		0.453*	0.088
constant	-0.610*	0.357	0.088			
Wald chi2(10)	74.73					
Prob>chi2	0.0000					
Pseudo R^2	0.0851					

*, **, *** indicate significance at the 10, 5, and 1 percent level, respectively.

Table 7: Description of case studies (CS)

Criteria	CS 1	CS 2	CS 3	CS 4	CS 5	CS 6	CS 7	CS 8	CS 9	CS 10
Ownership	Group	Group	Group	Holdings	Sole proprietorship	Partnership	Group	Group	Sole proprietorship	Holdings
District	Kalutara	Gampaha	Colombo	Kalutara	Kalutara	Monaragala	Colombo	Gampaha	Kalutara	Kurunegala
No of employees- (factory)	986	1,150	572	5,300	358	475	2,100	680	980	127
Years in operation	5	35	10	21	12	2	9	19	33	6
Located in EPZ	No	No	No	No	Yes	No	No	No	No	No
Business Operation type	Manufacturing of knit garments	Washing plant and apparel manufacturing	Washing, dyeing, finishing	Manufacturing of ladies foundation garments	Apparel	Apparel	Apparel	Washing	Manufacturing apparel accessories	Apparel
Market (share to export market)	100%	100%	100%	100%	100%	100%	100%	100%	70%	100%

Table 8: Environmental Management Practices by case studies

Criteria	CS 1	CS 2	CS 3	CS 4	CS 5	CS 6	CS 7	CS 8	CS 9	CS 10
ISO 9001 certificate	no	Yes	no	No	no	no	no	yes	yes	no
ISO 14001 certificate	yes	Yes	yes	Yes	no	no	no	yes	no	yes
Environmental policy	yes	Yes	yes	Yes	no	yes	yes	yes	yes	yes
Water recycling	yes	Yes	yes	Yes	NA	NA	NA	yes	no	NA
Materials reuse	plastic cones	plastic cones	NA	plastic cones	paper and fabric	paper and fabric	paper	paper	paper	NA
Availability of energy use monitoring	yes	Yes	yes	Yes	yes	yes	yes	yes	yes	yes
Employee competence on EMS	Trained staff	Trained staff	NA	Trained staff	NA	NA	Trained staff	Trained staff	Trained staff	Trained staff
Managers' interest towards EMS	high	High	high	moderate	moderate	moderate	moderate	high	high	moderate
Inspection by authority	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Figure 1: Number of factories adopting each of the four EMPs

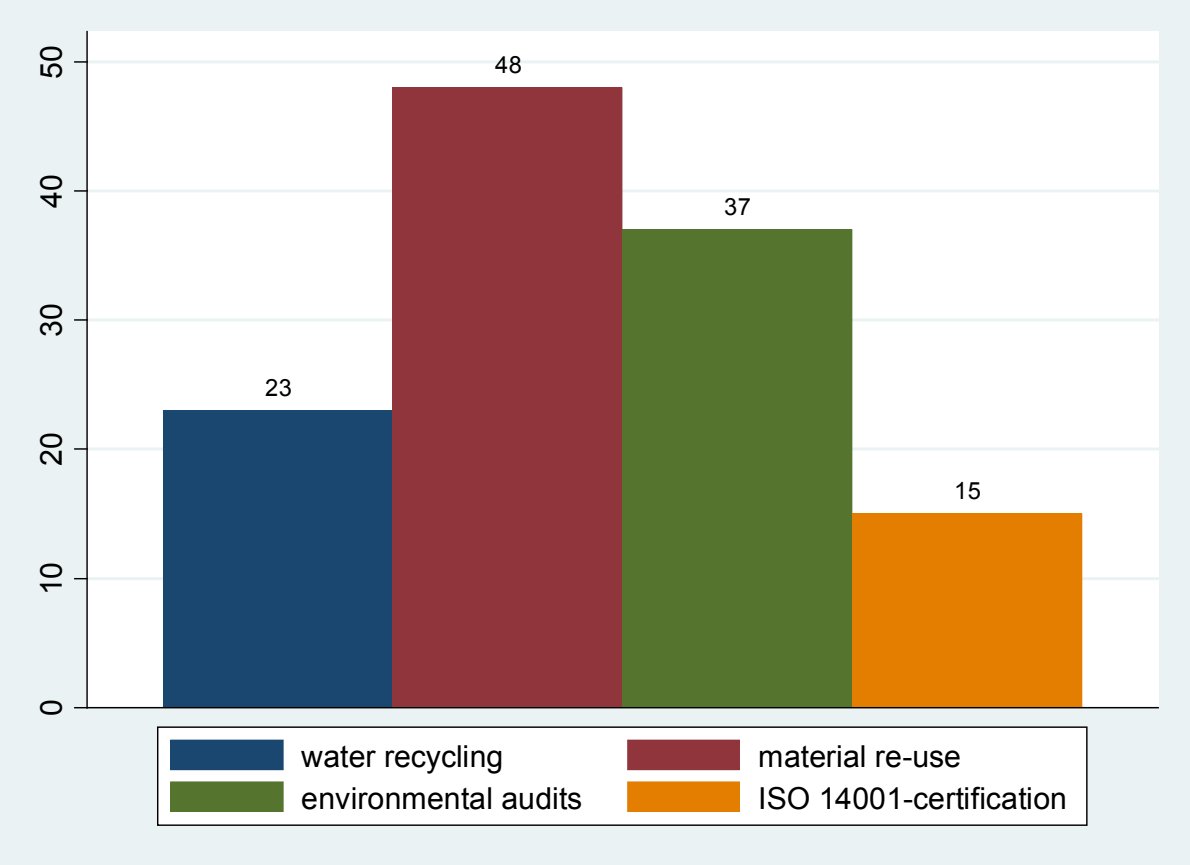


Figure 2: Proportion of factories adopting each of the four EMPs for factories outside and within an EPZ

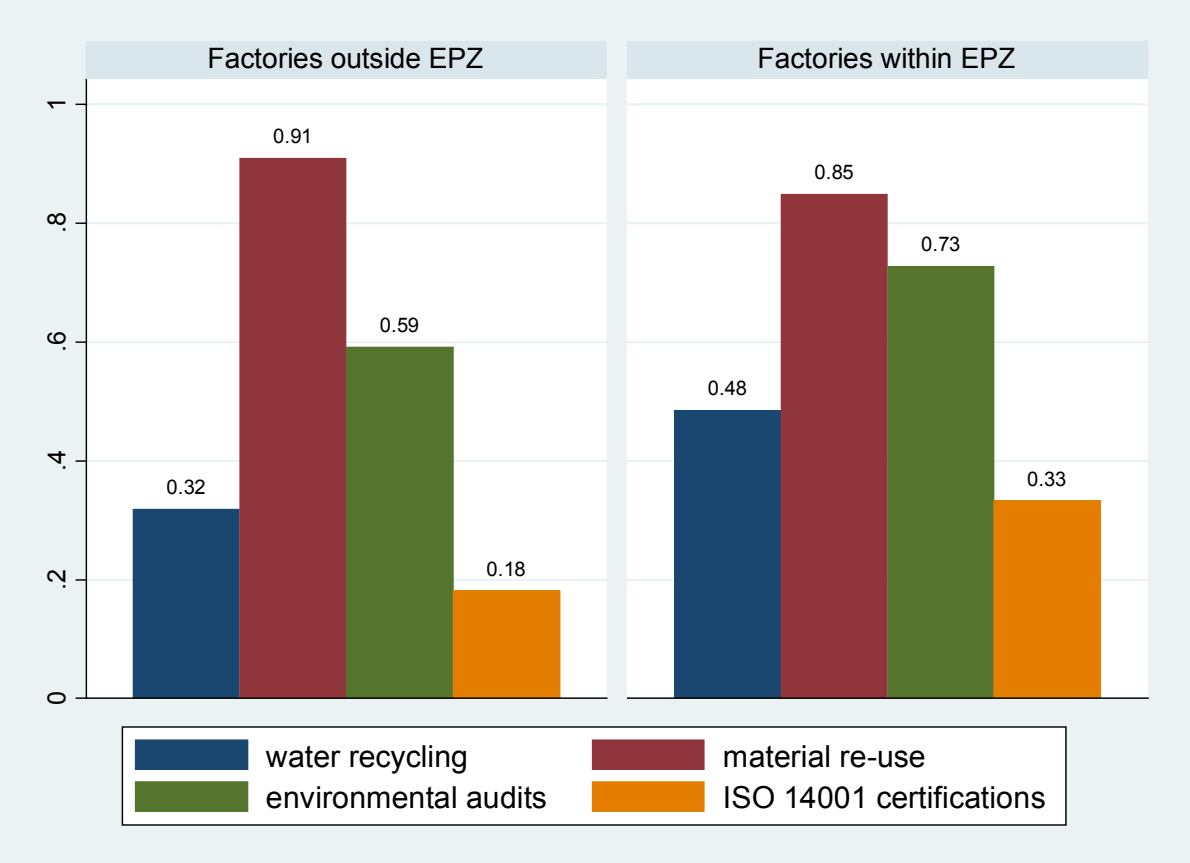
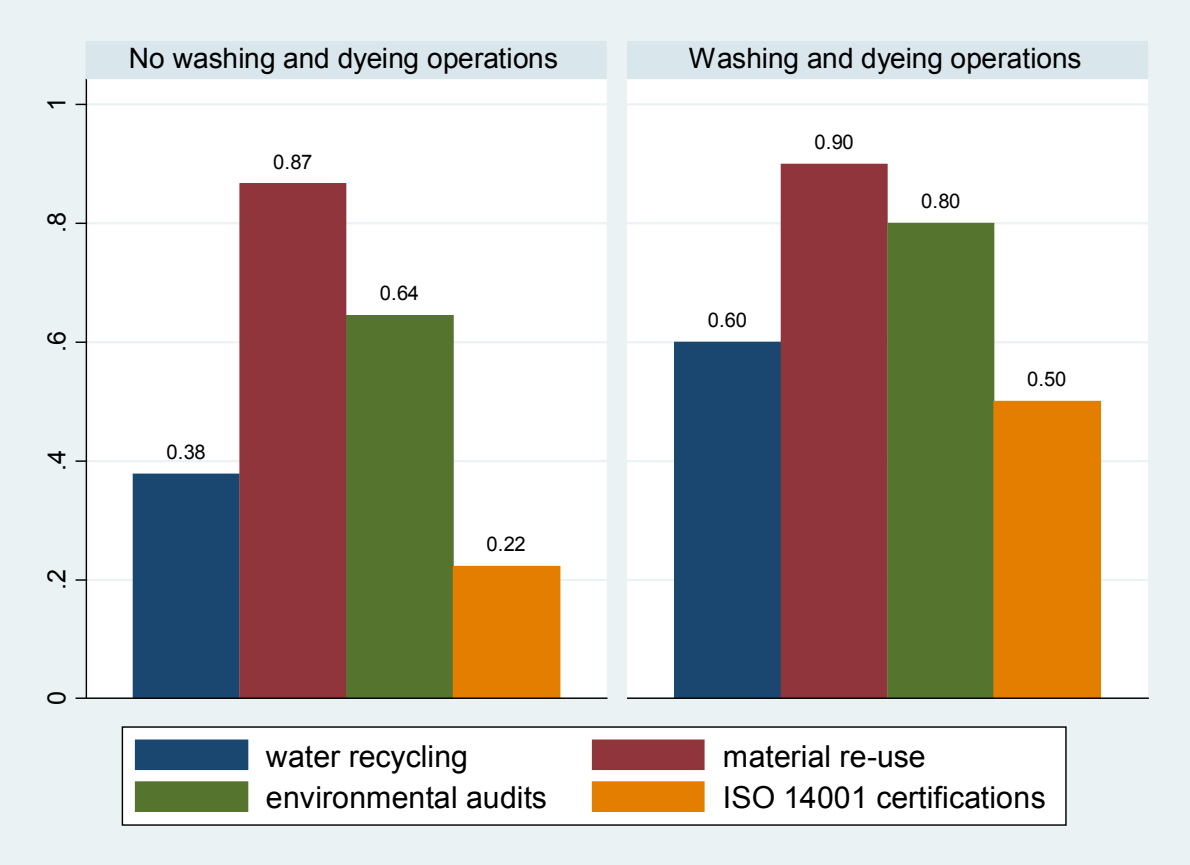


Figure 3: Proportion of factories adopting each of the four EMPs for factories with and without washing and dyeing operations



Annex 1: Industry Survey

Part I: About the respondent

1.1	Name: (Please write)	Mr ☐ Ms ☐ (Please put a ✓ here) ……. ……. First name Surname
1.2	Managerial position	(Please write) ……
1.3	Year of birth	(Please write) …….
1.4	Year of Appointment	(Please write) …….
1.5	Contact details:	(Please write) Telephone: …… Fax: …… E-mail: ……

Part II: About the Factory

2.1	Company name	
2.2	Factory name	
2.3	Location of the factory (please write)	Street City District …… Province …… Postal code
2.4	Whether the factory is within the BOI zone (please tick "✓" mark)	Yes ☐ No ☐
2.5	Y Year of establishment of the fafactory (please write)	……
2.6	Number of textile and apparel manufacturing factories that this company owns (please write)	……
2.7	Number of managerial level employees in the factory	……
2.8	Number of operational level employees in this factory (please write)	Permanent …… Temporary …… Contract basis ……
2.9	Monthly sales (please tick "✓" mark)	Less than Rs 5 Mn ☐ Rs 5 Mn – Rs 15 Mn ☐ Rs 15 Mn – Rs 50 Mn ☐
		If you wish, please indicate the average amount of monthly sales ……

2.10	Production items during the last month (please tick "✓" mark)	1. Below 500 pieces ☐ 2. 500- 1000 pieces ☐ 3. 1001- 10,000 pieces ☐ 4. More than 10,000 pieces ☐
2.11	Type of operation at the factory (please tick "✓" mark where it is appropriate) 1. Dyeing ☐ 2. Washing ☐ 3. Viewing ☐ 4. Apparel ☐ 5. Accessories ☐	
2.12	What share of this factory output goes to (please write) The export market .....%. 2. The local market .....%..	
2.13	Five years ago, what was the share of this factory output going to (please write) 1. The export market .....%. 2. The local market.....%.....	
2.14	If you have exports, what percentage of exports goes to (please tick "✓" mark) EU .....%..... USA .....%..... 3. Asia .....%	
2.15	What is the type of ownership of this factory? (please tick "✓" mark) 1. Sole proprietorship ☐ 2. Partnership ☐ 3. Limited liability company ☐ 4. Group of company ☐ 5. Branch of foreign company ☐	
2.16	What is the size of the share capital / capital at the factory? (please write) Rs.....	
2.17	Awards received by the company for their green environmental practices during the last 5 years	

Year	Name of the award	National or international	Awarding agency

2.18	Did your factory pay any penalty or fines for damaging environment or for any complaints by the neighbors nearby the factory? No ☐ Yes ☐ → ↓ 1. What was the reason? ..... 2. How much was the value of the penalty? ..... 3. Who imposed the penalty? .....

Part III: Present environmental practices / systems of the factory

3.1 Material used	Whether it is used as inputs in the following phases of production. (Please tick "✓" in the appropriate cell)				
	Washing	dyeing	apparel	textile	accessories
Water					
Chemical					
Dye					
Diesel					
Coconut shell					
Saw dust					

3.2 Waste generated	Whether it is a waste generated within the following phases of production. Please tick "✓" in the appropriate cell.				
	Washing	dyeing	apparel	textile	accessories
Water waste					
Chemical waste					
Dye waste					
Fabric waste					

3.3 If the factory engage in washing or dyeing; please answer the following questions;

1. Level of BOD in the waste water .....

2. Level of COD in the waste water .....

3. Availability of effluent treatment plant (ETP) No ☐ Yes ☐

4. Whether the ETP is operating at present No ☐ Yes ☐

3.4.1	Whether the factory has ISO 14001 (please put a ✓)	No ☐ Yes ☐ → ↓	3.4.1.1 Year it was awarded 3.4.1.2 Renewal period (please tick ✓) Annually 3 yearly 3.4.1.3 Name of the certification body ..... 3.4.1.4 Cost of Application Rs. ..... Inspection Rs. ..... Renewal Rs. ..... Any other Rs. .....
		If not, have you applied for (please put a ✓) No ☐ Yes ☐	
		If not, do you have plan to apply in next year (please put a ✓) No ☐ Yes ☐	

3.4.2	Whether the factory has Environment Protection License (EPL)	No ☐ Yes ☐	3.4.2.1 Year it was awarded 3.4.2.2 Renewal period (please tick ✓) Annually 3 yearly 3.4.2.3 Inspected by (please tick ✓) CEA BOI Other 3.4.2.4 How many times (during the past five years) the factory was inspected by the above parties? (please write .....) Department / section in the factory that is maintaining the files and documents relating to EPL (please tick √) HR Dept Engineering Dept Production Dept Other 3.4.2.6 Please tick ✓ on the types of documents you need to maintain for EPL Waste water quality report (Effluent treatment plant) Noise level control report Waste sludge thermal disposal certificates Bio mass consumption Indoor air quality report Flue gas analysis reports Stack particles (fly ash) report Ecotex certification for dye stuff of chemicals 3.4.2.7 Please tick ✓ on the types of documents you need to maintain for EPL renewal Cleanliness of water COD BOD Air pollution Solid waste treatments 3.4.2.8 Cost of Application Rs. ..... Inspection Rs. ..... Renewal Rs. ..... Any other Rs. .....

3.4.3	Whether the factory has ISO 9001	No ☐ Yes ☐ →	3.4.3.1 Year of awarded 3.4.3.2 Renewal period (please tick √) Annually 3 yearly 3.4.3.3 Cost of Application Rs. ..... Inspection Rs. ..... Renewal Rs. ..... Any other Rs. .....

Part IV: Reporting and publishing environmental management related information

4.1 Please put ✓ on the appropriate responses in the following table on issues relating to preparation of various reports by the factory to manage environmental impacts:	
Report Name	Period of reporting (If prepared)
4.1.1.Solid waste disposal reports No ☐ Yes ☐	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.1.2. Waste water test reports No ☐ Yes ☐	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.1.3. Effluent treatment plant discharge reports No ☐ Yes ☐	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.1.4. Boundary noise level reports No Yes	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.1.5. Flue gas analysis reports No ☐ Yes ☐	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.1.6. Hazardous waste disposal report No ☐ Yes ☐	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.1.7. Sludge disposal report No ☐ Yes ☐	Weekly ☐ Monthly ☐ Quarterly ☐ Annually ☐
4.2	4.2.1 Does this factory display any information about the ways of protecting the environment? (Please put ✓): No ☐ Yes ☐
	4.2.2 If yes, please put ✓ against the places where the display is made: 1. At the entrance ☐ 2. Factory floor ☐ 3. Canteens ☐ 4. Toilets ☐ 5. Office area ☐ 6. Lobby ☐ 7. Training centre ☐ 8. Any other places ☐
4.3	Does this factory have its own environmental policy? (Please put ✓) No ☐ Yes ☐

4.4	4.4.1 Does the company carry out environmental audit?	No ☐ Yes ☐	4.4.1.1 How frequently? (Please put ✓): Monthly ☐ Quarterly ☐ Annually ☐ 4.4.1.2 Who conducts the audit? (Please put ✓) Internal ☐ auditor ☐ External auditor ☐ 4.4.1.3 Have you published any audit report in last three years? No ☐ Yes ☐

Part V: Energy use and energy use monitoring methods

5.1	Please tick ✓ against the plants/equipments which this factory possesses:	
	1.Converting lighting equipments	
	2.Acquisition of improved air conditioners	
	3.Purchase of improved rice cookers	
	4.Water boilers	
	5.Purchase of hybrid vehicles	
	6.Introduction of sky lighting	
	7.Fixing of sensors at the factory area to switch off lights during breaks	
	8.Energy use monitoring methods (machines, computer programs)	
	9.Fixing small LED lights to the sewing machines	
	10.Arrangement of factory floor to save energy (painting, layout arrangements etc)	
	11.Recycling of water for reuse (toilet flushing, cooling purposes)	
	12. Water from the tube wells in the factory	
	13.Usage of waste for generating any energy source like biogas	

5.2 Waste disposal / waste handling at the factory (Please put ✓ where it is applicable)							
	Paper	Water waste	Fabric waste	Dye waste	Food waste	Air pollution	Scrap iron
1. Reuse							
2. Sell for reuse							
3.Sell for recycle							
4.Sell - unspecified							
5.Burn at the factory premise							
6.Burn outside the factory premise							
7.Give freely							
8.Dump to municipal waste collection							
9.Checking the cleanliness of recycled water							
10.Availability of safe chimney							
11.Cyclonic filter and water sprinkler system							
12.Please specify any other methods							

5.3 What is the level of benefits generated from recycling procedures to the factory? (please tick ✓ on the cell)					
	1	2	3	4	5
Reduction of resource usage					
Reduction of amount of waste					
Improvement of operational profits					
1 - no benefit 5 – highly benefitted					

5.4	What is the present energy use monitoring method at the factory? (Please put ✓ on the box where it is appropriate)					
	Level	1	2	3	4	5
5.4.1	The factory has taken actions to control energy use					
5.4.2	The factory has given targets to control energy use					
5.4.3	There are some machines to measure their energy use like kilo watt hour meters to measure electrical energy, steam flow meters					
5.4.3	The factory maintains records for energy use					
Strongly disagree 5 – strongly agree						
5.4.4	Number of employees engage in energy use monitoring in the factory (please write in numbers)	.....				
5.5	What is the present environmental management system at the factory?					
5.5.1	There is a separate section to deal with environmental responsibilities No ☐ Yes ☐					
5.5.2	They incorporate any environmental commitments in their activities No ☐ Yes ☐					
5.5.3	There any separate section for environmental responsibilities in the company No ☐ Yes ☐					
5.5.4	No of staff members involved in the environmental management system (please write in numbers)					
5.5.5	They are qualified to conduct EMS No ☐ Yes ☐					
5.5.6	They are given training often No ☐ Yes ☐					
5.5.7	The qualifications with the mangers at the EMS Degree holder ☐ Certificate level ☐ School leaver ☐					
5.5.8	Please mention the percentage of spending on research and development other than product development (please mention as a percentage of total operating expenditure, annually)					

Part VI: Reasons for practicing environmental friendly practices

6.1 How would you consider the degree of the pressure on environmental practices from following parties? (Please put √)					
Level	1	2	3	4	5
1. Industrial association					
2. Regulators					
3. Local communities					
1 - None 5 – Very high					

6.2.1	Any increase in demand for eco-friendly products in the last 5 years? (Please put ✓): No ☐ Yes ☐
6.3.2	Do your customers specify any environmental friendly production system? (Please put ✓): No ☐ Yes ☐

6.3.3	Do you charge any additional price for eco friendly products when compared to normal or products without environmental friendly features/ production systems? (Please put ✓): No ☐ Yes ☐
6.3.4	Do your buyers conduct any of the following types of audits by themselves? (Please put ✓): No ☐ Yes ☐ SWOP ☐ GAT ☐
6.3.5	How would you consider the degree of pressure from buyers' or customers'? (Please put ✓): 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 1 - No pressure 5 - Highest level of pressure
6.3.6	Do your foreign buyers subsidize part of environmental management systems? No ☐ Yes ☐
6.3.6	Do your local competitors follow environmental friendly business/ production practices? (Please put ✓): No ☐ Yes ☐
6.3.7	Do you have any concern about your local competitors' environmental friendly business/ production practices? (Please put ✓): No ☐ Yes ☐
6.3.8	What is the cost of implementation of EMPs? Capital expenditures / capital investments Rs ..... Recurrent expenditures: Monthly Rs..... Annually Rs.....
6.3.9	What percentage or rupee amount of cost is saved with the environmental management practices in the factory? Monthly Rs..... or .....% Annually Rs..... or .....%
6.3.10	How would you consider the degree of pressure from owners' of the factory? (Please put ✓): 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 1 - No pressure 5 - Highest level of pressure

Table A1: Major provisions in the environmental regulations of Sri Lanka

Rule / Act No	Clause	Remarks
National Environmental Act, No 47 of 1980	Section 9	Appointment of District Environmental Agency
	Section 10 (1)	The powers, functions and duties of the Authority
	Section 23	Environmental research
	Section 24	Furnishing of information
	Section 25	Appointment of analysts and Pollution Control Officers
	Section 31	Violation of the Act and regulations and fines
National Environmental (Amendment) Act No 56 of 1988	Section 10	Increase of power, functions and duties of the Authority
	Section 23A	Prohibition of the discharge, emission of deposit of waste into the environment
	Section 23B	Issue of a license
	Section 23C	Refer the application to Government Department or Public Corporation
	Section 23D	Suspense or cancellation of license
	Section 23E	Appeal against refusal of license
	Section 23G	Restriction on regulation and control of pollution of the inland waters.
	Section 23H	Pollution of inland waters of Sri Lanka
	Section 23L	Failure to fit and maintain prescribed control devices an offence
	Section 23U	Failure to comply with notice an offence
	Section 23X	Certificate to be prima facie evidence of facts stated therein.
	Section 23AA	Approval of prescribed projects
	Section 23BB	Submission of environmental impact assessment report
	Section 24A	Power to enter and inspect
National Environmental (Amendment) Act No 53 of 2000	Section 23A	Power to issue a license
Environmental Protection License Prescribed activities (Gazette notification No 1533/ 16 of 25 01 2008)	Section 23A	Prescribed activities for which a license is required
National Environmental (Protection and Quality) Regulations, No. 1 of 2008	Section 23A	Issuance of EPL for emission or disposal of waste

Source: National Environmental Act, No 47 of 1980, National Environmental Regulations 2008, 1998

Figure A1: Export earnings from 2009 to 2014 (March records)

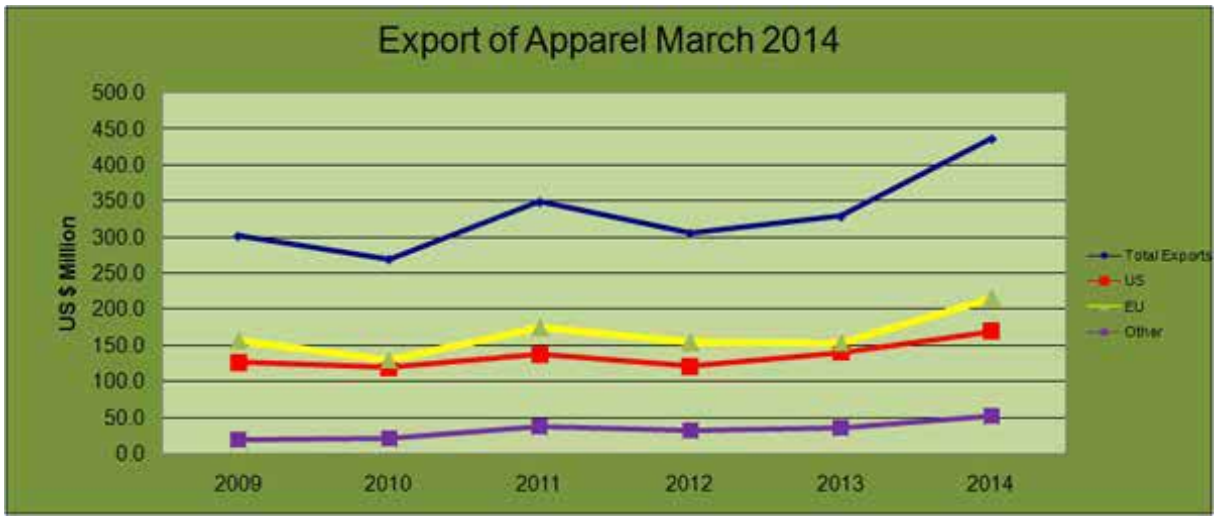


Figure A2: Procedures for obtaining an EPL

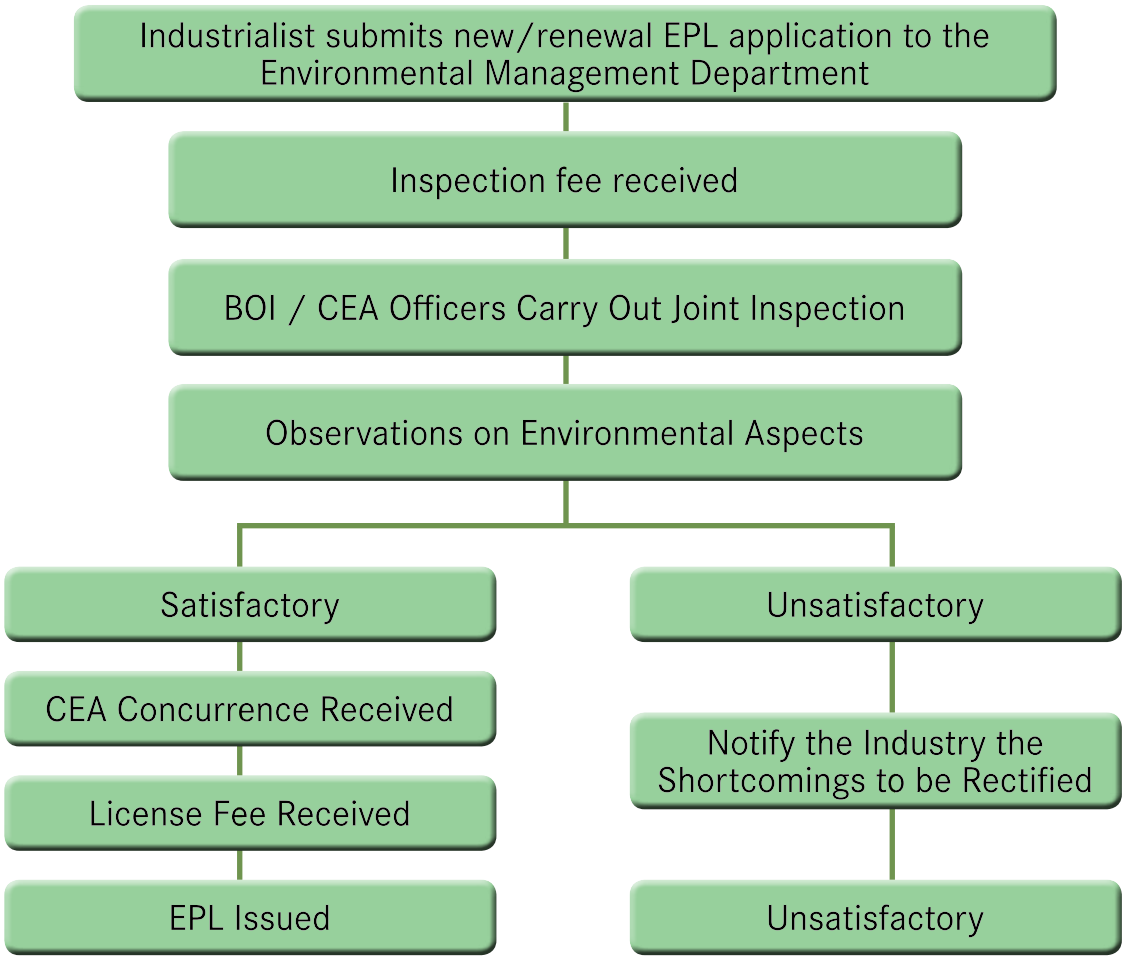
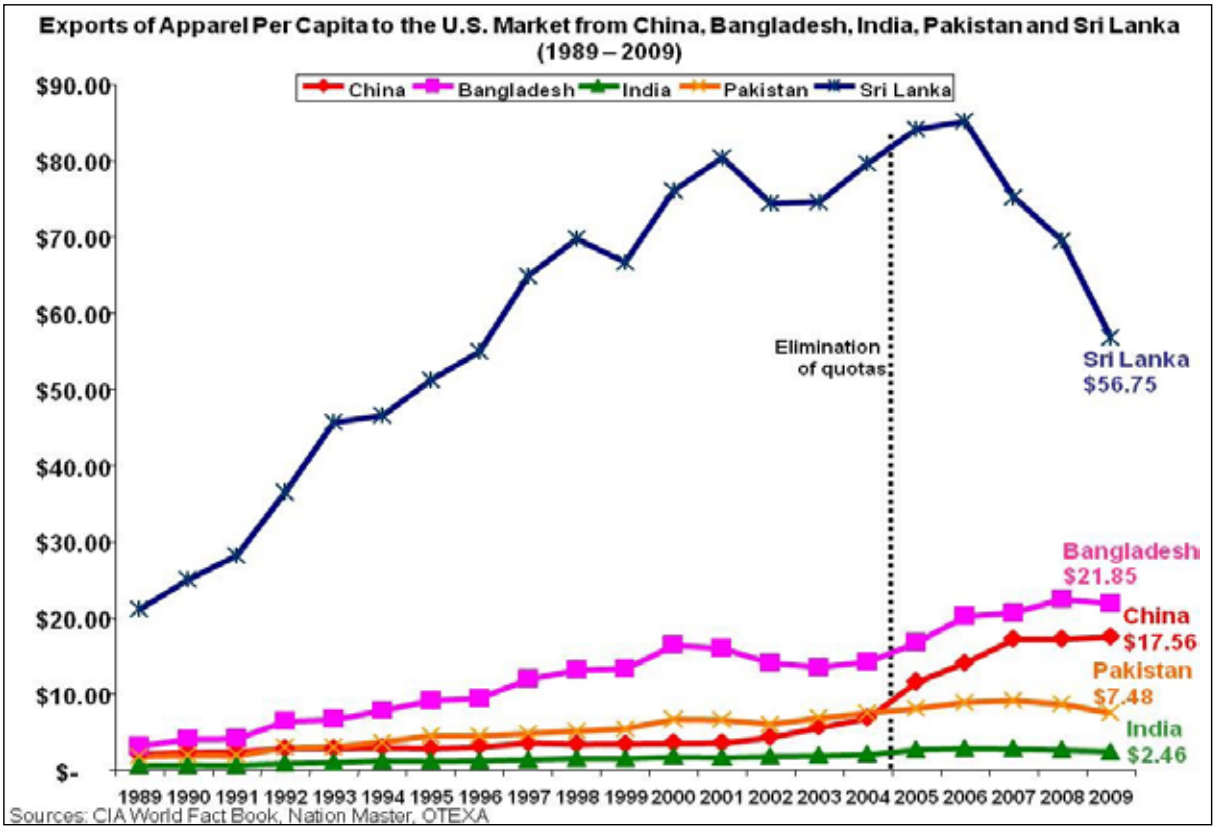
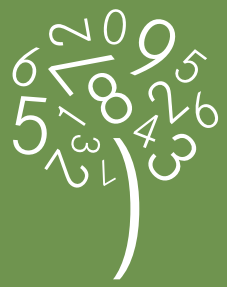


Figure A3: District Map of Sri Lanka

Source: Google map

Figure A4: Exports of Apparel per capita to the US





SANDEE

P.O. Box 8975, E.P.C 1056, Lalitpur, Nepal

Street address: c/o ICIMOD, Khumaltar, Lalitpur, Nepal

Tel: 977 1 5003222**, Fax:** 977 1 5003299**, Email:** info@sandeeonline.org, **Web:** www.sandeeonline.org

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