Environmental Impacts and Mitigation Costs Associated with Cloth and Leather Exports from Pakistan[1]

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By

Shahrukh Rafi Khan, Mahmood A. Khwaja, Abdul Matin Khan, Haider Ghani and Sajid Kazmi

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Acronyms

ASDCs	Annual Sustainable Development Conferences
ATBT	Agreement on Technical Barriers to Trade
ATC	Agreement on Textiles and Clothing
BOD	Biological Oxygen Demand
CIDA	Canadian International Development Assistance
COD	Chemical Oxygen Demand
CTE	Committee on Trade and Environment
DPGs	Domestically Prohibited Goods
ECOSOC	Economic and Social Council
ESCAP	Economic and Social Commission for the Asia and Pacific
EPAs	Environmental Protection Agencies
FAO	Food and Agriculture Organisation
GATT	General Agreement on Trade and Tariffs
GEF	Global Environmental Facility
IMF	International Monetary Fund
IUCN-P	International Union for Conservation of Nature - Pakistan
LIDO	Leather Industry Development Organisation
MEA	Multinational Environmental Agreement
MFA	Multifiber Arrangement
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NWFP	North Western Frontier Province
OECD	Organisation of Economic Co-operation for Development
PCSIR	Pakistan Council of Scientific and Industrial Research
PEP	Pakistan Environment Program
PEPC	Pakistan Environmental Protection Council
PPM	Process and Production Methods
SDPI	Sustainable Development Policy Institute
SPSC	Sarhad Provincial Conservation Strategy
TTSID	Technology Transfer for Sustainable Industrial Development
TSS	Total Suspended Solid
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Social and Cultural Organisation
WTO	World Trade Organisation
WWF	World Wildlife Fund

Executive Summary

Pakistan, like many other poor Southern countries, is currently in a double bind. On the on hand, it finds that the rich countries are being very slow in implementing the Uruguay Round trade agreements in liberalizing imports, particularly in sectors such as textiles and agriculture which are of interest to Pakistan. On the other hand, the world trade scenario is changing, independently of the sway of the WTO, as governments and businesses respond to consumer preferences for ecologically friendly production and consumption and set and impose environmental standards. Thus, even the goods currently being exported are increasingly being expected to meet stringent environmental standards.

While poor countries could, with considerable justification, confront rich countries with the old rhetoric of "let the market decide," this will not achieve much in so far as the standards are responding to consumer preferences. However, poor countries obviously need to be wary of the protectionist use of environmental standards by rich countries. In such cases, they should lobby via the WTO to ensure that the old time market rule of consumers' sovereignty prevails, particularly now that this benefits the poor countries.

International justice notwithstanding, our research shows that there are good reasons for poor countries to want to meet the environmental standards being imposed by rich countries because the benefits of doing so for them exceed the costs. This argument is based on several premises. First, meeting environmental standards such as the ISO 14,000, can ensure efficiencies and economies within the firm. Second, these standards have built into them a process of quality controls and efficient management and these may go a long way to winning and retaining export markets. Third, meeting environmental standards also represents a win-win scenario on a macro-economic level, since a cleaner environment would lead to a reduction in health care costs, health-related productivity losses, health-related working days lost and health related livelihood losses.[2] Fourth, from a social justice perspective, this saving gets more weight, since the poor are the most vulnerable to environmental depredations. Fifth, our research for cloth production and leather tanning shows that, contrary to the view held in the South that the costs of mitigating environmental damage are very high, in fact mitigation costs are quite modest at both the macro and micro level.

The objective of this research was to estimate the increase in exports of cloth and leather and footwear, based on the Uruguay Round Agreement on Textiles and Clothing (ATC) and past trends, and identify the associated pollution and the benefits and costs of pollution mitigation. Textiles and leather are among two of the most polluting industries and, with in these industries, producing cloth and tanning leather are the most polluting processes. We selected the textile and leather industries because of their economic significance and their pollution impact. The textile industry ranks as number one in terms of exports, value added and employment. Leather ranks fourth in terms exports and, while it is not as significant in terms of value added or employment, it is the most polluting of all the industries.

We estimated the export related environmental impact of cloth and leather. Following that, we

[2] These benefits would be forthcoming if the pollution in question was domestic. However, If the standards were concerning greenhouse gas emissions, few of these benefits would be achieved domestically.

assessed the mitigation impact of using cleaner technologies in terms of reducing the scale of pollution and then assessed the cost of mitigation. One way of building a strong case for mitigation is to demonstrate that these industries are highly damaging to the environment and human, plant and animal life. Ideally, one ought to precisely quantify the cost in rupee terms. A reduction of such cost thus becomes the benefit of mitigation that can then be compared to the monetary cost of mitigation. Unfortunately, since cost quantification is difficult, we have instead documented the environmental cost and indicated how this is likely to increase due to the export related increase in production.

The main finding of this research is that, at current emission rates, the pollution impacts of the exports of cloth and leather and footwear are very large. However, the mitigation cost at the macro level of reducing the pollution load by up to 91 percent for cloth production and 66 percent for leather tanning are much smaller than commonly considered to be the case in the South.

For textiles, BOD, COD and TSS are the main parameters for which current emissions are above local and international standards. The chemicals used in the textile industry are very toxic and corrosive and prolonged exposure poses a health risk. The cotton dust is a health hazard since it can result in respiratory diseases. Other problems, resulting from the air emissions, include the pernicious odor and smog. The main problem results from the liquid effluents that are pumped untreated into drains that enter fresh water flows. This is not only a nuisance aesthetically, but also threatens aquatic life and the use value of the water. Metals and compounds like chromium and phenol are carcinogenic and dyes like azo are both carcinogenic and allergy inducing. These effluents also pose a threat to inland and coastal fisheries and seepage into the water table means an entry of toxic chemicals into the soil and food chain.

For leather, the pollution load currently far exceeds national and international standards on all parameters. Leather is in this respect an even more hazardous industry. In addition to the problems of liquid effluents indicated for the textile industry, solid wastes contain chromium residues that can cause perforations and bronchial carcinoma from prolonged exposure. Poultry feed manufactures often buy wastes and this can result in the entry of chromium in the food chain. Tests have shown chromium residues in the poultry feed. The chromium and other metals in solid wastes also adversely affect plant growth. The hydrogen sulfide formed by the presence of sulfide in the effluent is highly toxic. Ammonia emissions cause irritation of the respiratory tracts. Other problems include headaches, stomachaches, dizziness, night blindness, leprosy, dermatitis and skin disorders. Leather dust can be carcinogenic and causes allergies, both of which represent a threat to the local population.

Research shows serious problems of such contamination in Korangi and Charsadda. Along the Karachi coast, tanneries contribute 10-15 percent of the total pollution. In the Punjab, prime agricultural land is being contaminated and the crop yield adversely affected.

Using an ARIMA model, we forecasted exports of leather and footwear based on past trends, and we drew on a World Bank forecast for the increase in cloth exports due to the Uruguay Round ATC and combined this with an ARIMA forecast of cloth exports to non-quota countries. Between 1996 and the end of 2004 cloth exports could be expected to rise by 45 percent and the corresponding increase in pollution load is calculated to be 81 percent**.** Leather exports are expected to decline so one can expect a 7 percent lower pollution load generated by leather tanning without mitigation measures. If mitigation measures are adopted, both in plant and external, up to 91 percent of the emissions from cloth and 66 percent of the emissions from tanning could be reduced.

The costs of such measures in 1996 at a macro level would have been Rs. 2.598 billion for textile processing which amounts to .0011 percent of GNP in 1996-97. The foreign exchange liability for this year would have amounted to Rs. 749.79 million or 1.6 percent of only cloth exports in 1996-97. More important, given government fiscal constraints, on a micro level the cost to industrialists for mitigation in a plant with a 21.45 million square meters production capacity would have been a maximum of Rs. 10.42 million or 1.6 percent of its sales revenue. For the leather industry, on a macro level the net mitigation cost (after subtracting the value of chromium recovery) in 1996 would have been .0025 percent of GNP and the mitigation cost to exporters of leather would have been .0048 percent of their export revenue. These mitigation costs are much lower than for cloth production since clean production technology is locally available. In view of negative effects of pollution generated by these industries, as indicated in the preceding paragraphs, these mitigation costs seem modest indeed. This is contrary to a view expressed in the literature that the costs of establishing and operating clean technology are very high.

Our stakeholder dialogues indicate that currently industry is inadequately informed of the rapid developments on the trade and environment interface. There is little awareness about standard setting that is currently underway in the OECD or about how competitors are positioning themselves. Often the market provides such information, but it can be when it is too late as happened in the case of Pakistani exports of surgical goods and shrimps. Since information is a public good that confers positive externalities, the Ministry of Commerce, Industries, Environment and the Export Promotion Bureau should be proactive and invest resources in the relevant information generation. The private sector would have an incentive to restrict information dissemination to recover private costs rather than encourage wide dissemination to maximize social gain. This is a classic case for state provision.

A section dealing with trade and the environment in a larger WTO cell in the Ministry of Commerce, with the relevant expertise drawn from all three Ministries, may work well. Such a cell could then work closely with the various Industry chambers and ensure Pakistan does not lose markets on account of non-compliance with environmental standards and gains green niche markets. The response of the Textile Committee of the Government of India to the ban in OECD countries on azo dies is particularly instructive.

The timing is very opportune for the government to work actively with industry and civil society to pursue an environmental and sustainable development agenda and at the same time reap the dividends of export promotion this will bring. The National Environmental Quality Standards (NEQS), which are part of the 1997 National Environmental Protection Act, are due for implementation this year (1999). Industry has been involved in the process of standard setting, has agreed to paying a pollution change for pollution in excess of the NEQS via an enforceable process of self-monitoring (as in the case of taxation) and has even agreed to the amount of the charge. The Ministry of Commerce, Industries and the Environment can strategically provide the necessary information as this process gets underway.

As earlier pointed out, cleaner production in Pakistan may mean more exports but it also represents an important step in the direction of sustainable development that can be viewed to be about justice for current and future generations. While the impact of poverty on the environment is often mentioned, less attention is paid to the poverty inducing aspects of environmental degradation via a loss in access to resources for livelihood and a loss in health, productivity, working days and jobs.

I. **Background: trade liberalization, manufacturing and the environment**[3]

Principle 21 of the "Rio Declaration on Environment and Development" [UNCED (1992, p. 10)] suggests that international cooperation to create a supportive and open economic system would lead to both economic growth and sustainable development. The document also suggests that trade and environment goals can be mutually supportive (p. 19). Fair market access and prices (without subsidy distortions) for poor countries can generate resources and also ensure the efficient allocation of resources (p. 20). First, these resources can be utilized for sustainable development.[4] Second, the mechanisms of trade itself can enhance sustainable development via cleaner processes and production methods (PPM), with the impetus for this coming from discerning consumers, shareholders and responsive governments.

On April 15, 1994, at Marrakesh, the contracting parties to the GATT put their signatures on the agreement to set up a World Trade Organization (WTO), concluding thus the elongated Uruguay Round. The first task before the General Council of the WTO, after being set up at the start of 1995, was to constitute a Committee on Trade and Environment (CTE). This reflected the priority attached to bringing environment in the purview of trade discussions. The terms of reference of the CTE were as follows: (a) the identification of the linkages between trade and environmental measures in order to promote sustainable development, and (b) appropriate recommendations on whether any modifications of the multilateral trading system are required. Within these terms of reference and with a view to promoting the UNCED objective of making international trade and environmental policies mutually supportive, an extensive work programme in ten areas was decided upon and initiated in a specially set up sub-committee of the Preparatory Committee of the WTO.[5] The center-stage of the international debate on development in the remaining part of the 1990s and the early part of the next century is likely to be occupied by the issues of trade, environment and sustainable development.

Pakistan's commitment to environment and sustainable development is outlined in its *National Conservation Strategy* (NCS, 1992). The authors of this Strategy, not unlike the authors of the World Conservation Strategy, could not foresee the pervasive impact of trade on the environment. Indeed, the Ministry of Commerce was not represented on the steering committee. The representation from NGOs and the private sector did not reflect this aspect either. Nor was there any effort to commission a background paper to outside experts.

Thus, so far as trade and environment were concerned, the situation was one of two distinct cultures. Knowledge and postures existed separately, with a conspicuous lack of cross-cultural view. Yet the need, in the wake of the WTO work programme, is for a cross-cultural view. Before this can be accomplished, it is important to expose policy makers, NGOs and the private sector to the main issues involved in the debate on trade and sustainable development and the findings of

[3] This section draws on earlier proposals on trade and the environment prepared by SDPI.
[4] There is of course no guarantee that this will happen.
[5] Initially seven items were on the list and three (services and the environment, TRIPs and the environment and relationships with other institutions and organizations) were later added to make ten. Meecham (1998, pp. 87-90) provides an account of the recent history of trade and the environment and also the trend in thinking within the CTE on various issues (pp. 94-109). A good source for the latter are the regular WTO Trade and Environment Bulletins. Refer to UNDP/UNCTAD (1998, pp. 24-27) for the mandate of the CTE.

primary research on key areas in this field.

Traditional trade theory, based on the concept of 'comparative advantage', claims that trade brings mutual benefits to all parties engaged in exchange. However, the theory of comparative advantage assumes that all external costs are internalized, when typically they are not. The terms of trade of a country thus do not reflect the social costs involved in the production and consumption of goods and services to be traded.

The trade and environment literature deals with a number of other issues and hypotheses that are not a part of traditional trade theory. Many of these are related to concerns in the North or the South about fair trade. First, that trade liberalization could result in strategic movement on the part of Northern multinational corporations to Southern countries with more lax environmental regulations and hence result in a loss in Northern jobs. Second, that the North could use trade liberalization to dump its dirty technology and other domestically prohibited goods (DPG) on the South. Third, that the structural adjustment induced export promotion could result in the South exporting its environmental capital in the form of high pollution and domestic resource degradation. Fourth, that the multilateral environmental agreements (MEAs) are increasingly affecting the world-trading environment and these MEAs could block southern exports. Fifth, that the North has a greater resource and technological ability to meet the standards it sets and that this will mean blocking access to Southern exports and enhancing its market share Sixth, that the cost of mitigating such pollution in the South are very high. Our research is mainly concerned with the last two hypotheses but we address the other hypotheses here.

LOSS OF NORTHERN JOBS

Companies in the North may fear that with the dismantling of trade barriers, developing countries may have a competitive edge due to their less stringent or more lax enforcement of environmental regulations. This might lead to a relocation of factories to developing countries to take advantage of lax environmental regulations and/or enforcement. Repetto (1993), Dean (1991) and Tobey (1990) refute this hypothesis. They argue that relocating a plant entails a complex and lengthy processes which includes selling an existing plant, severing its work force, relocation of key personnel, choosing a new site, building a new factory, recruiting and training new staff. All these processes are not feasible just to take advantage of savings on pollution control cost which total less than two percent of total sales. The *World Development Report* (1992, p. 67) also states that environmental costs are a minor share of output value – averaging only 0.5 percent for all US industries in 1988 and 3 percent for the most polluting industry.

Mani and Wheeler (1997) find using cross-country analysis that the pattern of evidence does seems consistent with the pollution haven pattern of investment. However, upon closer examination, they suggest that there are several other reasons explaining “dirty production” in the South that have little to do with the “pollution haven” story.

IMPORTS OF “DIRTY INDUSTRY” INTO THE SOUTH

Developing countries feel threatened that, with trade liberalization (i.e. reduced tariffs on imported capital and intermediate goods), there may be an influx of dirty technology coming into their countries. While evidence on this is limited, there was an instance in Pakistan whereby a second hand Danish mercury chlor-alkali plant was being imported in 1994.[6] Green Peace International, with the support of local environmental organizations, frustrated this attempt. Similarly, the newspapers reported on the proposed dumping of toxic wastes off the coast of Pakistan's Balochistan's province. Thus the World environmental community needs to be alert to the disposal of various DPGs including "dirty machinery", toxic wastes, insecticides, fertilizers, chemicals and pharmaceuticals.[7]

EXPORTING THE ENVIRONMENT

Critics of the free trade ideology claims that increased exports, particularly in the aftermath of liberalization, will be at the cost of natural resource depletion and degradation and increased industrial pollution. Thus the World Commission on Environment and Development (1987) pointed out, in what is referred to as Brundtland Report, that, during the 1980s, the South's commodity trade was based on the over harvesting of nature in order to service its debt. The problem will be especially acute in that the South lacks the resources and technological prowess to combat environmental degradation.

Proponents of liberalization argue that, quite to the contrary, enhanced exports are likely to benefit the environment in the long run. Birdsall and Wheeler (1992) point out that competition would induce the drive towards the latest manufacturing technologies and, since these are likely to be procured from the North, they are likely to be much cleaner. Further, western importers may require cleaner processes to ensure greener products.[8] They present evidence from their own cross-country analysis showing greater openness to be associated with less pollution intensive industrialization.[9] Eliste and Fredriksson (1998) found that for the agricultural sector, trade liberalization does not induce a "race to the bottom." Their findings suggest a positive relationship between stringency of environmental regulations and trade openness. Their findings also suggest that there is a positive association of the degree of stringency in regulations among trading partners.

Cross-country evidence can at best be viewed as suggestive. Thus, more evidence on this issue, based on industry case studies, is awaited. Dean (1998) developed and estimated a simultaneous equation model for Chinese provincial data to show that the direct effect of liberalization, via the terms of trade, is negative but the indirect effect via income growth is positive. Again, the income growth effect could equally be neutral and essentially depends on the political economy of resource allocation in a particular setting. Strutt and Anderson (1998) develop a methodology to study the impact of trade liberalization and environmental depletion and apply this to Indonesia. They find that trade policy reform expected in the next two decades would, in many cases, given the current state of environmental regulation, improve the environment and reduce resource depletion with regards to air and water. In other research done by the authors that they

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[6] Mercury–based production of chlor-alkali will be phased out by Paris Convention countries, of which Denmark is a member, by 2010. Also Jha and Teixeira (1997, p. 179) note the movement of leather tanning to the South as the North imposed stringent environment standards.

[7] OECD (1994).

[8] They cite evidence of German imports of fish meal and paper products from Chile which required treatment of effluent to ensure reduced bacteriological contamination of products (p. 160). Another example cited by eds. Robins and Roberts (1997, p. 22) is the production adjustment of Indian textile producers to the ban on azo dyes.

[9.] Wheeler and Markin (1992) present evidence of greater openness leading to cleaner technologies due to competitive pressures in the case of wood pulp production.

cite, the same is claimed for land degradation via soil erosion and associated off-site damage. In the worst-case scenarios, trade liberalization is expected to add only slightly to environmental degradation.

MEAS AS A TOOL OF PROTECTION

In recent years, trade policy has been considered as an instrument to enforce environmental compliance in the form of inclusion of trade provisions in multilateral environmental agreements (MEA).[10] These may include unilateral use of trade measures to enforce environmental compliance on the part of trading partners. The sanctions, if applied, would mean trade with non-parties to the agreement would in principle be prohibited. So far the WTO has not endorsed the use of such sanctions. Nonetheless, these MEAs are an important feature in the trade environment scene.

The provisions of the Montreal Protocol required signatories to ban imports of CFCs (chloroflourocarbons) and products containing CFCs from non-signatory countries. Precedence now exists regarding the unilateral use of trade measures to enforce environmental compliance e.g. the US ban on shrimps to encourage the use of turtle excluder devices to protect sea turtles is a case in point.[11] The Convention on International Trade in Endangered Species (CITES) has agreed to a ban on ivory. Other countries have import bans on whales, fur seals, polar bear and some specific migratory birds and species. The Basel Convention bans some types of trade in hazardous and toxic wastes.

In addition to MEAs, countries may adopt Trade Related Environmental Measures (TREMs). These could be triggered by environmental concern such as:

- To discourage unsustainable exploitation of natural resources;
- To discourage environmentally harmful production processes;
- To induce producers to internalize the costs of the environmental harms associated with their products and production processes;

or by competitive concerns such as:

- To prevent states not implementing a given policy from gaining a competition advantage by avoiding costly environmental investment or expenses;
- To prevent the migration of industries especially affected by a policy from migrating to states not implementing the policy (so called "pollution havens").

NORTH HAS COMPRATIVE ADVANTAGE IN MEETING ENVIRONMENTAL STANDARDS

The emphasis by the Northern environmental community on uniformity of production and process

[10]. Cai et. al (1997, p. 21).

[11] While the WTO dispute settlement procedures have struck down this unilateral US action, which is also in violation of principle 21 of the Rio Declaration, the US is moving ahead with enforcing an import ban on all but 37 certified countries. Pakistan media has been reported on this act of unilateralism in "US bans shrimp imports from Pakistan, India," *The Nation*, May 6, 1999 and "Trawler owners asked to comply with rules," *Dawn*, May 23, 1999.

methods and environmental effects of production processes is interpreted by the South as an effort to restrict its access to Northern markets. The argument is that Southern countries do not have the capacity of Northern countries to cope with detailed regulation and also that the regulations are tailored to Northern concerns and may thus be inappropriate. Thus benefits of liberalization and environmental conservation, in the presence of harmonized standards, will be skewed in favor of the North.[12] Brazil raised this issue originally in 1993 over European Union regulations for tissue paper production. Brazilian pulp manufacturers complained that the regulations on consumption of renewable and non-renewable resources, waste generation and sulfur emissions would disadvantage foreign producers who could not meet these standards.[13] Brazilian growers could not get an EU eco-label because they did not have high enough re-cycled content. However, their product was sustainably produced on plantations. Thus the EU criteria were set based on EU concerns for re-cycling and gave no credit for sustainable production.

HIGH MITIGATION COSTS IN THE SOUTH

Many Southern countries exporting to OECD countries have had to confront standards, particularly in the leather and textile industries, and this is viewed as an unfair protectionist cost being imposed on them by Northern governments.[14] Our take on this issue differs. Southern countries like Pakistan must distinguish between restrictions imposed by Northern Governments and those imposed by Northern businesses. If Northern Governments imposed import restrictions because Southern countries are not doing enough about child labor or cleaning production technologies, this constitutes a non-tariff barrier. However, this is not the big danger that faces Southern exporters. Increasingly, businesses in the North are being required by their boards/shareholders to do business with firms that meet certain "voluntary" environmental and quality standards. In some ways, a cleaner environment is viewed as a luxury good and the more prosperous Northern consumers are viewed as requiring it.[15] This is thus a market-dictated standard and not as such a non-tariff barrier imposed by Northern governments. This is a very important distinction. The only option Southern exporters have is to conform or lose markets.

Even if the standards are imposed by Northern governments and they provide an edge to Northern producers who are more capable of meeting them, it would still be wise for LDC to conform. It does appear that such standards are patently hypocritical. For years, market trained academic and non-academic economists have lectured the third world to “let the market decide.” Now that LDCs have the comparative advantage and want the market to decide, they have various additional hoops to jump through to get product acceptance. In fact, the reality is that various product related environmental standards should be seen as an on going consumer protection movement in the West. If LDCs confront process-related standards, they can legitimately complain about an infringement on their sovereignty as long as governments impose these. However, they can’t argue with consumer sovereignty in the West. Further, based on research subsequently described in this report, our view is that cleaning up production processes generates far more social benefits than costs in

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[12] Nath (1997).
[13] *Ecologist*, Vol. 25, No. 1, 1995.
[14] WWF (1997) points out that India, China and Zimbabwe confronted barriers due to textile dies. Refer to CBI/CREM *Environmental Quick Scans* for identifying bans, standards and existing and intended environmental legislation applicable to EU imports from developing countries.
[15] This positive income elasticity for a cleaner environment is the logic underlying the controversial environmental Kuznet’s curve. Refer to Grossman and Krueger (1991).

producer countries and win markets as well.

There also appears to be a mis-perception among political authorities in Pakistan that cleaning up the environment is a luxury we cannot afford or that preventing environmental damage imposes an unbearable economic cost. This is true only when viewed from a limited short run perspective. Politicians and businesses need to realize that environmental damage depletes the natural resource base via water, soil and air degradation and results in current and future loss in productivity. Much more important is the loss of productivity resulting from the impairment of the health of current and future generations.[16] Politicians always speak for the poor, but it is the poor who are least capable of defending themselves from environmental ravages. If improving the health, productivity and quality of life of the current and future generations is not a sufficient inducement to act quickly, the potential huge loss of export markets should be. The Uruguay Round induced increased in exports for developing and transitional economies has been estimated to be between 14 percent and 37 percent.[17] Thus the dividends from the right decisions are potentially very high.

An analytical framework developed in OECD (1994, pp. 7-17) categorizes the environmental impact of trade into product, scale, structural and regulatory effects. In each category, there can be positive and negative effects. Our focus is on the negative scale effects that can result from trade expansion and trade liberalization in two of Pakistan's key manufacturing export sectors. Thus, as production expands to respond to growing export markets, without proper environmental policy and enforcement mechanisms in place, these enhanced exports will prove to be environmentally disastrous. Fortunately, in Pakistan's case, a reasonable environmental policy is in place. Currently, government, business and civil society groups are groping towards appropriate implementation mechanisms. This research will indicate the urgency of coming to a quick resolution. We will also demonstrate the cost and benefits of mitigation strategies. Our main finding is that the costs of mitigation are much lower than perceived to be the case in the South.[18]

II. **Research objectives and method**

The overall objective is to do a heuristic benefit cost analysis of the abatement of the incremental pollution resulting from cloth and the leather industry exports.[19] The following four-step procedure has been adopted.

• Estimate the increased cloth and leather exports up to the end of 2004. The end of 2004 is when textile and clothing quotas in developed countries are expected to be removed as negotiated in the Uruguay Round ATC. While, in principle, end 2004 represents an important date for our research, its significance is somewhat reduced since 72 percent of Pakistan's cloth exports go to non-quota

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[16] Da Silva and Qazilbash's (1998, p.13) upper bound estimate for the cost of inaction in dealing with environment degradation in Pakistan was $4.36 billion in1996, over half of Pakistan's export earnings in that year.

[17] Metha (1997).

[18] For example UNCTAD (1995, p. 7) and Lalonde and Chabason (1994, p. 13) suggest that the costs of mitigation are very high. A WWF (1997, p. 19) study reports that large firm cost increases range from 8 to 10 percent in textiles. Similar fears are expressed by Bharucha (1997, p. 134 and p. 136) and Jha and Teixeira (1997, p. 179).

[19] Cloth is the most polluting product in the textile industry and tanning the most polluting process in the leather industry.

countries.[20]

• Estimate the environmental impact of cloth, leather and footwear exports. By using unit discharge rates of chemical, organic and suspended pollution loads, based on data collected by the Sustainable Development Policy Institute's (SDPI) Technology Transfer for Sustainable Industrial Development Project (TTSID) and the Environment Technology Program for Industry (ETPI), predict the effluent pollution associated with exports. Here we also document the health and other social costs resulting from the pollution, although these are not quantified. In effect, the reduction of such costs represents the benefit from pollution mitigation. It would have been useful to also assess the total production related pollution and mitigation cost. However, recent production data in Pakistan is not available since the last *Census of Manufacturing Industries* took place in 1990. The textile and leather plants were purposively selected and can be viewed as representative of medium units in Pakistan.[21]

• Assess the import costs of using cleaner technologies. The technologies being referred to for the textile sector are the ones best suited to local conditions to meet the currently applicable environmental quality standards in Pakistan.[22] The technology being considered for the leather sector is locally available.

• Assess the mitigation impact of using cleaner technologies and set that in an understandable context for business and government.

III. **Justification for industry selection**.

Table 1 below indicates the economic significance of textiles and leather industries for Pakistan.

Table 1. The economic significance of the textile and leather industries in Pakistan.

	Textiles & clothing	Leather & products
Exports as % total exports[@]	55.0 (1)	3.0 (4)
Value added as % of total value added in major industries	27.7 (1)	1.6 (15)
Employment as % Of avg. daily empl. in major industries	41.5 (1)	2.4 (8)

Source: Government of Pakistan, *Economic Survey 1996-97*, Statistical Appendix (1997, pp. 74-75).
Exports figures are taken from *Foreign Trade Statistics*, (May 1996, pp. 29-30, p. 338).

[20] Ingco and Winters (1995, p. 12).
[21] There are no large sized plants textile plants to speak of. For more details on textile plant selection, see fn. 35 and SDPI/TTSID (1995) and for leather plant selection see Khwaja et. al (1995) and EPTI (1997).
[22] For more details on the choice of technologies see pp. 21-23.

Notes: Parentheses contain ranks.

@ Pakistan share of World exports of yarn and cloth in 1995 were 28.3 and 5.8 percent respectively according to the *Cotton World Statistics*, Quarterly Bulletin of the International Cotton Advisory Committee, Vols. 35, 45 & 48.

The rankings in Table 1 above show that textiles are clearly the sector of major economic importance to Pakistan in all categories. While leather is not quantitatively of similar significance, it clearly is so from an environmental perspective as the next section indicates.

IV. **Environmental impacts**

A. *Environmental impacts of cotton exports*[23]

In investigating the environmental impacts, we start with cotton production, which is where the commodity chain begins.[24] Two of the most damaging inputs into cotton production are pesticides and fertilizers and so we start the analysis with the environmental impacts of these inputs.

1. Pesticides

The main negative environmental impact from cotton production results from the use of chemical inputs. Carson's *Silent Spring* (1962) started the questioning and concern and many writers have since written about the negative effects of pesticides,[25] particularly concerning their use in developing countries.[26] Weir and Schapiro in The *Circle of Poison* (1981, p. 11) pointed out that pesticide poisoning in LDCs was thirteen times greater than in the USA, due to the lower level of education, despite the much greater use in the US. Drifting pesticide sprays, leaky applicators, inappropriate and overuse result in run offs and seepage into water and soil.

Residues in soil, food and water and unsafe handling result in various medical problems for people including enzyme imbalances, skin and allergic reactions, delayed neurotoxicity, behavioral changes, lesions, changes in the central nervous system, peripheral neurities, carcinogenic and oncogenic diseases, sterility, cataracts, lung perforations, memory loss and damage to the immune system. Colborn (1994, p. 89) points out that most of the past testing focused on individuals directly exposed and not on the functionality of their offspring. He points out that studies reveal that "as a result of [pesticide] exposure in the womb of mammals including human, the endocrine, immune and nervous systems of embryos do not develop normally."

Sadhu (1992, p. 23) cited an FAO study claiming that only 5 percent of the insecticide fell on target plants; the rest pollutes the environment.[27] The adverse impact on the land base includes a reduction in the natural fertility of the soil, harm to the soil structure and soil aeration, reduction of the water holding capacity of the soil making it more prone to soil erosion by water and wind, and lower drought tolerance of crops. Finally, pesticides are viewed as indiscriminately killing

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23. Von Moltke et. al. (1998, pp. 135-138) and Chaudhury et. al. (1998) include useful sections on the environmental and health impacts of pesticides in their reports. The findings concerning Pakistan draw on these sources.

24 For a conceptualization of commodity chains, see von Moltke et. al. (1998, pp. 25 – 65).

25 By pesticides we mean insecticides (predominantly), nematicides, herbicides, defoliants and desiccants.

26. Not all were persuaded by *Silent Spring* and the literature it spawned. Avery (1994, p. 89) argues that such argumentation roots from "an almost mystical belief that manmade chemicals are more dangerous than 'natural' chemicals." The latter, such as caffeic acid, limonene, hydrazines are in various foods and ingested in much larger quantities than pesticide residue. Also, natural chemicals test out to be as dangerous as the synthetic variety in rats. By implication, he argues, the human body is capable of handling the "small carcinogenic insults" resulting from pest residues.

27. This is more likely to be the case for aereal spraying. Since 1981-82, the maximum aereal spraying has been 1.6 percent of total cropped area in 1992-93. Ground plant protection in 1991-92, the latest year for which data were available, was about 20 percent of total cropped area. *Agricultural Statistics of Pakistan 1993-94* (1995, pp. 154-158).

useful insects, micro - organisms and insect predator species, breeding more virulent and resistant species of insects and vectors, and reducing the genetic diversity of plant species.[28]

In Pakistan, there is evidence that cotton pests such as the American bollworm and the whitefly have developed resistance against common pesticides and this has had a devastating economic impact in Pakistan's mono-economy in 1992-93. Sale of adulterated pesticides is perceived as one cause of such resistance.[29] This kind of phenomenon results in what has been referred to as the "pesticide treadmill" where farmers feel compelled to use more pesticides when less does not work and where more is perceived to be better if less is working. In addition aggressive marketing by multinational pharmaceutical companies leads to overuse and also a market for adulterated pesticides sold at lower prices.

Jabbar and Mallick (1994) reviewed the scanty evidence on this issue in Pakistan and based on that reported the existence of residues in water, soil, food and people.[30] This evidence also indicated the existence of the above-mentioned maladies resulting from pesticides.

2. Fertilizers

Qutub (1994, p. 16) documents the costs to human health and the environment. Excess nitrate and nitrite in water and foods can result in methemoglobinemia in infants, are viewed as carcinogenic and can result in respiratory illnesses. Run-off can result in eutrophication via enhanced algae growth and hence hurt fish stocks and also humans via algae toxins. Soil erosion could result from volatilization and denitrification. Finally, nitrates contribute to "soil-pan formation and nitrogenous gasses can result contribute to the green house effect.

Fertilizer use in Pakistan has steadily increased from 20 kgs. per hectare in 1971-72 to 91 kgs. per hectare in 1991-92 and 103 kgs. in 1994-95. Evidence on the negative environmental impact of fertilizers in Pakistan is once again very limited. Ali and Jabbar (1992, p. 92) tested soils in Faisalabad in a pilot study and concluded that nitrates are present in sub-surface soils in considerable quantities.

3. Anticipated increase in insecticide and fertilizer use

Since farmers do not use herbicides or defoliants, the main source of concern is the use of insecticides.[31] The consumption of pesticides in 1997 was 44,872 matrix tons[32] and a large portion

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28. See Carr-Harris and Dudani (1992, p. 10, p. 14).
29 This involves mixing in material difficult to detect but cheaper than the actual ingredients, including water, and hence diluting the pesticide's efficacy.
30. Most dramatic is an account of 194 cases of endrin poisoning in Talagang, Attock (p. 15). Seventy percent of the cases were among minors between one and nine years and in all 19 people died. Harris and Dudani (1992, pp. 9-11) document pesticide poisoning cases in India and report 3,029 known deaths occurred in 1990-91. Sadhu (1993, p. 22) cites a WHO study claiming about half a million people in the world are poisoned each year and about 5,000 of these people die.
31 Most of this sub-section is based on von Moltke (1998, pp. 132-138).
32 Government of Pakistan, Agricultural Statistics of Pakistan 1996-97 (1998, p. 155).

of it is use in cotton production (about 65 percent).[33] Pakistani farmers use about 8-13 sprays per season, which is about twice the level recommended by cotton researchers and extension staff. The number of sprays and the area covered has increased dramatically over time. Thus while the area sprayed as a percentage of total area under cotton cultivation was 5-10 percent in 1983, it was 95-98 percent in 1991.

To get a handle on the quantitative increases in fertilizer and pesticide use associated with cotton production, we adopted the following approach. Much of the cotton produced gets exported either directly as raw cotton or indirectly as cotton products. Also, almost all the pesticides are imported. Thus the changes in chemical input use can broadly be viewed as trade related..

$CRIU = \phi \delta IU$

Where

CRIU	=	Forecast of growth in cotton related chemical input use
ϕ	=	Cotton production share in total chemical input use
δIU	=	Forecast of growth in chemical input use

Cotton production share in pesticide and fertilizer use in the base year (1996) was about 65 percent and 50 percent.[34] We assume that this continues to be cotton production's total share in pesticide use in the terminal year. Having an estimate of ϕ, one can simply multiply that with the increase in chemical input use (δIU) to get an estimate of the change in chemical input use that can be attributed to an increase in cotton production.

We used the auto-regressive, integrated, moving average approach (ARIMA) to generate the forecasts of the right hand side of the equation above i.e. of the increase in cotton production to get ϕ and of the increase in chemical input use to get δIU. The details of the procedure used, estimation models and data sources are explained in Appendix I. In Table 2 below, we present the base and terminal year pesticide and fertilizer consumption and the expected contribution of cotton production to the increase in chemical input use.

[33] von Moltke (1998, p. 134).
[34] The estimate of cotton production share in pesticide use is cited above in fn. 29 and the estimate of cotton production share of fertilizer use is based on conversation with the Cotton Commissioner.

Table 2. Forecasted increase in chemical input use due to increase in cotton production

Input	Base year (1997)	Terminal year (2004)	Change in input use (1997-2004)	Change in input use attributed to cotton production
Pesticide (MT)	44,872	63,192	18,320 (40.8)	(31.7)
Fertilizer (‘ 000 / NT)	2,409	3,480	1,071 (44.4)	(22.2)

Sources: See Appendix I
Notes: MT = Metric tonnes
NT = Nutrient tonnes
Parentheses contain growth rates

Projecting from past trends, pesticide and chemical fertilizer use is expected to continue to increase in Pakistan. Chemical fertilizer use is much more intensive in Europe and Japan with the Netherlands applying the most (554 kgs. per hectare) in 1994-95 compared to Pakistan’s 103 kgs. per hectare. However, while use among the major OECD countries is much higher, use in all of them has been steadily declining since the middle to late 1980s and use in the USA is already as low as Pakistan.[35] Pakistan does not need to wait for the same intensity of use to derive the same lessons because well known alternatives like integrated plant nutrient system (IPNS) and integrated pest management (IPM) are already available.

B. *Environmental impacts of textile and clothing production*[36]

The environmental impacts result from the impacts associated with the various cotton processing (cloth producing) stages including spinning (blowing, mixing, carding, combing, drawing, simplexing, ring spinning / open end spinning, cone winding, bleaching, dyeing and drying), weaving (done after wraping and sizing) and finishing (singeing, de-sizing, washing, bleaching, scouring, heating, washing, mercerizing, washing, dyeing, washing, printing, finishing, calendering and wraping). The various chemicals and substances used in these processes include, enzymes, wetting agents, acids, polyvinyl alcohol, polyvinyl acetate, carboxymethyl cellulose, gelatin glue, gums, sodium silicates, sodium carbonates, caustic soda, synthetic detergents, hydrogen peroxide, hydrogen sulfide, ammonium and sodium phosphates. Some of these chemicals are a fire risk if not carefully stored, others are corrosive or extremely toxic and other solvents represent a chronic health risk if prolonged exposure takes place.

Various kinds of pollution are possible from the above processes. The release of cotton dust to the air from spinning operations can be a health hazard. It can cause acute respiratory diseases. Most of the spinning is done in modern plants, which are equipped with dust extraction equipment or

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[35] Government of Pakistan, *Agricultural Statistics of Pakistan, 1996-97* (1998, p. 138).
[36] The description for this sub-section draws on SDPI / TTSID (1995). This information is based on data collected from an audit of three textile units. Two were composite textile mills performing the whole spectrum of operations while the third was a garment manufacturing unit. The selection was based on the size of the units and the range of processes they engaged in.

waste recovery units for reducing particulate emissions. However, a serious problem of dust pollution continues to exist in small-scale units in the informal sector. The potential adverse impacts of other air emissions include damage to animal life, vegetation and the incidence of smog. Excessive noise and odor levels, resulting from textile processing, can also impinge upon worker health and safety. Again, small and medium sized enterprise (SME) workers are more susceptible because these do not use the more modern technology utilized by the larger plants. Soil pollution resulting from untreated effluents seeping into the water table is dangerous because it is largely irreversible. It takes a long time to decrease the concentrations of contaminants to acceptable levels. However, the environmental impacts associated with the textile industry are mainly those associated with water pollution caused by the discharge of untreated liquid effluent in the main channel, which eventually flows into rivers. Liquid wastes mostly arise from washing operations and it is estimated that 100 kgs. of effluents are generated by one kg. of textile.

These effluents contain high bio-chemical oxygen demand (BOD), suspended solids (SS) such as fiber and grease, chemical oxygen demand (COD), and TDS (total dissolved solids).[37] The effluent is generally hot, alkaline, strong smelling and colored by chemicals used in the dyeing processes. High BOD and COD lower the dissolved oxygen of the receiving waters, threaten aquatic life and damaging both the aesthetic value and water use quality downstream. High COD also results in obnoxious odors, toxic sulfides. Suspended solids raise water turbidity, reduce light penetration and hence plant production. They settle to the bottom where they destroy fish spawning grounds and other organisms that serve as fish food. Fish gills can also be plugged if SS are high. TDS are the inorganic salts and substances that are dissolved in the water. This process accelerates corrosion in the water systems and pipes and depresses crop yields if used for irrigation. Metals and compounds such as phenol and chromium, which are used in textile processing, are known to be carcinogenic. Phenol compounds have a objectionable taste and chlorine odor and chromium can result in liver necrosis and nephrites that are lethal. Large dosages can result in irritation of the gastro-intestinal mucosa and cancer in the human digestive tract. The azo dyes are also believed to be carcinogenic and allergy inducing. Thus they can represent a health hazard for both the worker and the consumer.

The release of contaminated water can also pose a serious threat to surface and ground water resources in areas where textile units are concentrated and, in extreme cases, render water unfit for drinking. In addition, the eventual contamination of seawater also results in harm to fisheries.

To get a sense of how polluting the effluents are, Table 3 below reports the results of the audits of the three textile units in Pakistan relative to Pakistan Environment Protection Agency (EPA) standards and EPA standards in the USA.

[37]. eds. Robins and Roberts (1997, p. 22).

Table 3. Measured contamination levels and discharge standards in the textile sector

Parameter	Measured Level mg/1	Pakistan EPA Standard mg/1	US EPA Standards mg/1
PH	8-9	6-10	6-9
BOD	112-120	80	58
COD	430-480	150	524
TSS	25-1,200	150	157
TDS	2,300-3,600	3,500	-
Total Chromium	0.05-0.30	1	0.9
Phenol	Not detected	0.1	0.9
Sulfide	0.07-15.0	1	1.75
Temperature ^{o}C	52	40	5+AMb.

Source: SDPI (1995, p. 28).

Table 3 above shows much higher measured levels for BOD and COD relative to recommended standards.

C. *Environmental impacts of leather production*

The main source utilized for the first three paragraph of this sub-section is ETPI (1997) that drew its information from an audit of three tanneries. Parikh *et. al.* (1995) was also extensively drawn on. Leather tanning has been ranked as one of the most polluting activities compared to other manufacturing sector activities. It also has one of the highest toxic intensity per unit of output.[38]

Converting hides into leather is a heavily chemical intensive process utilizing roughly 130 chemicals. The main chemicals used in the various processing stages include sodium sulfide, lime powder, ammonium sulfate, sodium chloride, sulfuric acid, chromium sulfate, sulphonated and sulfated oils, formaldehyde, pigments, dyes and anti-fungus agents. The processing stages are pre-tanning (soaking, unhairing and liming, fleshing, deliming, washing, bating and de-greasing), tanning (pickling, chrome tanning, wet-blue storage, sorting, splitting and shaving), wet finishing (wet back, neutralization, retanning, washing, fat liquoring, dyeing and washing), dry machine process (sammying/setting, drying, stacking/toggling, shaving, trimming and pressing), and finishing (buffing, spraying/coating, drying and glazing/polishing).

Pollution or wastes resulting from these processes are air, solid and primarily liquid. Hydrogen sulfide and ammonia are the major gases released into the atmosphere. However, laboratory results showed emissions lower than the national environmental quality standards.

[38] [WTO, (1997, P. 52)].

Most of the solid wastes are recycled. The drums, cartons and chemical bags are procured for re-use. Fleshing, raw trimming and buffing dust is bought by leather board or poultry feed manufacturers. These solid wastes contain chromium residues which is known to cause perforations and bronchiogenic carcinoma to humans who are continuously exposed. Chicken feeds prepared from proteins containing tanneries solid wastes is likely to cause direct entry of chromium into the food chain. The results of tests conducted by the Pakistan Tanners Association showed chrome residues in poultry feed. Leather shavings are used as cheap fuel in kilns causing the release of chromium into the environment. The remaining solid wastes are usually illegally dumped around the factory area on unutilized lands. These solid wastes include metal contents, such as chromium, aluminum and zirconium, which have a detrimental effect on plant growth.

In the course of processing of hides into leather, roughly 50-150 liters of water were used per one kilogram of converted leather. Thus effluents discharged from tanneries are voluminous, highly colored, contain a heavy sediment load including toxic metallic compounds, chemicals, biologically oxidizable materials and large quantities of putrefying suspended matter. Tannery effluents, without any pretreatment, are discharged indiscriminately into water bodies or open land, resulting in contamination of surface as well as sub-surface water. The lack or effective implementation of legislative control, poor processing practices and use of unrefined conventional leather processing methods have further aggravated the pollution problem caused by the tanning industry in the South Asian region including Pakistan.[39]

As in the case of textile effluents, the low pH of tannery effluents cause corrosion of the water-carrying system. Large pH fluctuations and the high BOD value, caused by tannery effluents, can kill all natural life in an effected water-body. Studies have revealed that the water of river Ganges at Kanpur and the sub-surface water of the Paler river basin of India and Korangi and Charsadda areas of Pakistan have been significantly polluted by tannery wastes.[40] The contribution of tanneries pollution in the contamination of the Karachi Coast is estimated at about 10-15 percent of the total pollution. Hydrogen sulfide formed due to the presence of sulfide in the effluent and chromium is highly toxic to many forms of life. Some workers died in Karachi in 1980 while clearing monsoon ditches filled with tannery sludge.[41]

In the Pakistani Punjab and the Palar river basin in India, tanneries are directly contaminating prime agriculture land. Research has shown that the crop-yield has been adversely affected and also of course the food is contaminated.[42] Most of the tanneries in Punjab and NWFP in Pakistan are located in residential neighborhoods which causes a direct threat to the health of the urban population.[43]

Parikh *et. al.* (1995) also mention several other environmental effects in their Report on the Indian leather industry. These include the overgrazing by cattle, the smell of rotting flesh near the tanneries, the odor of sulfide emissions from the dehairing and the ammonia emissions and flue gas

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[39] ETPI (1997), Khwaja, et. al. (1995) and Nasreen, (1997).
[40] Suresh and Krishna (1983, p.63) and Khwaja, et. al. (1989).
[41] Beg, (1990, p. 431).
[42] Srinivas, Teekaraman and Ahmed, (1984, p.314).
[43] Saddiq, (1989, p. 61).

emissions from the unhairing and fleshings. The ammonia emissions during the deliming cause irritation of the respiratory tracts. Other negative effects of the ammonia emissions include the loss of land productivity, retardation of the germination of plants and seeds, headaches, stomachaches, dizziness, night blindness, leprosy, dermatitis and other skin disorders. Leather dust results in allergies and cancers that injure the locals around the tanneries.

As in the case of textile effluents, the audits generated data enabling us to compare the effluent parameters relative to Pakistan and USA EPA standards.

Table. 4 Measured contamination levels and discharge standards in the leather sector

Parameter	Measured Level mg/1	Pakistan EPA Standard Mg/1	US EPA Standards mg/1
PH	7.4-9.8	6-10	6-9
BOD_5	1,740-11,050	80	58
COD	3,800-41,300	150	524
TSS	440-890	150	157
TDS	10,580-20,000	3,500	-
Total Chromium	3.0-133.0	1	0.9
Sulfide	0.0-288.0	1	1.75

Source: ETPI (1997, p. 19).

Table 4 above shows that there is much more to be concerned about in the leather industry relative to the textile and clothing industry since leather production effluents far exceeded both Pakistani and US EPA standards on all counts.

As in the case of all industries, the poorest are the worst affected by the pollution. First, for generations, leather related jobs are done by the lower castes. Second, the competition for such jobs is so intense that the manufacturers don't have to improve the dangerous working conditions. Third, the emissions affect those with living around industrial sites in low value land that have the least political power.[44]

V. **Trade liberalization and export growth in the textile and leather sectors**

The non-tariff barriers on trade in textile and clothing have significantly affected Pakistan under the Multifibre Arrangement (MFA) – the GATT rules carve out that determined import quotas for various developing counties into the OECD countries, particularly the USA and EU. This assertion is premised on the fact that a substantial part of its textile exports is geared towards restricted markets, and the quota utilization rates have been high. In 1994, Pakistan exported 5% of yarn, 28%

[44] Taken from the internet site Trade and Environment: South Asian Cases, "Leather Production in Pakistan," hhttp://www.american.edu/mandala/TED/HP242.HTM

of fabrics and 71% of textile made-ups to countries that impose textile quotas under the MFA. In 1992, 86.5% of Pakistan's exports to OECD countries comprised textile and clothing. Between 1985-88, the average weighted quota utilization rates for textiles exported to the United States for Pakistan was 89.6%; for the European market, this rate was 107.2% (Ingco and Winters, 1996, Tables 11 and 12).

The Agreement on Textiles and Clothing (ATC) aims to reduce non-tariff restrictions under the MFA as well as non-MFA restrictions on trade. The agreement includes the following: progressive expansion of existing quotas; integration of textiles and clothing products into GATT rules; and safeguards to deal with cases of market disruption during the transition.

The MFA related quantitative restrictions are to be removed in three phases by the year 2004.[45] In each phase, importers will transfer, from the MFA to normal GATT rules, a tranche of products related to the share of these items in their total 1990 import volume. The integration into GATT rules is supposed to be implemented in three phases. In the first phase, countries were to integrate into the GATT, products from the specific list in the agreement, which in 1990 accounted for at least 16% of the total volume of imports. The second phase, that was due to commence on January 1, 1998, products specified in the agreement which in 1990 accounted for at least 17% of the total volume of 1990 imports were to be integrated into the GATT. The third phase, beginning January 1, 2002, is to integrate products in the specified list that accounted for at least 18% of the total volume of 1990 imports. All remaining products are to be integrated at the end of the implementation period -- January 1, 2005. A formula was developed to increase the existing growth rates for quotas of products that were under bilateral restraint. During the first phase, the growth rates were to be raised annually by not less than the growth rate established for the respective restrictions increased by 16%. In phase two, the growth rates were to be the phase I rates increased by 25%. In the third phase, the growth rates are to be phase II rates raised by 27%.[46]

As earlier indicated, since much of the textile industry pollution is generated from the production of cloth, our focus is exclusively on cloth exports. Pakistan's future exports of cloth could be contingent on a number of factors that could include the following:

i. WTO Agreement on Textiles and Clothing (ATC);
ii. Growth in production of raw materials like cotton;
iii. Growth in manufacturing production capacity and domestic absorption;
iv. Quality and exchange rate determinants of competitiveness.

Ingco and Winters (1995, Table 9) forecasted the increase in Pakistani cloth exports based on the Uruguay Round agreements. As explained in Appendix I, since only 28 percent of cloth exports went to quota countries, we used the ARIMA model to forecast exports to non quota countries. The same model has also been used to forecast exports of hides and skins, leather and footwear.[47]

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[45] This paragraph is based on Cai et. al. (1997, p. 17).

[46] GATT, 1994

[47] Obviously, the ARIMA model is not capable of picking out export fluctuations such as those resulting from economic events such as the "Asian Contagion." Thus this model implicitly assumes a return back to the trend line. This is adequate for our purpose since we are only concerned with the terminal year export value.

The results are presented below in Table 5. While our concern is with identifying the environmental impact of export related leather tanning (i.e. directly as leather or the leather equivalent of footwear exports), forecasts of hides and skins provide context for the overall export scenario for the leather industry that is discussed below.

Table 5. Benchmark and forecasts for cloth, hides and skins, leather and footwear.

Product	1996	2004
Cloth (million sq. meters)	1,257.4	2,276.1
Hides and skins (‘000 kgs.)	45.0	57.6
Leather (million sq. meters)	14.3	13.2
Footwear (million pairs)	8.2 (3.01 millions m2 Leather)	8.0 (2.94 millions m2 Leather)
Total Leather Export (million sq. meters m2)	17.31	16.14

Source: Benchmark data were drawn from Government of Pakistan, Economic Survey 1997-8, Statistical Supplement (1998, pp. 168-170). For forecasting method, see Appendix I.

The cloth exports forecast for Pakistan reported above may be overstated for four reasons. First, the transitional safeguard measures against import surges have already been used by the USA, about two dozen times, against over a dozen countries.[48] Second, Pakistan faces many potential trade barriers on environmental ground (both for textile and leather).[49] Third, Metha (1997) pointed out that in the first phase of the ATC (January 1, 1995 to December 31, 1997), developed countries have not implemented the ATC clauses of 16 percent integration of MFA into the GATT i.e. the quotas have not been removed. Finally, Pakistan will face stiff competition from traditional competitors such as Bangladesh, India and China, and perhaps new ones, and so cannot take for granted availing of the new market opportunities that will open up.

Tough controls on the highly polluting tanning process have contributed to a large cut in the number of tanneries in most OECD countries.[50] As a consequence, exports from LDCs like Pakistan filled in the availability gap in these OECD countries. This probably partly explains the cumulative rapid leather export growth statistic from 1980 to 1990 of 108 percent for Pakistan.[51] Since then, leather imports have confronted restrictions in some OECD countries based on health criteria. For example, in 1990, Germany imposed a ban on leather treated with pentachlorophenol (a carcinogenic chemical preservative). Subsequently, several European countries have imposed a ban based on the use of azo dyes.[52] Thus, it is not surprising that leather export growth has tapered off for Pakistan and the trend forecast suggests declining growth into the future.

Another reason for this is the tariff escalation used by industrialized countries. Thus while hides and skins face zero tariffs, semi-manufacturing leather faces an average tariff of 4.8 percent and

[48] Cai et. al. (1997a, p. 14).
[49] Ibid, p. 31
[50] Robins and Roberts (1997, p. 21).
[51] Government of Pakistan, *Economic Survey 1997-98*, Statistical Supplement (1998, p. 169).
[52] CBI/CREM (1998, PP. 10-11).

finished goods face a tariff of 12 percent.[53] It should not be surprising that our trend forecast shows a continued robust export growth for hides and skins. Thus it seems that as industrialized countries have adopted cleaner technologies, they would rather import the raw materials from the South and again engage in the higher value added activity themselves.[54]

Exports of leather products are slated to receive below average tariff reductions in industrial countries as a result of the Uruguay round. The overall reduction is 18 percent that is decomposed into 11 percent for North America and 23 percent for Europe.[55] Thus our forecast of footwear could be biased downwards by not explicitly taking account of this tariff reduction, but not by much.

The decline in the exports of leather and footwear have occurred despite a range of export incentives provided by the Government of Pakistan. These include rebates on leather product exports, duty free imports of raw hides and skins for re-export as higher value products and an export refund scheme for leather footwear.[56]

A more serious issue from Pakistan's perspective, however, is the immense contribution to total industrial pollution currently made by leather tanning as suggested by Table 4. Anticipating and addressing the scale of the environmental threat this industry represents is critical for environmental policy.

VI. **Environmental impacts and mitigation options in the cloth production and leather tanning**

A. *Cloth manufacturing*

1. <u>Selection of parameters to compare the baseline information with the increased Pollution load</u>

Table. 3 above indicated that out of the nine parameters, four are within or very close to the permissible limits (pH, TDS, Total Chromium and Phenol). The temperature is not liable to be affected with the increase in production or the effluent quantity. Sulfide is of relatively minor importance as the generated quantity is small as compared to some other parameters. Some toxic compounds, which are generated in very small quantities, like metals, surfactants and chlorinated solvents have also not been included in the study. Therefore, based on the findings of Table 3, we have concentrated on BOD, COD and TSS.

2. <u>Baseline pollution load</u>

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[53] WTO (1997, p. 51).

[54] It would appear that since tariff escalation results in more of the leather tanning taking place in industrialized countries who use cleaner technologies, the global pollution level is lower and leather exporting developing countries also benefit from lower pollution. Brazil however took up the issue of tariff escalation and argued that if developing countries are denied higher value added production due to such escalation, they also have less resources and hence less ability to adopt cleaner technologies [WTO (1999, p. 17)].

[55] Cai et. al. (1997, p. 17).

[56] Refer to web site reference cited in fn. 41.

As indicated below in Table 6, textile effluents have high BOD, COD and TSS. Natural impurities extracted from the type of fiber being processed, along with the chemicals used for the processing, are the two main sources of pollution. Other pollution related variables are the nature of technology and extent of water and chemicals used in a particular manufacturing plant.

Effluents from each individual process, therefore, vary substantially. For all textile mills processing the same fiber, effluent characteristics are broadly similar but quantities may vary. For this study, the average values of the audit results given in Table.3 have been taken as the baseline pollution level. These average figures have then been converted into pollution load per ton and per million square meter fabric and reported below in Table 6.

Table 6. Base line pollution load

Parameters	Mg./l.[@]	Kg./ton fabric	Tons/million sq. meter fabric[*]
BOD	116	13.28	2.656
COD	455	52.08	10.416
TSS	612	70.05	14.010
Total	-	135.41	27.082

Source: Table 3 and SDPI/TTSID (1995). For conversion factors from mg./l to kg./tons and tons/million sq. meter (see next sub-section).

Notes: @. Effluent flow of 1488 m3/day from 13 tons/day fabric production.

* Basis: 1 ton equivalent to 5,000 sq. meters i.e. 200 GSM (grams per square meter).

From the above information, it is evident that 1 ton processed cloth produces 135 kg. pollution load and one million square meter processed cloth produces 27 tons (or 27,000 kg.) pollution load. The pollution load increases proportionately with the increase in production if no mitigation measures are taken.

3. <u>Cleaner technologies and mitigation</u>

The purpose of this exercise is to identify costs and benefits of pollution mitigation. Some of the cleaner technologies need to be imported while local adaptation is possible in other cases. SDPI's Technology Transfer Project for Sustainable Industrial Development (TTSID) that is described in section VII, has investigated various pollutants in the effluents discharged by three medium size textile mills. Samples of effluent streams have been collected and analyzed for different parameters of the NEQS.[57] Simultaneously, flow rates of these effluent streams have also been measured and information about raw materials, process details and actual production was also collected as part of the environmental audit.

Based on this information, a base line is available from which we can calculate the pollutants being discharged in weight per ton of production. This information is used to estimate the increased production attributable to export growth and the proportionate rise in pollution load is calculated.

57. These results are expressed in mg/l.

We have conducted empirical exercises for two alternative scenarios: first, that of the increased pollution loads if no mitigation measures are taken, and second, that of the pollution load after installing pollution control technologies/equipment. The costs are calculated theoretically based on the pollution loads and effluent flows.[58]

Liquid waste can be reduced in both volume and concentration by a combination of internal in-plant control measures as well as external end-of-pipe treatment. Various in-plant control measures can substantially reduce the generation of wastes and wastewater and this represents a low cost treatment. The cost of end-of-pipe treatment largely depends on the volume and concentration of the effluents to be treated. In any case, industry can cut down its initial investment, operation and maintenance (O&M) costs by reducing the use of chemicals and water. SDPI/TTSID (1995) project gives several recommendations on in-plant control measures, such as substitution and reduction of chemicals, water conservation and recycling and process changes to substantially reduce the pollution load. It is generally estimated that the cost of effluent treatment can be reduced by 20 to 25 percent with the adoption of simple measures like water reduction, water recycling, screening, equalization and sedimentation.[59] Since the textile plants are not presently using these measures, the mitigation costs have been estimated without taking these savings into consideration.

External effluent treatment methods can be categorized into chemical or primary and biological or secondary processes. Both types of treatments have limitations. Biological processes are inadequate in removing color, whereas chemical processes are incapable of removing biodegradable organic matter. In order to meet strict standards applied in some industrialized countries, a tertiary treatment follows the biological treatment. To meet the currently applicable environmental quality standards in Pakistan, TTSID studies recommend setting up treatment facilities primarily to meet BOD levels in effluent discharge. The COD levels drop with BOD treatment and come closer to Pakistan EPA standards. They recommend combining primary and secondary treatments to attain specified standards cost effectively.

Primary treatment includes processes such as screening neutralization, equalization and gravity sedimentation to remove suspended matter and to achieve uniform flow and concentration. As the suspended matter is removed, the BOD and COD are also reduced to a reasonable level. Secondary or biological treatment involves the development and cultivation of microorganisms to further reduce the effluent BOD. This process may be achieved either in the presence of oxygen (aerobically) or in the absence of oxygen (anaerobically). Amongst various aerobic biological processes, the activated sludge treatment process has proved to be very useful for secondary treatment of textile effluents.

A typical activated sludge system consists of a primary sedimentation tank, an aeration tank and a secondary sedimentation tank placed in sequence. Provision is made to recycle settled biological sludge from the underflow of the secondary sedimentation unit into the aeration tank to maintain the desired level of microbial population. In the aeration tank, the microbial population is generally expressed in terms of mixed liquor suspended solids (MLSS). To lower

[58] We can also calculate a progressive decrease in pollution load if mitigation measures are taken in more than one step.
[59] SDPI/TTSID (1995).

or remove the BOD effectively, it is desirable to maintain a MLSS of 2,500 to 3,500 mg/l. Aeration devices such as mechanical aerators or air blowers are used to supply the necessary oxygen to maximize the use of substrata in the aeration tank by its microorganisms. Biologically treated wastewater is chlorinated by calcium hypochlorite and stored in a balancing tank. There are a wide variety of aerobic biological processes that are effective for dealing with textile wastes. These include aerobic lagoons, activated sludge processes and trickling filters. In general, systems using less energy are recommended for the treatment of textile effluents in Pakistan because of their lower operating costs and maintenance requirements. These systems can be upgraded at a later stage when higher removal efficiencies can be justified.

An SDPI/TTSID study (1995) estimated the reduction in pollution loads based on primary and secondary treatment using activated sludge technology in a 13 ton per day cloth processing facility. The reduction in pollution load attained is reported in Table 7 below.

Table 7. Reduction in load through mitigation measures

Parameters	Present load Tons/ m. sq. meter	Total present load[@] without mitigation (Tons)	Reduced load with mitigation (Tons/m. sq. meter)	Total reduced load[@] After mitigation (Tons)
BOD	2.656	3,339.654	0.1062	133.536
COD	10.416	13,097.078	2.0832	2,619.415
TSS	14.010	17,616.174	0.2802	352.323
Total	27.082	34,052.906	2.4696	3,105.274

Source Table 6 and SDPI/TTSID (1995).
Notes: @ Based on 1257.4 million sq. meters cloth exported (see Table 5).

These mitigation measures are likely to reduce the BOD level by 94 percent, the COD level by 80 percent and the TSS level by 98 percent. In absolute terms, the following reduction in pollution load can be achieved:

Present pollution load without mitigation:	34,052.906 Tons
Pollution load after mitigation:	3,105.274 Tons
Reduction achieved:	30,947.632 Tons (or 90.88%)

It is also clear from the above figures that pollution load will reduce from 27.082 tons to 2.4696 tons for every million sq. meters of processed cloth if proper mitigation measures are taken.

With the trade related increase in exports from 1,257.4 to 2,276.1 million sq. meters by end 2004, the pollution load is estimated to increase as follows:

Without mitigation	:	61,641.34 Tons
With mitigation	:	5,621.06 Tons

Thus there is considerable urgency for introducing mitigation measures since without them, the export related pollution load would increase by 81 percent.

The cost estimates based on primary and secondary treatment using activated sludge technology for a 13 ton per day cloth processing facility are reported in Table 8 below.

Table 8. Mitigation cost estimated in 1995

Rs. Million

Items	Local	Foreign	Total	% of total capital cost
Civil work	6.20		6.20	16.00
Utilities and off sites	-	-	-	0.00
Plant & machinery	14.35	8.30	22.65	58.45
Inland transportation	0.20	-	0.20	0.52
Installation costs	-	-	-	0.00
Detailed engineering	-	-	-	0.00
Process design fee	-	-	-	0.00
Projects overheads	0.50	-	0.50	1.29
Contingencies	3.00	-	3.00	7.74
Sub Total	24.25	8.30	32.55	84.00
Interest during construction	4.62	1.58	6.20	16.00
Total project capital cost in million rupees	28.87	9.88	38.75	100.00

Source: SDPI/TTSID (1995).

Based on the above total mitigation cost of Rs. 38.75 million, and assuming an inflation rate of 12 percent per year, the total mitigation cost is estimated to be Rs. 54.8 million in 1996 for a 13 ton/day (or 4,290 ton / 21.45 million sq. meter cloth per year) plant. This is approximately Rs. 2.55 million per million sq. meters annual capacity. What follows below are three exercises that provide context for policy decisions for government and industrialists.

a. INCREMENTAL EXPORTS RELATED MITIGATION COST. Based on the above mitigation cost and the forecast increase exports of 1,018.7 million sq. meter cloth between 1996 and 2,004, the total estimated mitigation cost is about Rs. 2.598 billion. Thus while the incremental trade related pollution is very high, as are the potential benefits from avoiding health and other social costs, the direct costs of mitigation are quite low in a macro perspective. Rs. 2.598 billion represents about .0011 percent of 1996-97 GNP.[60] Considering that textiles represent twenty eight percent of total industrial sector value added, this would be mean achieving sizable benefit at very modest costs.

b. TOTAL FOREIGN EXCHANGE LIABILITIES**.** The cotton chain study in von Molkte (1998, p. 157) estimated that there are 650 units in the integrated sector, with a finishing capacity of 1,150 million square meter finished cloth per year. As calculated above, the total mitigation cost of one million square meters cloth is Rs 2.55 million. Table 8 above also suggests that the foreign exchange liabilities are about 25.5 percent of the total mitigation cost (1,150*2.55 = 2,932.5). Thus the total foreign exchange requirement of the country for mitigation is therefore about Rs

[60] The GNP statistic is taken from Government of Pakistan, *Economic Survey 1997-98*, Statistical Supplement (1998, p. 39).

747.79 million, which is expected to increase to about Rs 1,480.03 million by 2004, if mitigation measures are adopted. The base year foreign exchange liability represents 1.5 percent of the 1996-97 value of cloth exports.[61]

c. MITIGATION COST AS PERCENTAGE OF SALES REVENUE**.** Given government fiscal constraints, it is important to demonstrate that the mitigation costs for the industrialist are modest. Sales price of finished cloth has a large variation depending on the processing cost and its end use. For this exercise, we drew on von Moltke *et. al.* (1998, p. 165) to assume an average sales price of Rs. 30. Total sales revenue from a plant of 21.45 million square meters production will thus be Rs. 643.5 million. An initial investment of Rs 54.8 million on the effluent treatment facility for this plant forms only 8.5 percent of their sales revenue. This treatment plant would require an annual operating costs of Rs 3.14 million. The annualization of capital costs depends on import duties, interest rate and other taxes. These will range between zero (in the case of a grant) and Rs 7.28 million per year as computed in von Molkte (1998, p. 165). This yields a total annual cost ranging between Rs 3.14 million and Rs 10.42 million. In other words, the annual operating costs of treatment facilities are between Rs 0.15 and Rs 0.49 per square meters of finished cloth. The total annual treatment cost thus constitutes 0.48 percent to 1.6 percent of sales revenues. Thus at a micro level, the costs are once again rather modest relative to anticipated benefits.

B. *Leather*

According to Leather Industry Development Organizations, there are currently 526 leather tanneries in the country, most of them medium sized. The benchmark and export forecast of leather and footwear are reported in Table 5 above. The pollution loads have been computed based on estimates of leather exports and the leather equivalent of footwear exports.

1. <u>Pollution load for chrome tanned leather production</u>

Both the vegetable and chrome tanning processes are employed in the manufacture of leather. When applied to skins or hides, these produce different levels of pollution loads. In Pakistan, since most of the tanneries are chrome-process based, therefore all reported pollution loads are based on this process. A comparative material balance sheet representing chrome-tanned leather from hides and skins is described in Table 9 below.

[61] The cloth export statistic is taken from Government of Pakistan, *Economic Survey 1997-98*, Statistical Supplement (1998, p. 170).

Table 9. Comparative material balance sheet (kg) representing chrome tanned leather from hides and skins

	Hides 10,000 (kgs.)	Skins 10,000 (kgs.)	Average
Leather	1880	1160	1520 (1868 m^2)
Wastewater (M^3)	120-370	1100-2860	610-1615 (Ave. 1112.5)
Untanned solid wastes	2700	2274	2487
Tanned solid wastes	2490	1710	2100
Biological Oxygen Demand $(BOD)_5$	1000	11354	6177
Chemical Oxygen Demand (COD)	2500	28386	15443
Suspended solid	1500	2315	1908
Chromium	60	66	63
Sulfide	100	144	122

Source: ETPI (1997 p.30); Sadiq (1989, p.45).

Biological Oxygen Demand $(BOD)_5$, Chemical Oxygen Demand (COD), Suspended Solids (SS), chromium (Cr) and sulfides $(S)^{2-}$, are the major pollutants in tannery waste water and hence the subject of analysis. Since separate data for the annual production of leather from hides and skins is not available, the average values computed above in Table 9 have been used to determine the baseline (1996) and forecast (2004) pollution loads for manufacturing leather for exports as described in Table 10 below.

Table 10: Baseline (1996) and forecast (2004) pollution loads for chromium tanned leather manufacturing from hides and skins for leather and leather footwear exports.

	Pollution load per 1868 m^2 leather (Average Values) Kgs.	Baseline pollution load (1996) for 17.31 million m^2 leather Kgs. (million)	Forecast pollution load (2004) for 16.14 million m^2 leather Kgs. (million)
Untanned solid wastes	2487	23.02	21.47
Tanned solid wastes	2100	19.39	18.08
Wastewater (M^3)	1112.5	10.21	9.52
Biological oxygen demand (BOD_5)	6177	57.30	53.42
Chemical oxygen demand (COD)	15443	143.15	133.48
Suspended solids	1908	17.65	16.46
Chromium	63	0.59	0.55
Sulfide	122	1.13	1.05

Source: Table 5 for benchmark and forecasts for leather and footwear.
Table 9 for average pollution load.

Data in Table 10 indicates that in 1996, a pollution load of 219.82 million kgs., consisting of $(BOD)_5$, COD, SS, chromium and sulfide, resulted from the manufacture of 17.31 million m^2 of leather and the leather equivalent of footwear exported in the benchmark year of 1996. For the forecast value of 16.14 million m^2 of these exports in 2004, the total load of the same pollutants would be 204.96 million kgs.

2. Mitigation measures for pollution control

Tannery effluents are regarded as a very peculiar form of polluted wastewater because they vary across tanneries both in volume as well as in pollution load.[62] As such, each tannery presents its own effluent problem. Therefore, even for a special type of leather, it is difficult to formulate a standard scheme for effluent treatment.

The methods in use for the effluent treatment may be of a physical, chemical or biological nature, used either alone or in combination. A brief account of some of these methods employed in the country has already been reported above. Like all other industrial waste water treatment, the treatments cost can be substantially reduced by adopting good in-house practices, measures related to waste reduction at source and employing more environment friendly processes/technologies as recommended by the Environmental Technology Program for Industry for the leather sector in Pakistan.[63] The pollution removal performance of some preliminary and primary processes for tanneries' wastewater treatment is reported below in Table 11.

Table 11. Pollution removal in percentages and performance of preliminary and primary processes for tanneries waste water treatment

	BOD	COD	SS	S	Cr
Screening equalization in	5	-	7	-	-
Holding basins	-	-	-	-	7
Sedimentation	45	60	70	15	53
Electrocoagulation	56	-	83	32	65
Chemical coagulation	62	-	87	-	98
Catalytic oxidation	-	-	-	90	-

Source: Sadiq (1990, p.66)

Beside the pollution removal performance, other factors considered for assessing the feasibility of a process/technology to develop a treatment plant for a tannery unit include the size of the factory area, volume/flow-rate of waste water, characteristics (qualitative and quantitative) of raw wastes, operation/maintenance requirements and cost.[64] The data described in Table 12-13 is based on the findings and recommendations by ETPI (1997) from an environmental audit of three tanning units in Pakistan.

[62] Beg (1990).
[63] EPTI (1997).
[64] Sadiq (1989).

Table 12. Possible reduction in baseline (1996) and forecast (2004) pollution loads of export related tanneries waste water.

Pollutants	Estimated reduction (%)	Baseline (1996) pollution load Kgs (millions)		Forecast (2004) pollution load Kgs (million)	
		Untreated	Treated	Untreated	Treated
Water (M^3)	18.50	10.21	8.32	9.52	7.76
Suspended solids (Kgs)	80.00	17.65	3.53	16.46	3.29
(BOD)5 / COD (Kgs)	65.00	200.45	70.16	186.90	65.4
Sulfide (Kgs)	56.50	1.13	0.49	1.05	0.46
Chromium (Kgs)	90.00	0.59	0.06	0.55	0.05
Combined pollution load		219.82	74.24	204.96	69.20

Source: For estimates of percentage pollution reduction see ETPI (1997).
For pollution loads for 1996 and 2004 see Table 10.

It is evident from the data in Table 12 that, with the ETPI recommended treatment technology, the (1996) combined pollution load (BOD_5, COD, SS, S^{-2} and Cr) of the effluent after the treatment would be reduced from 219.82 million kgs to 74.24 million kgs. For the year 2004, the reduction would be from 204.96 to 69.20 kgs., suggesting an overall 66.23 percent reduction in the pollution load. Table 13 below provides cost estimates for such mitigation and for chromium recovery.

Table 13. Cost estimates for primary treatment plant (PTP) and chemical recovery plant (CRP) for export related tannery effluents.

PTP for a tannery with average production load 12,000 kgs. hides/day (average waste water discharge approx. 2700 m3) Million rupees			CRP for a tannery with average production load of 12,000 kgs. hides/day (average recoverable chromium load approx. 72 kgs.) million rupees		
Capital Cost	Annualized cost	Operations and maintenance cost/annum (17.5% of capital cost	Capital Cost	Annualized cost	Operations and maintenance cost/annum (17.5% of capital cost)
45.00	8.96	7.88	1.00	0.199	0.175

Source: ETPI (nd.) technical brochure/leather sector report
Note: The annualization was done based on a 10-year plant life and a 15 percent interest rate. While the market rate is currently about 20 percent, subsidies are available for clean technology.

The data given in Table 13 indicates that the operations and maintenance cost for treating 8.32 million m3 wastewater (Table 12) and reducing the volume of waste water through in-plant control measures, for the manufacture of 17.31 million sq. meters (Table 5) of leather, is Rs. 66.48 million.

The total treatment cost to achieve the desired reduction in pollution, including the annualized cost (8.96 million rupees) of the PTP, is Rs 75.44 million.

Again, the data in Table 13 indicates that the operational and maintenance cost of CRP for the recovery, from 0.59 million kgms. waste chromium produced during the manufacture of 17.31 millions sq. meters leather (Table 5) is estimated at Rs 3.93 million. The total chromium recovery cost for 95% recovery (0.56 million kgs) of waste chromium, including the annualized cost (Rs. 0.1999 millions) of CRP, would be 4.12 million.

To summarize:

Cost of primary treatment of 8.32 million m3 wastewater = Rs 75.44 million
Cost of chromium recovery (0.56 million kgms.) from waste water = Rs. 4.12 million
Total cost for wastewater treatment and chrome recovery for pollution load generated from the manufacture of 17.31 million sq. meters leather (1996 leather exports) = Rs 79.56 million.
The market value @ Rs 45/kg of 0.56 million kgms of recovered chromium = Rs 25.22 million
Thus the net cost of mitigation (total cost minus value of recovered chromium) = Rs. 54.34 million

The numbers above can be used to provide macro and micro context as in the case of cloth mitigation costs.

a. INCREMENTAL EXPORTS RELATED MITIGATION COST. In the case of leather, the incremental export related mitigation costs are not applicable since, based on past trends, we project a decline in "gross" leather exports. Thus, we calculated the macro total mitigation costs of putting all export-related leather wastewater through a primary treatment plant in the base period (1996). The cost of achieving 66.23 percent mitigation would be Rs. 79.56 million or .0036 percent of GNP. If the value of chrome recovery is netted out, the mitigation cost would have been .0025 percent of GNP. These costs of mitigation are much lower than for cloth since clean technology is locally available. In any case, these results strongly reinforce the finding emerging from cloth exports that the macro mitigation costs are very modest.

b. TOTAL FOREIGN EXCHANGE LIABILITIES**.** Since the technology used and recommended is indigenous, there would be no capital cost related foreign exchange liability resulting from the mitigation.

c. MITIGATION COST AS PERCENTAGE OF SALES REVENUE**.**
Since the primary treatment plant is anticipated to serve several manufacturing plants at the same time, we have estimated the mitigation costs for the producers as a whole rather than for an individual unit as in the case of cloth production. At the export unit value of value of Rs. 651.9 /sq.meter for leather and Rs. 245.6 per pair for footwear, the total export revenue for 17.31 million sq.meters leather was be Rs 11,336 million in 1996.[65] Thus the mitigation costs amount to .0048 percent of the export revenue of industrialists. Thus, at a micro level, the mitigation costs are once again rather modest relative to anticipated benefits.

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65 The leather and footwear export statistics are taken from Government of Pakistan, *Economic Survey 1997-98*, Statistical Supplement (1998, p. 169 and 171).

VII. **Stakeholder dialogues and policy**[66]

The purpose of this section was to draw on our findings, stakeholder consultations and the literature to derive policy lessons in the Pakistani context. Based on discussions with officials in the relevant ministries, we found that there are no institutions in Pakistan that is presently dealing with the subject of trade, environment and sustainable development. Consultations with industry representatives revealed that, besides the need for ISO 9000 certification, Pakistani exporters are not aware of the relevant environmental policies being adopted by OECD countries.

One could rely on information flows regarding standards and environmental policies via normal market channels. However, in the case of surgical goods exports to the United States, by the time such information became available to exporters, it was already too late. The surgical goods industry had to face a ban of several years before government intervention and support enabled required standards to be met. The same is true for the shrimp industry exports to the EU. Thus, the government needs to be pro-active in acquiring information about environmental standards and passing this information on in a timely manner to industry working closely with the various industry chambers. The economic case for this derives from information as a public good that confers positive externalities.

There are various government institutions though which awareness regarding environmental standards and regulations could flow to the export sector in a timely fashion. These include the Ministry of Commerce, Ministry of Industries and the Ministry of Environment, Local Government and Rural Development and the Export Promotion Bureau. The lack of such information is resulting in a loss of markets. The Ministry of Commerce may consider including a trade and environment section in the cell that deals with the WTO and draw on the relevant expertise from the other ministries.

The policy development processes relating to trade and environment in Pakistan are handicapped due to a lack of coordination and information sharing among the relevant agencies. Trade polices are developed and implemented by the Ministry of Commerce and environmental policies by the Ministry of Environment, Local Government and Rural Development. While mechanisms exist in principle to deal with inter-agency co-ordination in a general sense, a specific mechanism of joint work agenda for the trade and environment section of the Ministry of Commerce will facilitate coordination. This should enable the Pakistani exporters to avoid standards related market loss and to target green consumers.

WWF (1997) and OECD (1996) provide excellent policy prescriptions and examples of policies adopted to meet the challenge of environmental and health standards. A particularly relevant example for Pakistan cited by WWF (1997, P. 17) and Jha (1997) relates to the response of the Government of India to the challenge of meeting standards regarding dyes. The textile committee of the Government of India prepared a comprehensive list of market regulations and acceptable alternatives to banned dyes. This information was then systematically disseminated, although SMEs were hard to reach. Eleven laboratories were also established to test for the azo

[66] See Appendix II for the list of stakeholders consulted.

dye level in products on a cost basis to ensure that standards were not being violated.

Pakistan now has a rigorous environmental policy in place. The 1997 Environment Protection Bill, which emerged from a consultative process, was enacted in December 1997. One key feature of the Bill is that it requires manufacturing companies to conform to National Environment Quality Standards (NEQS) or else pay a pollution charge. In July 1999, the Pakistan Environment Protection Council, the highest executive organ responsible for implementing the Environment Protection Bill, met for the first time after the Bill was enacted. In a very positive development, it set January 2000 as the date for the implementation of the NEQS. Thus companies have an incentive to put environment management systems in place.[67]

Our focus on showing the likely environmental impact of exports is to persuade policy makers of the importance of effective implementation of the NEQS. The exercise, which indicates the modest costs of mitigation by using cleaner technologies at both the micro and macro level, also indicates to both business and government the feasibility of adopting cleaner technologies and the likely trade and environmental benefits of doing so.

[67] At the time this research was being conducted, Pakistan was subsidizing ISO 9000 series certification. Via awareness raising and lobbying, this subsidy has now been extended to the ISO 14000 series.

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APPENDIX I

A. *Forecasting method*.

For cotton cloth, we combined two approached to get the terminal year forecast. Ingco and Winters (1996, Table 12) reported that 28 percent of total cloth was exported to quota countries in 1994. Thus we assume that their estimated 133.6 percent ATC related quota increase between 1994 and 2004 (Table 10) applies to this portion of the increase in cloth export. For the non-quota country estimate of the increase in cloth export, we rely on the ARIMA model. Unfortunately, since data on exports is not available in disaggregated form (by quota and non-quota country), we used total exports to arrive at an estimate of cotton exports for 2004. The cloth export growth estimate was arrived at as a weighted average with a .28 weight on the ATC related quota relaxation export growth and .72 weight for the ARIMA model derived export growth. Thus, the estimate for the terminal year cloth export was arrived at by multiplying the base year cloth export number (reported in Table 5) with the weighted average cotton export growth rate.

For hides and skins, leather and footwear, we used the ARIMA model. Given that there is no perfect forecasting method, we identified the single equation autoregressive integrated moving average method (ARIMA) as the most parsimonious in data requirement and as one that is reasonably suited for our forecasting needs. This method relies on a time series of a given variable and projects that forward based on lag terms of the variable (the AR or autoregressive component) and error terms (the moving average or MA term). Reasonable forecasts require that the series be integrated or stationary (the I term). Details on this Box-Jenkins approach (1976) are now readily found in the literature.

To operationalize this approach, the practitioner is first required to identify if the series is integrated which can be done via an Augmented Dicky Fuller test (ADF). A lack of integration would either require taking the appropriate differential of the equation until it is integrated (differencing it twice would make the series I(2)) or, if appropriate, transforming the variable to make the series an integrated one (e.g. converting into a log form). Once the series is integrated, the next order of business is to identify the appropriate lags for the autoregressive and moving average terms. The procedure we adopted for this is to rely on the Akaike information criteria (AIC) and Schwarz Bayesian criterion (SBC). Different combinations of lag lengths are tried until the values on these criteria are maximized. Ideally, both give the same message. Once the appropriate model is identified, the forecasting can be done. Diagnostics can once again be used to identify if the forecasting was reliable.

Since we were using a small sample of twenty seven observations for the forecasting (1970-96), we used the Ljung-Box statistic, based on ensuring that the residuals were not autocorrelated for various orders, and verified that the forecasting was reliable. In the one case that it was not, (fertilizer consumption), we went back to the drawing board and picked the next most likely model based on the Akaike information criteria (AIC) and Schwarz Bayesian criterion (SBC). Even so, it is evident from eyeballing the forecasts of our non-trended variables that very conservative forecasts resulted centering on the intercept term. Thus we view the forecasts as suggestive.

B. *Application*

The table below shows how using the above method we arrived at the ARIMA forecasting model and estimate for the variables included in our analysis.

Table I. ARIMA model estimate for the forecast for 2004

Variable	ARIMA model[@]
Pesticide consumption (metric tonnes)	(0,1,1)
Fertilizer consumption (‘000 N/tonnes)	(0,1,1)
Cloth (million sq. meters)	(0, 0, 0) OLS
Hides and skins (‘000 kgs.)	(0,0,1)
Leather (million sq. meters.)	(0,1,2)
Footwear (million pairs)	(0,1,2)

Notes. @ Represents the ARIMA model (p,d, q) selected, where p represents the number of autoregressive terms, d the number of times a series has to be differenced to make it stationary and q the moving average terms.

Sources: For pesticide consumption, Government of Pakistan, *Agricultural Statistics of Pakistan 1996-97* (1998, p. 155), for fertilizer consumption, Government of Pakistan, *Economic Survey 1997-98*, Statistical Appendix, (1998, p. 59). The latter source (pp. 168-170) was also utilized for the remaining variables.

APPENDIX II

Stakeholders consulted for the trade and sustainable development study

01.	Dr. Mian Asad Hayauddin	P.S. to Advisor to the Prime Minister	PM Secretariat
02.	Mohammad Akhtar Tufail	Director LE & E	Ministry of Foreign Affairs
03.	S.M Tahir	Deputy Secretary	Ministry of Commerce
04.	Nazir Ahmad Saleemi	Assistant Chief	Ministry of Commerce
05.	Muhammad Iqbal	Assistant Chief	Ministry of Industries & Production
06.	Mumtaz Ahmed	Section Officer	Ministry of Environment, Local Government
07.	Imran Habib Ahmad	Section Officer	Ministry of Environment, Local Government
08.	Irfan-Us-Sami	Deputy Director-I	NCS Unit C/o Environment
09.	Mr. Abdul Qayum	Deputy Chief (Physical Planning & Housing Section)	Planning and Development Division