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Cleaner Production in Pakistan's Leather and Textile Sectors

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Abstract

This study evaluates the dissemination of cleaner production in Pakistan's industrial sector by assessing the performance of two of Pakistan's three cleaner production (CP) centers. The study examines the adoption of CP measures by firms, as well as firms' compliance with Pakistan's National Environmental Quality Standards and certification to ISO 14001. A survey of 80 leather tanneries and textiles processing firms served by a CP center is the primary data source.

Surveyed firms adopted the majority of CP measures proposed by the centers, even though firms had little understanding of CP concepts. Many of the commonly reported factors motivating CP adoption were present, but one was conspicuously absent: the need to meet ambient environmental quality standards. Survey results also indicate that firm size and engagement with foreign business customers are correlated with: the adoption of CP, the establishment of environmental management systems and certification to ISO 14001.

Keywords: Pakistan; tanneries; textiles; cleaner production; ISO 14001; management systems.

1. Introduction

For more than 15 years several initiatives have been launched to advance cleaner production (CP) practices in Pakistan. Among the key actors in moving CP forward, those that stand out involve Pakistan's cleaner production centers, which have been funded by trade associations, domestic and foreign government organizations, and international aid institutions. Examples of

donors include: the Government of Pakistan, the United Nations Environment Program, the Norwegian Agency for Development, and the Royal Netherlands Embassy.

This paper examines CP at leather tanneries and textile processing firms served by two of Pakistan's three CP centers.¹ The Cleaner Production Institute (CPI) has the broader scope of the two and provides services (primarily in Lahore, Karachi and Faisalabad) to firms engaged in leather tanning and textile processing, and to a lesser extent in the sugar and pulp and paper sub-sectors. The second center examined herein, the Cleaner Production Center (CPC), is headquartered in Sialkot, a city north-west of Lahore near the Indian border, and works with leather tanneries in and around Sialkot. These firms are almost all small and medium sized enterprises (SME), defined herein as firms with at most 250 employees. More than 250 employees is a commonly used basis for distinguishing SMEs from large firms in Pakistan. Over 95% of manufacturing SMEs in Pakistan have fewer than 10 employees (Kureshi et al. 2009).

There is general agreement in the literature that barriers and drivers for adopting CP measures can be usefully divided into three broad categories:²

- Government actions, including promulgation and enforcement of environmental standards as well as market-based instruments, such as effluent charges and tradable pollution permits.

¹The third center, the National Cleaner Production Centre-Foundation is a for-profit organization that provides services (primarily to the oil and gas sector) that include: compliance monitoring of industrial effluent and emissions, incineration and bioremediation to dispose hazardous waste, environmental impact assessments and energy audits. It is omitted here because we were unable to collect sufficient high-quality data from the firms served by NCPC-F.

² For examples of recent literature reviews, see Murino-Luna et al. (2011) and Montalvo (2008).

- Market-based pressures, including green supply chain demands from business customers and high production costs.
- Community demands, reflected in environmentally-related pressures exerted by NGOs and the media as well as the public at large.

Few generalizations about barriers and drivers can be made because high variations in CP adoptions exist across countries, industrial sectors and firm sizes (Luken and Van Rompaey, 2008). Moreover, variations exist even for a particular country, sector and firm size: for example, some leather-sector SMEs in Pakistan have embraced CP whereas others have not.³ However, there is agreement in the literature that SMEs have particular challenges in implementing CP measures.

This study uses survey results to evaluate the overarching motivations and obstacles in adopting CP measures in Pakistan's industrial sector. The study also presents results concerning firms' certification to ISO 14001 and compliance with Pakistan's National Environmental Quality Standards (NEQS). It is based primarily on a random sample of firms served by CPC and CPI, with an emphasis on leather tanneries and textiles processing firms; leather and textiles are Pakistan's leading export products. In addition to the survey, interviews were conducted with officials in environmental protection agencies (EPAs) and representatives of trade associations. Arguably, CPC and CPI together have undertaken the most ambitious efforts to diffuse CP among firms in Pakistan.

³ On this point more generally, see Darnall (2001).

The remainder of the paper is organized as follows. Following a description of data gathering methods, the paper examines the extent to which surveyed firms are aware of and in compliance with environmental regulations. The next two sections analyze the impacts of the cleaner production centers on CP adoption at surveyed firms and the firms' evaluation of the centers' work, respectively. Then we examine the extent to which surveyed firms were aware of environmental management systems (EMS) and compliant with ISO 14001. The penultimate section considers the results in the broader context of the literature on factors affecting CP adoption; the final section summarizes key conclusions.

2. Data Gathering Approach

A survey was conducted during 2009 and 2010 of a random sample of tanneries and textile firms served by CPC and CPI. In addition, interviews were conducted with: (i) staffs at CPC and CPI; (ii) officials with Pakistani EPAs; and (iii) staffs of relevant business chambers, trade associations, and NGOs.

Our survey involved structured interviews that lasted three to five hours each. Typically, individuals interviewed included a firm's CEO and/or its top managers. The survey documents 42 of the 222 leather tanneries using the services of CPC, and 8 of the 45 tanneries served by CPI in Lahore and Karachi. The survey also presents data for 30 of the 117 textile processing firms served by CPI. In the survey results presented herein, sample sizes are slightly lower because of missing responses to some survey questions.

The survey concentrated on leather and textiles because they are key sectors in Pakistan's manufacturing economy, and because textile production and leather tanning are the most polluting processes in these sectors, which are known to contain major pollution sources. While leather is not as important as textiles in contributing to Pakistan's economy, the pollution from

leather elevates its significance from an environmental perspective. In presenting results below, “n” represents the size of the sample that contained usable responses for the variables presented.

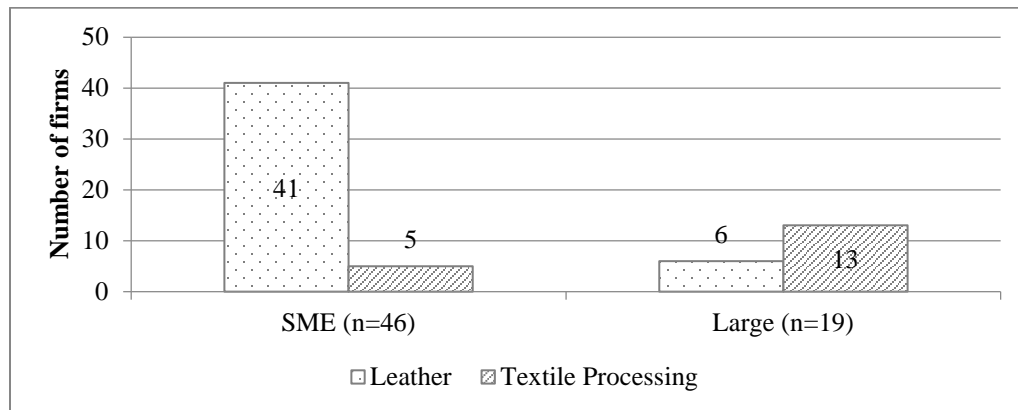
A survey questionnaire was used to structure interviews at each firm in the study and the main parts of the questionnaire are summarized here. The initial section was used to document the understanding of the concept of cleaner production on the part of the interviewee representing the firm; it also included questions about the extent to which the firm had conducted environmental and/or energy audits. The next section, which was the most extensive, included questions concerning several issues, including: the CP measures implemented by the firm and why those measures were selected, the firm’s benefits and costs from implementing CP, and obstacles to CP implementation. This section also included questions about the firm’s compliance with environmental regulations and whether it had an environmental management system. Another section of the questionnaire covered general environmental policy issues, including the identification of policies that hindered CP implementation. Still another section asked questions about how the firm interacted with the CP center that provided it with assistance.

3. Awareness of and Compliance with NEQS

Figures 1 and 2 present data from surveyed firms that responded fully to questions on NEQS awareness, NEQS compliance, firm size and whether or not they exported outputs. Figure 1 shows the distribution by firm size of the 65 firms providing usable responses: 89% of the SMEs are tanneries, whereas 68% of the large firms are engaged in textile processing. The awareness of NEQS among surveyed firms varied significantly by firm size. Larger firms were more aware of

NEQS than SMEs: all but one of the surveyed large firms were aware that NEQS existed, while only one-third of the SMEs were aware that Pakistan had such standards.

Figure 1: Industry Distribution in Terms of Firm Size and Sector (n= 65)

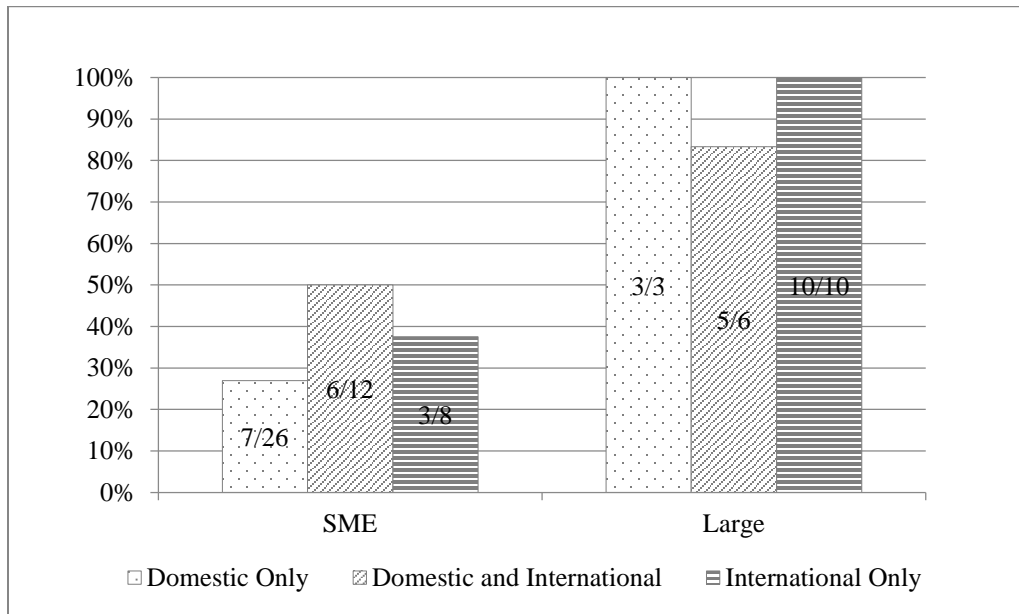


The data within the bars in Figure 2 show that only 16 of 46 SMEs were aware of the NEQS, and of those 16 firms, 9 exported at least part of their output. (The term “engagement in exports” in the caption for Figure 2 indicates that a firm either sold all of its output in international markets or sold part of its output domestically and part internationally.) In contrast, nearly all of the large firms knew about the existence of NEQS, regardless of whether they were engaged in exporting. As Figure 2 also reveals, firm size and engagement in exports are correlated, and a far higher share of large firms sell all or part of their output overseas. (See Table A1 for correlation coefficients.) Whether a firm was aware of NEQS was significantly correlated with *each* of the following variables: firm size, industrial sector, and engagement in exports (Table A1). It is difficult to distinguish the individual influences of firm size, industrial sector and engagement in

exports on NEQS awareness because firm size is strongly correlated with both industrial sector and engagement in exports (Table A2).

Figure 2: Variations in Awareness of NEQS with Firm Size and Engagement in Exports

(Numbers within bars correspond to total firms aware of NEQS out of total firms responding; n=65)



Survey results included information on NEQS compliance for the same 65 firms in Figures 1 and 2, and the extent of noncompliance is striking: only 10% of the surveyed firms satisfied the NEQS, and none of the 46 SMEs met the standards. While the compliance results for large firms were better in relative terms, they were nonetheless poor. The 3 large firms that operated in domestic markets only were out of compliance with NEQS. Of the remaining 16 large firms only

6 of were in compliance.⁴ All of the compliant firms were engaged in exports, and the one firm that elaborated on its survey response indicated that compliance was motivated by “international customer demands” and “increased competitiveness.”

Survey respondents from firms that were aware of the NEQS but failed to comply with the standards offered several reasons for the lack of compliance. By far the most common reason was the inability to afford construction of a secondary wastewater treatment plant, which is widely viewed as a requirement for tanneries and textile mills to meet Pakistan’s water quality standards. Here is a representative comment:

Installation of a wastewater treatment plant is required. It is expensive and also considered to be a dead investment as we also have to spend to operate it and do not get any revenues. Moreover it requires space for its installation that we do not have.

A number of firms mentioned the need for “combined effluent treatment plants” (CETPs); i.e., facilities to treat wastewater from multiple firms. It was typically inferred that these facilities should be built and operated by others (the government, managers of an industrial cluster, or an industrial association), and that users should pay fees based on waste volume and strength. A number of firms located within industrial clusters also mentioned that they would be able to meet the NEQS if CETPs were constructed for their clusters. Some firms cited the CETP at Korangi Industrial Area (Karachi) as an example of what is possible. The CETP at Korangi provides secondary treatment of the wastewater from 130 clustered tanneries, and that treatment is

⁴ Of the 6 firms meeting NEQS, 3 operated in international markets only and the other 3 operated in both domestic and international markets.

adequate for meeting the NEQS. According to the Korangi CETP's general manager, the industrial estate houses more than 2000 firms from different sectors, and most firms discharge wastewater to surface waters untreated.⁵ Moreover, while the Korangi CETP was built for tanneries, not all of the tanneries use the facility. More generally, a challenge in using CETPs is not only getting the plants built and operated, but also getting all firms in a cluster to connect to them and pay their fees (Luken, 2009).

Another reason mentioned for non-compliance was that it was unrealistic of authorities to expect firms to satisfy the NEQS under prevailing economic conditions in Pakistan. Some respondents elaborated by arguing that the standards for biochemical oxygen demand (BOD) and chemical oxygen demand were too rigorous. These firms had constructed primary wastewater treatment plants but could not meet the NEQS for these parameters, and building secondary treatment plants was unaffordable.

The lack of awareness of NEQS on the part of many firms and the lack of compliance by nearly all surveyed firms makes it clear that the Pakistan EPA and the provincial EPAs have not been effective in enforcing compliance. This is not likely to change in the short term. The passage of the 18th Amendment to Pakistan's Constitution in 2010 requires that responsibility for environmental protection devolve from the federal level to the provinces. Given the ongoing devolution of environmental protection responsibilities, improvements in EPAs' regulatory enforcement are likely to take time. This makes an increased emphasis on the work of existing (and possible future) CP centers a promising mechanism for accomplishing two goals: improving Pakistan's environment and enhancing the competitiveness of Pakistani firms. Both goals are

⁵Personal communication in 2008 between Skip Luken, a consultant to the World Bank, and the general manager of the environmental engineering division of NEC Consultants (Southern zone) concerning the CETP at Korangi.

important. Damage from poor environmental management in Pakistan has been estimated at 6 % of GDP (World Bank, 2006). And Pakistan’s plans for economic expansion rely heavily on augmenting exports; these plans will be impeded if firms are not competitive on all dimensions, including environmental performance.

4. Influence of CP Centers on Firms

This section examines the impact that CP centers have had on tanneries and textile processing firms. Table 1 provides a breakdown by firm size and sector of the 76 surveyed firms that reported the number of CP options adopted. Survey findings reveal that firms adopted a notable fraction of the CP options presented by the centers. Typically the CP centers provide results of energy and environmental audits along with recommendations on which CP options to adopt. In some cases, the centers also provide information on expected cost savings.

Table 1: Distribution of Firms in the CP Center Evaluation Analysis, Organized by CP Center, Industry, and Firm Size (n=76)

	SME	Large	No Response	Total
CPC- Leather	40	1	0	41
CPI- Leather	2	5	0	7
CPI- Textile Processing	7	13	8	28

Table 2: Number of CP Options Implemented by Surveyed Firms (n=76)

CP Center, Industry, and Firm Size

	CPC- Leather	CPI- Leather	CPI- Textiles
Number of firms responding	41	7	28
Total number of CP options presented	19	37	40
Average number of options adopted	8.9	22.3	26.6
Average % of options adopted	46.9%	60.2%	66.4%

The adoption rate was about 47 % for firms served by CPC and over 60% for firms served by CPI (Table 2). However, these percentages represent an underestimate of actual adoption rates because not all options presented by the centers were applicable in every case. The centers employed a standard protocol that included the numbers of CP options noted as “presented” in Table 2. Comments on individual survey response forms reveal that some options that had been presented by the CP centers were not applicable to some firms. This is illustrated by data for

tanneries served by CPC. Of the 41 firms listed in Table 2 for CPC, 12 indicated that they had implemented all CP options presented by the CPC that were *applicable* to their firms. For these 12 firms, the average number of CP options adopted was 11.3, which is substantially lower than the 19 options presented by CPC. Thus, assuming the firms' responses are accurate, a notable number of CP measures that were presented were not applicable in many instances. Reasons for this include firm-specific details that were not evident a priori to the CP center staffs.

Firm size may explain some of the variation in adoption rates because larger firms have greater capacity for technical analysis and raising capital, and thus they may be able to take advantage of a larger number of CP options. Firm size appears to play a key role in explaining the relatively high uptake of CP measures by the textile processing firms. The biggest share of large firms was in the textiles sector, and textile firms adopted the highest percentage of CP options presented.

Another possible explanation for the differences in adoption rates concerns the number of measures presented by CPC as compared to CPI. The two centers operate independently and have their own protocols for examining CP options for firms in different sectors. As shown in Table 2, CPC presented the leather firms they served with 37 options, which is nearly twice as many as those presented by CPI. And the number of options presented to textile processing firms (40) was even higher.

An additional explanation for differences in CP adoption rates concerns the education levels and knowledge base of the owners and managers of firms, and here the differences between SMEs and large firms were striking. Although exceptions exist, the interviews with survey respondents made it clear that owners and managers of SMEs were often not highly educated and ran their

firms the way their family members had in previous generations.⁶ They often were not aware of the potential for CP to improve product quality and firms' competitiveness, and they typically faced virtually no pressure to meet environmental regulations. Indeed, many SMEs were unaware that NEQS even existed and some had never had any contact with an EPA staff member. In contrast, large firms had more highly educated owners and managers, and many understood the links between CP, environmental management systems, ISO 14001, and potential improvements in product quality and competitiveness.

Although the survey did not focus on gathering quantitative data on costs and benefits of adopting CP, it did provide some insights into the nature of such costs and benefits. Most of the information concerned benefits in the form of savings, in part because the initial search for CP options was practically costless for the firms; the options were identified by the CP center staffs, with some additional center services offered for free (e.g., environmental and energy audits).

Among the 47 leather firms that provided a valid response to questions regarding the most significant CP measure implemented, over half cited benefits from decreased use of energy, water, or materials, or increased product quality.⁷ One of the two responding large leather firms (in Punjab) reported saving 300,000 PKR per year as a result of installing a boiler stack

⁶In general, owners of surveyed SMEs in the leather sector learned their skills from their fathers and then carried the family business forward. They typically were not highly educated and their focus was on continuing the traditional ways of running the family business.

⁷ Of these 47 leather firms, 2 were large, 41 were SMEs, and 4 did not provide sufficient information to classify based on firm size.

economizer. As another example, an SME (in Sailkot) reported cutting daily costs by 250 PKR from chemical savings using mechanical de-salting.⁸

Other benefits to leather firms were not stated in monetary terms. For instance, 50% of leather firms responding to the questions on CP measures adopted reported installation of dust collectors as their most significant CP measure, with associated benefits in the form of improved cleanliness, employee health, and efficiency. Other benefits related to improved environmental conditions in facility environs.

In the textile processing industry, 26 firms provided a valid response to questions regarding the most significant CP measure implemented.⁹ Over 90% of these 26 firms indicated economic benefits from decreased energy, water, or material use. Environmental performance was also improved. Organic waste loads (as measured by BOD) dropped substantially in effluents from some firms; in one case the drop in effluent BOD was from over 1700 ppm to 80 ppm. A specific example of savings involves a large textile firm (in Lahore) that cut 13% in the cost of gas by installing a steam condensate recovery system. Another illustration concerns an SME (in Faisalabad) that saved PKR 85,000 per day by installing a caustic recovery plant.¹⁰

⁸ Other benefits to SMEs in the leather sector are illustrated by the following: (i) Sailkot -- a one-year payback period for installing a chrome recovery plant; (ii) Punjab -- a 10% electricity saving for measures to improve the power factor and a 5% cut in electricity from installing a condenser economizer; and (ii) Sailkot -- a 10% chemical savings from implementing pH control.

⁹ Of these 26 firms, 13 were large, 6 were SMEs, and 7 did not provide sufficient information to classify based on firm size.

¹⁰ Other examples involving large textile plants include one in Karachi that saved 60 tons of steam per year by installing air nozzles; and a plant in Faisalabad that had a payback period of one year for installing a reverse osmosis facility. Another example of an SME in the textiles sector is one in Faisalabad that saved between PKR 1.08 and PKR 1.44 million per month by constructing a caustic recovery plant.

5. Relationships between CP Centers and Firms

Regardless of firm size and sector, survey results indicate that the CP centers served as the primary source of information on CP for the vast majority of surveyed firms. Of the 75 surveyed firms that responded to relevant questions, 76 % indicated that a CP center played a major role in providing information on CP measures that firms could use to cut pollution and save money. Examples of survey responses classified as “major role” include: “CPC identified and evaluated all [CP] options for us,” and “CPI played the role of consultant and advisor for the CP options.” That is not to say that other organizations did not play a role. Indeed, occasionally a survey respondent mentioned the importance of industry associations in assisting with CP. And sometimes there was also mention of a firm’s in-house expertise. Overall, however, there is little question that the CP centers have played the dominant role in helping firms identify and implement CP measures.

As part of our survey, respondents were also asked to evaluate the support provided by the CP centers. In general, firms highly value this support (Table 3). Responses from the 75 firms that answered a question concerning the centers’ support were sorted into three categories based on terminology in the survey. Across both sectors and both CP centers, at least 80% of the responses were in the highest rating category, with none characterizing CP center support as poor.

Table 3: Firm’s Evaluations of Support Offered by CP Centers

Responses:	Leather - CPC: n=41	Leather- CPI: n=6	Textile Processing – CPI: n=28
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Excellent or very good	80%	83%	96%
Satisfactory or “so-so”	20%	17%	4%
Poor	0%	0%	0%

Table 4 shows specific comments from firms regarding services provided from their respective CP centers. As indicated, CP centers are generally well-respected by the firms they serve and are instrumental in promoting awareness of CP options. Collectively, the results in Tables 3 and 4 indicate that firms valued the services provided by the centers.

Table 4: Characterization of Support Offered by the CP Centers

CP Center	Industry	Representative Comments
CPC	Leather	“CPC is a very good institution and is well respected in the leather industry.”
		“CPC support and facilitation was excellent...physically their achievements are visible.”
		“CPC was instrumental for awareness and we have implemented all CP options.”
CPI	Textiles	“Very supportive and support was excellent”
		“Very good role; should be more active in

		supporting industry.”
		“CPI was instrumental in providing the information. In addition, our network of friends, our own interest, comparison with previous practices and observations on fellow companies were the major source of information....”
	Leather	Services provided were “very useful as far as the CP measures are concerned in terms of effectiveness, good housekeeping, unrealistic of workers and improvement in the working environment and enabling for compliance with regulatory measures.”
		“Very useful and helpful in reduction of cost and saving energy besides water conservation.”

While the survey results reveal the important role that CP can play in enhancing Pakistan’s program of industrial environmental management, questions exist regarding the level of dissemination and adoption of CP technologies beyond the firms served by the centers.

Interviewees from EPAs and industrial associations questioned the extent to which CP projects funded by international donors were impacting other firms and highlighted the need for increased diffusion of CP methods to a much larger group of firms.

6. Cleaner Production, ISO 14001 and Competitiveness

6.1 Absence of Cleaner Production in Firms' Business Strategies

Although the survey results indicate that the CP centers are valued by firms, the centers are apparently not effective in instructing the firms about underlying CP concepts. Indeed, the vast majority of the surveyed firms were unable to respond well to the question: "How do you define CP?" About 14% of the 80 firms that responded to this question indicated either that they had no idea of what cleaner production meant or they provided a response that was far from correct, such as equating CP with end-of-pipe waste treatment. Another 74% responded in very general ways, with the following responses being representative: CP means "to care and save the environment and use less water," and "to preserve environment and promote energy conservation." A much smaller fraction of the surveyed firms (12%) indicated the respondent had a good understanding of CP at the conceptual level; e.g., "CP is application of different practices in the production process by which we can minimize or eliminate risk factors on humans and environment." Only a relatively few respondents represented CP as an *ongoing process* of discovering ways to improve efficiency, minimize waste generation and reduce environmentally-related risks.

Many of the firms receiving CP services from the centers appear simply to have adopted a number of recommendations provided by the CP centers based on energy and environmental audits without having an understanding of CP as (using words from the widely cited UNEP definition) "the *continuous* application of a ... *strategy* ... to increase efficiency and reduce risks to humans and the environment."¹¹ The words "continuous" and "strategy" are missing from

¹¹From website of EIONET, European Topic Centre on Sustainable Consumption and Production <http://scp.eionet.europa.eu/definitions/cp> Accessed October 7, 2011. Italics not in the original.

most conceptualizations offered by survey respondents in their definitions of CP, but these words are essential if CP is to be part of a firm's ongoing way of doing business.

These results point to a missed opportunity for the CP centers. Instead of concentrating their efforts on presenting CP measures for firms to adopt, the centers could provide on-site instruction on how to conduct audits and help firms structure employee incentives and responsibilities so that discovery of new CP measures is rewarded and CP measures are implemented effectively. Moreover, as results below demonstrate, many of the firms, especially SMEs, are unaware of the advantages of establishing an EMS and becoming certified to ISO 14001.

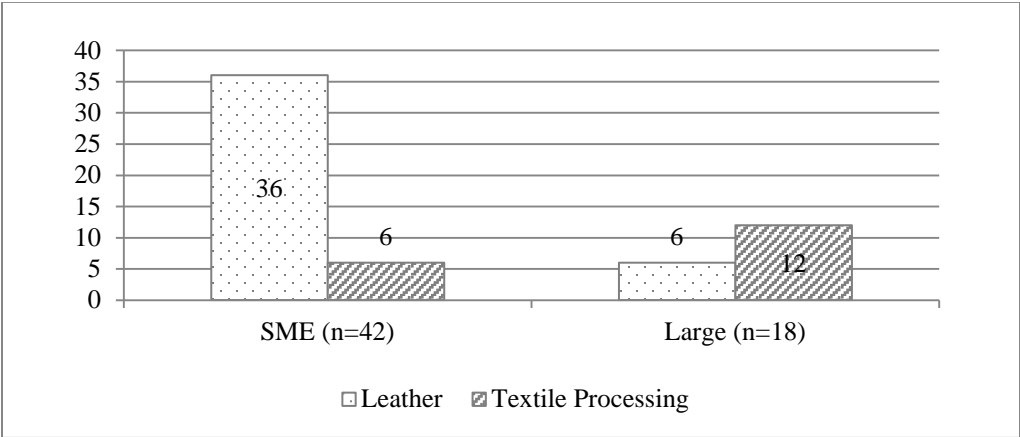
6.2 ISO 14001 Certification and EMS Adoption at Surveyed Firms

ISO 14001 certification is important for Pakistani leather and textile firms for three reasons.

- An EMS consistent with ISO 14001 provides a framework for discovering potential process improvements and resource conservation options that can cut costs and reduce waste.
- A number of Pakistani leather and textile firms export to multinationals that have explicit requirements that suppliers comply with home country environmental regulations, and some have requested supplier certification to ISO 14001.
- Increased use of green supply chain management by multinationals will eventually put pressure on Pakistani firms that do not themselves export to multinationals but supply firms that do export.

Our survey results provide insights into the extent of compliance with ISO 14001 and the reasons for compliance. A total of 60 firms participating in the survey provided complete responses to questions concerning creation of an EMS, ISO 14001 awareness and compliance, firm size and whether or not they exported their outputs (Figure 3). Data from these firms is also used in other figures below.

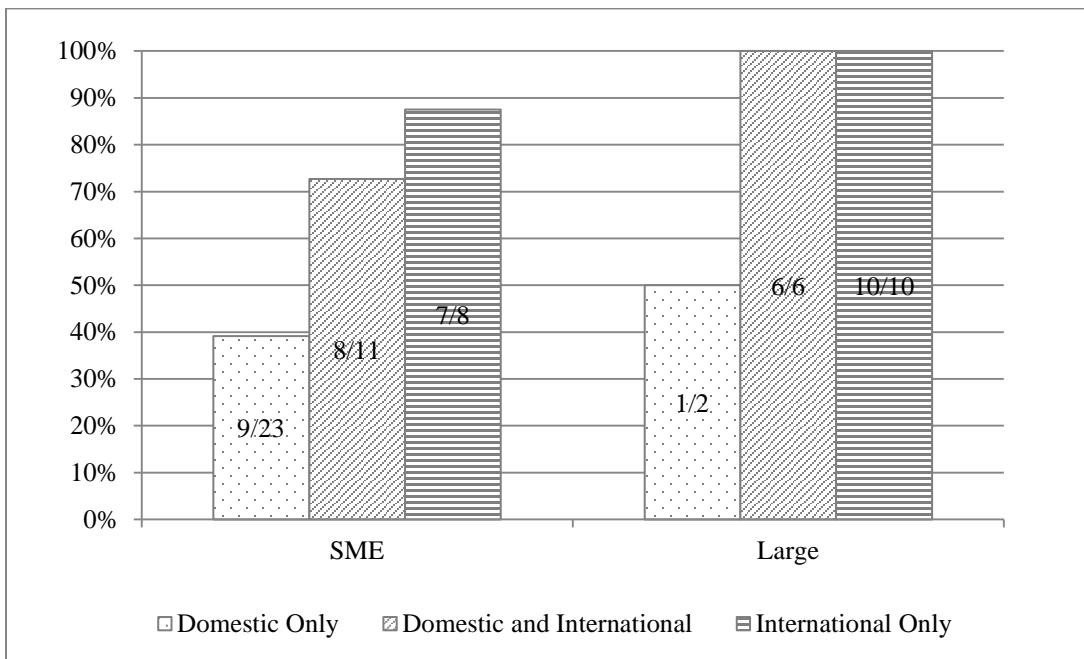
Figure 3: Distribution Firm Size and Sector (n= 60)



Survey results concerning awareness of ISO 14001 show a correlation between firm size and firms’ awareness of ISO 14001. Seventeen of the eighteen large firms were aware of ISO 14001 (94%), while only 57% of the SMEs were aware (Figure 4). However, an even stronger correlation exists between awareness and target market (domestic only vs. international or domestic and international), with firms engaged in exports being much more likely to be cognizant of ISO 14001. The result that sales overseas appears to play a key role in firms’ awareness of ISO 14001 is not surprising given the increasing importance attached to the performance of suppliers by business customers in Pakistan’s key export markets: the EU and the

US. Interestingly, the one large firm that was not aware of ISO 14001 was a textile processing firm that sold only in domestic markets. Since the variable used to reflect overseas sales is also correlated with firm size (Table A2), it is not possible to say which is more important: engagement in exports or firm size. Large firms clearly have more opportunities to hire staff members that specialize in ISO-related issues and they are, in this sample at least, the firms more likely to export some or all of their outputs.

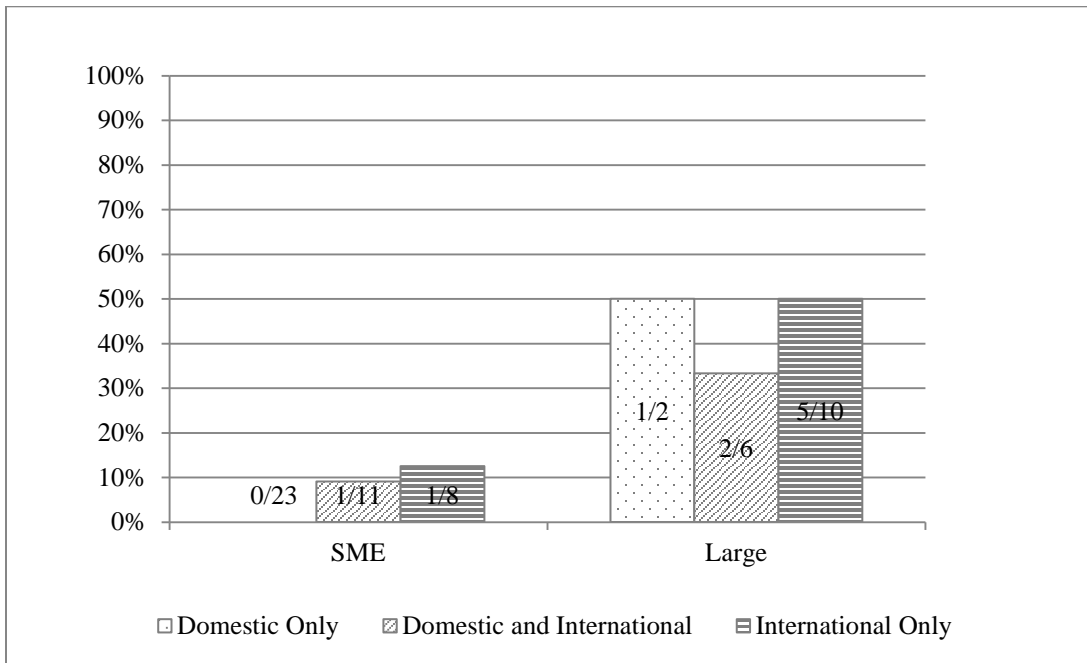
Figure 4: ISO 14001 Awareness in terms of Firm Size and Engagement in Exports (Labels correspond to total firms aware out of total firms responding; n=60)



In contrast to awareness of ISO 14001, the levels of *compliance* with ISO 14001 were quite low, even for large firms (Figure 5). Only 2 of the 42 SMEs (5%) in the sample were ISO 14001 certified; the corresponding figures for large firms were 8 out of 18 (44%). Clearly, firm size matters in terms of ISO 14001 compliance. But extent of sales overseas also matters: the two

SMEs that were ISO 14001 certified sold goods overseas, as did 7 of the 8 large firms that were certified.

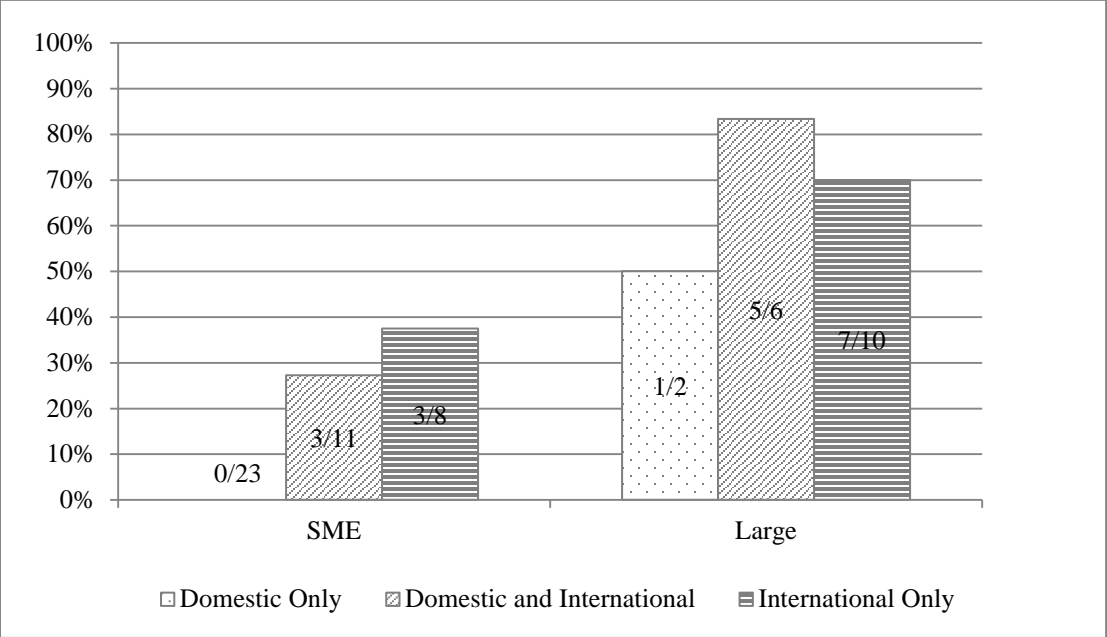
Figure 5: ISO 14001 Certification in terms of Firm Size and Engagement in Exports
(Labels correspond to total firms certified out of total firms responding; n=60)



In comparison to firms that are ISO 14001 certified, many more firms have an environmental management system: 19 of the 60 firms (31%) have an EMS, but only 10 of the 60 firms (17%) were ISO 14001 certified (Figures 5 and 6). The differences are particularly notable for SMEs: only 2 of the 42 SMEs (5%) were ISO 14001 certified but 6 of the 42 SMEs (14%) had an EMS. Based on respondents' comments, some firms that created an EMS did not think value would be added by obtaining ISO 14001 certification if their foreign business customers did not require it. They felt the benefits of an EMS could be obtained without incurring the costs and time needed

for certification and surveillance. Here also, whether a firm has an EMS is correlated with both firm size and engagement in exports (Figure A6).

Figure 6: Existence of an EMS in terms of Firm Size and Engagement in Exports (Labels correspond to total firms with an EMS of total firms responding; n=60)



7. Discussion

As mentioned in Section 1, the literature on cleaner production generally places the motivations and obstacles to implementing CP measures into three broad categories: government actions,

market-based pressures, and community pressures. Below we discuss our findings for tanneries and textile processing firms in Pakistan to compare our results with those in the literature.

7.1 Environmental regulations

Some literature highlights the importance of existing environmental regulations and perceptions of future environmental regulations as drivers for the adoption of CP and EMS (Johnstone and Labonne 2009; Luken and Van Rompaey 2008). A striking feature of our results is that environmental regulations per se were *not* a key driver.¹² This is clear from the behavior of tanneries served by CPC in Sialkot: 70% the 40 firms with responses (39 of which were SMEs) were unaware of NEQS. These firms experienced little or no pressure to comply with environmental regulations and typically faced no penalties for noncompliance. A number of SME respondents called the treatment plants needed for compliance “dead investments” (i.e., from the firms’ perspective, there is no return on investment).

Interestingly, when surveyed firms did discuss NEQS, their focus was on the NEQS for water quality. There was no mention of NEQS for air quality, but this is not because applicable air pollution emission standards do not exist. The lack of comment on NEQS for air quality reflects the absence of EPA monitoring of air pollution releases. NEQS for air quality were initially

¹² The current status of environmental regulations in Pakistan can be characterized as follows. In 1997, the parliament promulgated the Pakistan Environmental Protection Act (PEPA). It served as comprehensive legislation, and was followed by a number of specific policies, regulations and standards. Examples include: NEQS for Municipal and Liquid Industrial Effluents (2000); NEQS for Industrial Gaseous Emission (2000); Hazardous Substances Rules (2003); National Standards for Drinking Water Quality (2010); and NEQS for Ambient Air (2010). The challenge for Pakistan is that both enforcement and compliance are weak. Many companies in Pakistan – including both SMEs and large firms--find the standards excessively stringent given Pakistan’s level of economic development, and they have advocated for revisions. Their view is that compliance would be improved if firms considered the standards reasonable and based on consultation with industry.

issued in 1994 and then revised in 2009. They were officially notified for implementation in November 2009 but had not yet been implemented effectively during the 2009-10 period during which our survey was conducted.

In a number of cases, firms viewed NEQS compliance as important, but not because of enforcement pressures. Typically firms mentioned NEQS compliance as important because it was needed for attaining ISO 14001 certification. And the interest in certification itself was generally driven by pressures imposed by international business customers that called on their suppliers to meet applicable home-country environmental standards and considered certification to ISO 14001 as an indication of the positive environmental performance of their suppliers. This outcome is consistent with results reported by others (e.g. Kimitaka, 2010; Johnstone & Labonne, 2008)

In general, our results show that firms seeking compliance with NEQS are also interested in certifying to ISO 14001. Although immediate compliance with NEQS is not required for ISO 14001 certification, firms must have a plan to attain compliance and demonstrate progress in meeting the standards. Firms mentioned that adopting CP measures moves them closer to NEQS compliance, but many noted that compliance would be impossible without secondary treatment. In addition, many firms claimed it was impossible to provide secondary treatment because of problems in raising funds or lack of available land, or both. For SMEs interested in compliance with NEQS, the consensus was that unless CETPs were constructed to accept their effluents, they would be unable to meet the standards.

In the context of environmental regulations, results herein for the leather tanning sub-sector are strikingly different from those reported by Luken and Van Rompaey (2008) based on their study

of drivers and barriers to environmentally sound technology adoption in nine countries: Brazil, China, India, Viet Nam, Mexico, Thailand, Tunisia, Kenya and Zimbabwe. Aggregating across nine countries, they found that the dominant driver for the leather tanning sub-sector was anticipated future environmental regulation. This subject never even came up in interviews conducted at the tanneries included in our study.

7.2 Economic and community-based incentives

Interview results were consistent in highlighting the significance of monetary cost savings as a driver of CP adoption for the vast majority of firms in our study. Survey results contain much mention of good environmental citizenship and these sentiments were undoubtedly sincere. However, survey responses make it clear that CP options were adopted because they allowed firms to conserve on energy, water, and input materials and thereby drive down the cost of production. In some instances, CP measures were also adopted because they enhanced product quality.

A closely related issue centers on the financial gains obtainable by maintaining and augmenting sales to international business customers. In this context, EMS and certification to ISO 14001 play a dominant role. Some business customers of firms in our study want to buy from suppliers that have an EMS that has been certified to ISO 14001 (Bowen et al., 2001). In addition, Pakistani firms have been impeded in exporting to some OECD countries because products have not met international environmental standards (Khan et al., 2001).

The dilemma faced by many firms (especially SMEs) interested in NEQS compliance and ISO 14001 certification is that meeting NEQS seems beyond their reach. In addition to the aforementioned challenges concerning money and land, many of those interviewed felt meeting

NEQS requirements was unrealistic because of Pakistan's general economic conditions. Some also complained that the standards were promulgated without meaningful stakeholder consultation. In the face of standards viewed as unattainable (e.g., NEQS effluent limits regarding chemical oxygen demand and oil and grease) and in the absence of significant penalties for noncompliance, there has been massive noncompliance with NEQS.

In isolated instances, the motivation for CP adoption was the need to enhance the reputation of the company as being "environmentally friendly" among members of the local community.¹³ More generally, however, surveyed firms felt little pressure from domestic customers to improve environmental performance. In order for that to happen, Pakistani consumers will need to express their willingness to pay for products that are somewhat more expensive because they have been produced in ways that are more environmentally sensitive. This may occur in the long term, but circumstances in Pakistan are such that, in the near term, domestic consumer preferences are unlikely to drive improved environmental performance.

7.3 Organizational variables

One of the barriers frequently mentioned in the literature concerns difficulties that firms have in getting good information about environmental protection options. In this regard, the effort of CPC, CPI and industry trade associations in diffusing information regarding CP interventions is notable. These institutions have played central roles in providing information about CP options, particularly in the context of environmental and energy audits performed by CPC and CPI. For

¹³ Community pressures are sometimes brought in response to public health problems caused by pollution from tanneries. In many cases, massive releases of untreated pollution loads have entered local water bodies on continual basis, and the indiscriminate use of highly toxic chemicals has contaminated sub-surface waters. As a result drinking water is heavily polluted and is responsible for increases in stomach, liver and several other diseases.

many of the surveyed firms, CPC and CPI represented the main source of their information regarding cleaner production options. Notwithstanding the important work of the CP centers in introducing CP to firms, the center did miss important opportunities to educate firms on the meaning of CP. For most firms in the survey, CP was a one-time exercise that involved implementing CP measures suggested by CP centers as a result of energy and environmental audits. Very few of the firms embraced CP as a process that could yield continual improvements in both financial and environmental performance measures.

The role of leadership from CEOs and senior managers in the adoption of CP options is another frequently discussed topic in the literature. In our study, it was clear that some firms either moved forward or not based on the attitudes and capabilities of their CEOs as regards CP. In comparison to SMEs, large firms had more highly educated CEOs and many of them played important roles in moving CP forward at their firms. The leaders of many small firms were not aware of CP-related issues, and some seemed much less eager to pursue CP options than CEOs of large firms. The exceptions were SMEs working in international markets and experiencing pressure from international business customers to improve their environmental performance. In these instances, the SMEs were more responsive in adopting CP and establishing EMS.

Other organizational issues concern the enthusiasm of workers to make required changes after adoption of CP measures. A number of survey respondents mentioned that workers resisted using personal protection equipment that would safeguard them in handling chemicals. In these circumstances, effective leadership from CEOs and top management was essential in orchestrating behavioral change at the shop floor level.

8. Conclusions

The work of CPC and CPI has been pivotal in launching CP activities in Pakistan, but their impact has often been strong because many of their services are offered without charge. For example, the environmental and energy audits conducted by these centers have been completely (or almost completely) free to the firms served. In addition, the CP concept has not diffused much beyond the facilities that have worked with the centers or otherwise participated in donor-supported demonstration projects. In terms of numbers of firms involved, CP activities have been most extensive at leather tanneries in Sialkot, Lahore and Karachi.

The work of CPC and CPI has been impressive; they provided subsidized support that allowed firms to identify and quantify inefficiencies in their processes. Typically the CP centers provided results of energy and environmental audits along with recommendations for action, and sometimes they analyzed expected cost savings. However, the centers missed opportunities to introduce CP and EMS as approaches that can be integrated into business plans and operating procedures for continual improvement in firm performance. The overall approach used by the centers could be supplemented with training so that the SMEs could use standard CP tools and conduct energy and environmental audits on their own; additional training would also allow them to do more careful studies of costs and benefits and place results into a broader analysis of how adoption of CP alternatives would affect their competitiveness.

Significantly, many firms in the textile and leather sectors ranked demands from importing countries and international buyers as significant drivers of environmental compliance. They noted that implementation of CP measures helped them to enhance competitiveness, maintain ISO 14001 certification, and increase international business opportunities. The higher revenues obtained from selling in international markets appears to be sufficient to pay the cost of environmental compliance by these exporting firms.

The paper argues that CP has been slow to diffuse in Pakistan in part because one of the principle drivers for CP implementation -- the enforcement of ambient environmental quality standards -- is largely absent at the firms examined in our study. Indeed, many firms with significant pollution loads are unaware that Pakistan has environmental regulations that they are supposed to meet. Instead of pressure to satisfy environmental requirements, the main factors motivating CP implementation center on: pressure from international business customers; the awareness of CP by firms' owners and managers, and local environmental concerns.

Under the circumstances, a much increased emphasis by the Government of Pakistan on implementation of CP and EMS and certification to ISO 14001 would have two main advantages: (i) enhance the competitiveness of Pakistan's manufacturing firms, and (ii) improve environmental quality. However, unless the NEQS are revised in ways that reflect the conditions on the ground in Pakistan, this strategy will not be effective. The numerical limits in the NEQS are currently viewed by many firms, particularly SMEs, as being beyond their reach. Indeed, it would be a practical impossibility for many Pakistani firms to build their own secondary treatment plants, which are generally required to meet the NEQS for water quality. Under the circumstances, in order to make short term progress in improving environmental quality and enhancing the competitiveness of Pakistan's manufacturing industry, it would be appropriate to issue interim NEQS at levels that would be attainable given the political and economic conditions in Pakistan. Simultaneously, increased efforts could be made to build CETPs that serve SMEs located in industrial clusters. This would help make it possible for SMEs within clusters to satisfy NEQS, thereby removing one of the main impediments they face in becoming certified to ISO 14001.

Pakistan's CP centers provide firms with technical assistance, primarily in the form of needs assessments, environmental and energy audits and technical assistance in adopting CP measures. However, the CP centers have operated independently and in the absence of an overall national CP strategy or plan. While the technical assistance initiatives of the CP centers represent a good beginning, the challenge faced in Pakistan (and many other countries) is to change the long-term behavior of not just a few demonstration firms or a few hundred firms served by CP centers, but of the much larger number of company owners and managers in the many industrial firms that have significant waste discharges. Thus the key to making progress in improving industrial environmental performance in Pakistan involves the diffusion of information to allow firms to learn of economically-efficient CP options and how they can save money, enhance profitability and burnish their reputations as "environmentally friendly" enterprises. In the absence of regulatory pressures, Pakistani firms are more likely to be motivated to improve environmental performance when they discover that adoption of CP measures and EMS can cut costs, enhance profits and enhance opportunities for marketing and sales.

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Appendix A

To determine the statistical significance of the correlation coefficients, the “ p ” statistic was calculated as an estimate of the probability that the observed correlation could have occurred by chance alone. The lower the value of p , the more likely the result was not a chance occurrence. A 0.05 level of statistical significance indicates that there is only a 5% chance that the correlation occurred by chance alone. The “ χ^2 p-value” in subsequent tables summarizing correlation analysis results is associated with the Pearson Chi-Square test of independence, which is implemented to evaluate whether the observed frequencies of two variables are independent. Correlation analyses were performed using techniques for categorical variables; a categorical variable (sometimes called a nominal variable) is one that has two or more categories, with no intrinsic ordering to the categories.

For the case in which each variable could only take on one of two values, the Pearson Chi-Squared Statistic (ϕ) was calculated to indicate the strength of the correlation. For example, the variable NEQS awareness has only two categories: the respondent is either aware or unaware of NEQS. The value of ϕ ranges from -1 to 1, where 0 represents no correlation, 1 represents a perfect positive correlation, and -1 represents a perfect negative correlation.

For cases in which there were more than two values for a categorical variable, Cramer’s V (represented by the symbol “ ϕ_C ”) was calculated to provide an indication of the strength of the correlation. For instance, this was the case in calculating the correlation between NEQS awareness and engagement in exports, where engagement in exports is represented by one of three possible categories: domestic only, international only, or both domestic and international. The value of ϕ_C can range between 0 and 1.

For both ϕ and ϕ_C , a correlation coefficient of 0 represents no correlation, and the greater the deviation from 0, the greater the strength of the correlation. While there are no accepted rules, a value of ϕ or ϕ_C between 0.3 and 0.5 is often considered to reflect a moderate strength of association, whereas values above 0.5 are considered strong. For more on this interpretation, see AcaStat Applied Statistics Handbook (2011). <http://www.acastat.com/Statbook/chisqassoc.htm> Accessed October 17, 2011.

In the tables below, a “*” indicates that a table entry corresponds to Cramer’s V (ϕ_C), as opposed to the Pearson Correlation Coefficient (ϕ).

Table A1: In analyses of correlation, values for statistics indicating the strength of correlations with NEQS awareness are tabulated below.

	NEQS Awareness	
	χ^2 p-value	ϕ -coefficient
FIRM SIZE (SME vs. Large)	0.00001	0.55
INDUSTRY (Leather vs. Textile Processing)	0.003	0.34
MARKET (Domestic vs. International or Both)	0.025	0.323*

Table A2: In analyses of correlation, values for statistics indicating the strength of two-variable correlations among firm size, market and industry are tabulated below.

		FIRM SIZE (SME vs. Large)	INDUSTRY (Leather vs. Textile Processing)
FIRM SIZE (SME vs. Large)	χ^2 p-value		3.0E-06
	ϕ -coefficient range: -1 to 1		0.55
MARKET (Domestic vs. International vs. Both)	χ^2 p-value	0.0030	0.33
	Cramer's V range: 0 to 1	0.42*	0.17*

Note that the association between market and industry is not statistically significant.

Table A3: Values for parameters indicating the strength of correlations with NEQS compliance are tabulated below.

	NEQS Compliance	
	χ^2 p-value	ϕ -coefficient
FIRM SIZE (SME vs. Large)	.0004	0.42

INDUSTRY (Leather vs. Textile Processing)	Not statistically significant	
MARKET (Domestic vs. International vs. Both)	0.012	0.354*

Table A4: Values for parameters indicating the strength of correlation with ISO 14001 awareness are tabulated below.

	ISO 14001 Awareness	
	χ^2 p-value	ϕ -coefficient
FIRM SIZE (SME vs. Large)	0.005	0.356
INDUSTRY (Leather vs. Textile Processing)	Not statistically significant	
MARKET (Domestic vs. International vs. Both)	0.0003	0.496*

Table A5: Values for parameters indicating the strength of correlation with ISO 14001 compliance are tabulated below.

	ISO 14001 Compliance	
	χ^2 p-value	ϕ -coefficient
FIRM SIZE (SME vs. Large)	0.0001	0.48
INDUSTRY (Leather vs. Textile Processing)	0.024	0.26
MARKET (Domestic vs. International vs. Both)	0.0081	0.38*

Table A6: Values for parameters indicating the strength of correlations with EMS established are tabulated below.

	Firms with EMS	
	χ^2 p-value	ϕ -coefficient

FIRM SIZE (SME vs. Large)	0.000007	0.54
INDUSTRY (Leather vs. Textile Processing)	0.002	0.353
MARKET (Domestic vs. International vs. Both)	0.00007	0.514*

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