SMEP | Sustainable Manufacturing and Environmental Pollution

GAHP *SMEP C-002 Development of detailed designs for future research ITT*

Pakistan Tanneries Industry Final Report

Date: 29 July 2021

SMEP is funded with the UKAid from UK government) and is implemented in partnership with the United Nations Conference on Trade and Development (UNCTAD), providing Technical Assistance to the programme.

UKaid from the British people

UNITED NATIONS UNCTAD

AIR QUALITY ASIA www.AirQualityAsia.org

GAHP GLOBAL ALLIANCE ON HEALTH AND POLLUTION

DISCLAIMER

This report is an output of the Sustainable Manufacturing and Environmental Pollution (SMEP) Programme. UK Aid from UK Government and the United Nations Conference on Trade and Development (UNCTAD) provide financial and technical support for SMEP. The views expressed and information contained in this document (including any maps and their respective borders) are not necessarily those of or endorsed by UK government, UNCTAD or the entities managing the delivery of SMEP, which can accept no responsibility or liability for such views, completeness or accuracy of the information or for any reliance placed on them. This report has not been formally edited by members of the UK government or UNCTAD.

UKaid from the British people

UNITED NATIONS UNCTAD

SMEP is funded with the UKAid from UK government) and is implemented in partnership with the United Nations Conference on Trade and Development (UNCTAD), providing Technical Assistance to the programme.

AIR QUALITY ASIA
www.AirQualityAsia.org

GAHP
GLOBAL ALLIANCE ON HEALTH AND POLLUTION

1 Executive Summary

The Global Alliance on Health and Pollution (GAHP) and Sustainable World - Air Quality Asia (SW-AQA) have been contracted to the SMEP programe to provide:

1) A practical, rapid methodology - a hazard ranking analytical tool - for identifying the most suitable thematic focus for the next round of SMEP funding, whereby the tanneries, brick kilns, and textiles sectors were identified as priority sectors.[1]

2) A clear map of the selected industry, the used lead-acid battery recycling industry in Bangladesh, key stakeholders and understanding of the various intervention points at which solutions or changes are needed (Deliverable 2), incorporating key stakeholder input through consultations and a workshop (Deliverable 3). Findings from Deliverable 2 and 3 are summarized in this report (Deliverable 4).

For Pakistan, the identified industry is the tanneries sector.

The "industry map" aims to provide a clear understanding of the tanneries industry process, relevant stakeholders involved, key intervention points at which solutions or changes are needed to solve the selected manufacturing pollution problems, including technology, policy, regulatory, and enforcement changes; and the various research or knowledge gaps critical to enabling or identifying those changes.

This report includes notes on input from the stakeholder consultation workshop (Deliverable 3), which was a follow-up to the interim report, along with interventions suggested by participants. The interventions included consider their practicability and relevance to the dynamics of the industry, and support for a general plan of action to do so under Stage 2 of the SMEP program.

A section on the potential interventions is included, divided into interventions (i) in the processing practices in the industry, and (ii) in the institutional and zonal arrangements of the industry. Furthermore, from among these suggestions, the SW-AQA team has shortlisted recommendations and areas for further investigation.

Tannery Industry in Pakistan

Leather and leather products are the second largest export from Pakistan, after Textiles, and on average bring in $900 million annually through formal export channels. The Pakistan Tannery Association, which is the leading industry group, claims that 95 percent of its members production is export oriented. The industry is estimated to employ about 500,000 workers, and is linked with the informal sector, which further holds livelihood benefits. Due to its scale, it holds significant influence with policymakers, enabling the industry owners to limit regulatory controls.

However, the tannery industry is linked to high levels of pollution, particularly chemical and heavy metal laden effluents, which are ineffectively treated and directly impact the environment and local populations. Hazardous conditions inside tanneries are linked to occupational health

[1] The prioritsation process is included under GAHP's Deliverable 1; and is not discussed here, see separate report, titled "*SMEP C-002 Development of detailed designs for future research ITT – Final Report – Deliverable 1 – Hazard Ranking Tool*." The used lead-acid battery and tanneries sectors were selected as the most practical areas to develop intervention strategies within the parameters of this current contracted scope of work.

SMEP is funded with the UKAid from UK government) and is implemented in partnership with the United Nations Conference on Trade and Development (UNCTAD), providing Technical Assistance to the programme.

impacts. These health burdens have not been adequately studied inside Pakistan and significant gaps in knowledge exist, which require addressing.

During the progress of this study, several limitations were faced, particularly owing to the COVID-19 related restrictions on meetings and visits to offices. Some field visits and interviews were conducted, while adhering to strict protocols. Separately, the limited data availability from both the government and industry bodies, and limited evidence-based research in Pakistan further limited the extent of analysis that could be conducted for this report.

The following is a summary of key challenges that need to be addressed:

1) Non-availability of recent figures on livestock population, raw material production, and total sum of procured hides and skins.
2) Non-availability of accurate data on chemical usage in the industry, and limited data available on water and energy consumption.
3) Non-availability of public health data, as well as data disaggregated on the basis of district or smaller administrative units and typology of morbidities.
4) Large presence of Informal actors in the supply chain, making pollution traceability and footprint assessment very difficult.
5) Poor occupational safety record and lack of compensation for affected workers, primarily due to lack of contracts with employers.
6) Minimal or non-availability of personal protective equipment (PPE) for workers in the industry, which is linked to high disease prevalence.
7) Excessive use of chemicals and water at various stages, as a result of conventional, outdated knowledge about industrial practices.
8) Existing Central Effluent Treatment Plants (CETPs) in poor condition and inefficiently managed.

The following interventions have been suggested to partly address the highlighted challenges:

1) Introducing and piloting modern, sustainable practices in the Supply-chain and Process stages
    i. Formalize Single-stage Processors into small and medium size busineses (SMEs), which is more conducive for implementation for OSH laws, worker safety protocols, and reduce public health impact.
    ii. Unsalted, Cold-storage for Preservation of Hides, thus reducing salt content in the wastewater generated from soaking and washing salted hides, and associated rediced TDS[2].
    iii. Hair-save Unhairing of Hides, thus lowering chemical usage and the associated waste water impacts, especially BOD[3].
    iv. Water measurement of per-stage use and Metering of overall use, thus redicing volumes of waste water generated.
    v. Solar water and air heating to reduce fuel use and associated air emissions incuding particulate matter.
2) Reforming the institutional and zonal arrangements of key bodies linked to the environmental management in the tannery industry
    i. Develop Tannery clusters and advanced Central Effluent Treatment Plants (CETPs) to facilitate the implementation of regulations and increase compliance.
    ii. Improvements in the Management Models of the CETPs to make them self-sustaining.

[2] Total dissolved solids
[3] Biochemical oxygen demand

iii. Conduct a National and Zonal Tannery sector census to build a database for improved monitoring and compliance.

A shortlist of recommendations from among these suggestions for SMEP Stage 2 was created using a prioritization matrix, with the highest focus on Public Health and OSH benefits. The following is recommended:

i. Tannery industry should only operate in designated Cluster Zones, which have dedicated CETPs and Solid-waste Management, administered by specialist boards under performance-linked incentives.
ii. Knowledge gaps, highlighted during the investigation, should be filled by conducting a detailed Tannery sector census, assessment of internal air pollution of units, and Sub-division level Public Health survey of under-study Tannery clusters.

Acronyms

ACD	Advance Customs Duty
AGST	Advance General Sales Tax
AQA	AirQualityAsia
BAT	Best Available Technique
BOD	Biochemical Oxygen Demand
CETP	Combined Effluent Treatment Plant
COD	Chemical Oxygen Demand
CPI	Cleaner Production Institute
Cr	Chromium
CRU	Chromium Recovery Unit
EMS	Environmental Management System
EPA	Environment Protection Agency
EQS	Environmental Quality Standards
ETP	Effluent Treatment Plant
EU	European Union
FPCCI	Federation of Pakistan Chambers of Commerce and Industry
GAHP	Global Alliance for Health and Pollution
GDP	Gross Domestic Product
GIS	Geographic Information System
ILO	International Labour Organization
KTWMA	Kasur Tanneries Waste Management Agency

LWG	Leather Working Group
MoC	Ministry of Commerce
MNFSR	Ministry for National Food Security and Research
NILT	National Institute of Leather Technology
NIOSH	National Institute of Occupational Safety and Health
OSH	Occupational Safety and Health
PEQS	Punjab Environmental Quality Standards
PM	Particulate Matter
PPE	Personal Protective Equipment
PTA	Pakistan Tanners Association
SDPI	Sustainable Development Policy Institute
SEQS	Sindh Environmental Quality Standards
SME	Small and Medium Enterprise
SMEP	Sustainable Manufacturing and Environmental Pollution
SSP	Single-stage Processor
STAGL	Sialkot Tannery Association (Guarantee) Limited
STZ	Sialkot Tannery Zone
SWM	Solid Waste Management
TDAP	Trade Development Authority of Pakistan
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
UVAS	University of Veterinary and Animal Sciences, Lahore

Table of Contents

Figures + Tables

2 Introduction

Sustainable World – Air Quality Asia (SW-AQA) was contracted by the Global Alliance on Health and Pollution (GAHP) to evaluate industrial pollution sources in Pakistan under the Sustainable Manufacturing and Environmental Pollution (SMEP) programme of the UK Foreign, Commonwealth and Development Office and the UN Conference on Trade and Development. SW-AQA identified the tanneries sector in Pakistan as one of the most polluting industrial sectors in the country, with significant public health and environmental impacts. The rationale behind this assessment encompassed variables such as the size of industry, types of pollutants, and direct public health impact of pollutants for a number of key industry groups in Pakistan. After initial investigation and literature review for the Pakistan Country report, several limitations were highlighted, including lack of recorded data, government reports, industry reports and any comprehensive sectoral emissions reporting.

3 Context + Scope

3.1 Selection of Target Industry

The first step of this study evaluated the potential for investment and feasibility to solve manufacturing/industry related pollution and health problems in various industries. The hazard ranking prioritisation process is described in detail in the report titled "*SMEP C-002 Development of detailed designs for future research ITT – Final Report – Deliverable 1 – Hazard Ranking Tool"* and is only referred to here. While health was the most important criteria for our approach to select a target industry, it was not the only factor considered. Our approach, which is designed to result in the selection of the industry (relative to the others) with the highest cost of inaction, and the best potential to have a positive impact is outlined below. This can be in terms of eliminating adverse health impacts, ability to transition to clean practices and the potential to generate good return on investment both for health and GDP.

The following criteria were used in the selection of the focal target industry for Deliverables 2-4. A brief discussion on their relative importance and weighting/ranking is included. Results for each industry are included as Annex 6.

- **Health** was the most important criteria for selection. Therefore, only industries that received a score of "very high risk" or "high risk" of adverse health impacts were chosen for additional analysis. Very High risk was considered at 200+; high 100-200; moderate risk 25-100; Low risk 5-25, Very low risk <5.
- **Contribution to national GDP.** According to the World Bank, manufacturing in 2019 contributed 12.4% of GDP in Pakistan.[4] Given this, we felt that the following ranking as a % of GDP was practical: >5% - very high; 3-5% high; 1-3% moderate; <1% low <0.025% very low.
- **Feasibility** was a critical component, especially given the short project timeline, the current COVID pandemic crisis and the current political context. The issues were each scored on their feasibility for Stage 1 using a simple 0, 1 or -1 for each subcomponent: Feasible (3+ points), somewhat feasible (2 points), or not feasible (1 or less points).
    - Ability to work with stakeholders during the project timeline (1 point if engagement during Deliverable 1 was favourable or do-able);
    - Security considerations if any (-1 point if security concerns are present)
    - Industry willingness (1 point if industry has shown past or current interest in improving practices or engaged on the topic of pollution)

[4] Worldbank Data. "GDP (constant 2010 US$) - Bangladesh, Pakistan." <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD?locations=BD-PK>

- Government support (1 point if government has shown any past or current initiatives to improve the sector)
- Existence of significant ongoing work (especially by any project partners or identified stakeholders) or plans

Note: Contribution to work force was not included because the number of workers and the number of factories are already included in the hazard ranking under the health portion. **Ability to transition to clean practices** was also not included as we felt this was too subjective and more appropriate to be answered by research in Stage 2.

Discussion of Relative Scoring:

The top four industries were selected based on relative health impact, and a simple scoring sheet created with the above-mentioned categories, as follows.

Selection of the top three out of four industries was relatively straightforward. In Pakistan, the used lead-acid battery (ULAB) industry was eliminated due to challenges in accessing sites and security challenges for research personnel in the field. . While there are clusters of ULAB manufacturing in Gujranwala (Punjab) and Karachi/Hyderabad (Sindh), these are mostly informal and scattered. There are also ULAB manufacturing units in the northern areas of the country, but these are difficult to track because of access to remote areas is still difficult given the present security situation in the area.

The remaining industries in Pakistan for which assessment was feasible were Tanneries, Brick Kilns and Textiles.

Discussion of Relative Scoring for Tanneries, Brick Kilns and Textiles:

GDP Score

Information on relative contribution to GDP for both countries for the remaining industries was available and included in the annexes for Deliverable 1. In Pakistan, Tanneries and Textiles received very high scores, whereas Brick Kilns received a high score.

Feasibility Score: Pakistan

Tanneries had the highest score in the Hazard ranking score followed closely by Brick Kilns. There are an estimated 250,000 people working in the tannery industry in Pakistan, in mostly informal or semi-formal settings with approximately 200-250 medium-sized tanneries, 40-50 large factories (leading exporters) and an estimated 1200-1500 manufacturing units of leather products.[5] The major pollutants of concern are organics, chromium (principally hexavalent chromium), odours and sludges that are discharged to the water, air and land, and are especially of concern for workers and local communities.[6] Hexavalent chromium is well-known to be a carcinogen and a skin irritant among other major health issues.

The Brick Kilns industry was judged to be relatively less feasible by SW-AQA because they are scattered to mostly rural and remote areas. Brick kilns are a largely informal and under-regulated. At SMEP's request, SW AQA reviewed the brick kiln industry a bit more in depth in case it might shed light for SMEP Stage 2.

Brick kilns operating in Pakistan are known as Bull Trench Brick Kilns (BTBKs). The technology is primitive, and gaseous emissions from these kilns are associated with poor air quality. There

[5] Hashmi GJ, Dastageer G, Sajid MS, Ali Z, Malik MF,Liaqatl. 2017. Leather Industry and Environment: Pakistan Scenario. International Journal of Applied Biology and Forensics 1(2):20-25

[6] Junaid, M., Hashmi, M.Z., Tang, YM. *et al.* Potential health risk of heavy metals in the leather manufacturing industries in Sialkot, Pakistan. *Sci Rep* **7,** 8848 (2017). https://doi.org/10.1038/s41598-017-09075-7

are approximately 10,000-12,000 brick kilns in Punjab. There are no reliable figures for the other provinces. Due to public interest, litigation relating to the smog in Lahore in 2017, a "Smog Commission" was established by the Lahore High Court to report on the causes and methods to mitigate smog.

The report of the Smog Commission was filed before the Supreme Court of Pakistan which directed the EPA, Punjab to comply with its recommendations. Of the nearly 20 recommendations of the Smog Commission report, there was a suggestion to introduce the zig-zag brick manufacturing technique to the brick kiln industry. Zig-zag brick kilns are known to produce less air pollution in comparison to BTBKs, according to some estimates by 50%. However, zig-zag brick kiln emissions still do not comply with Punjab Environmental Quality Standards (PEQS) for Gaseous Industrial Emissions.

In order to enforce the recommendations of the Smog Commission, the Government of Punjab declared smog a calamity and, under powers vested in it by the Punjab Natural Calamities (Prevention & Relief) Act of 1958, directed the Punjab Disaster Management Authority to enforce conversion of all brick kilns in Punjab to use the zig-zag technology. Government sources report conversion of a sizeable majority (almost 8,000) of brick kilns to zig-zag technology in 2021.[7] It is now reported that the EPA of Khyber Pakhtunkhwa is about to embark on a similar exercise of converting brick kilns to zig-zag technology.

Brick kiln owners' association has challenged the enforcement regulation in court due to the presence in the market of local and imported emission control technologies (air sprinklers, sand bed filters etc.) that are cheaper alternatives to reduce bring brick kiln emissions and also within the parameters set by the PEQS on Industrial Gaseous Emissions. Results from the case are still pending.

Given the above, and as different provincial governments are currently working on this issue, there is limited space for impact or interventions in this area. Thus, SW-AQA did not feel they could adequately engage appropriate stakeholders during the short project timeframe. The COVID pandemic of course also presents further challenges to in-person consultations.

Tanneries in contrast, were given a higher feasibility score. They have a much higher footprint in Pakistan, and SW-AQA's relationship with leading experts and institutional stakeholders on tanneries would allow for the project to advance and get results within the assigned timeframe. Further, the literature suggests that there may be more willingness from the Tanneries industry to interventions or interference.

Given the relatively lower GDP and feasibility score of Brick Kilns, GAHP dropped Brick Kilns from the short list, which left Tanneries and Textiles. Given GAHP and SW-AQA's connections with key tanneries stakeholders, working on Tanneries was ranked slightly more feasible than working on Textiles. If two industries could have been chosen, we would have recommended Textiles as the second industry for Stage 2 as it is a formal sector with strong industry associations as well as a focus on export and data collection capabilities. With GAHP focusing only a singular agenda, the Tannery industry has been selected.

Industry	**Risk to Public Heath Score Range**	**GDP Contribution Score**	**Feasibility Score**
Tanneries	Very High	Very High	Feasible
Brick Kilns	Very High	High	Not Feasible
Textiles	Very High	Very High	Somewhat Feasible

[7] https://dailytimes.com.pk/751804/punjab-converts-all-brick-kilns-over-zigzag-technology-in-record-6-months-amin/

Table 1: Hazard Scoring of industries in Pakistan

This study of the tanneries sector is aimed at filling the identified knowledge gaps, by conducting primary and secondary research. Further, data sourced through various government, non-government and industry sources has been collated and added into the relevant sections to update the existing knowledge base for this sector. As mentioned earlier, the public health impact is of significant concern, and therefore, effort has been made to highlight pertinent issues throughout the industry map, and at various stages of the supply chain and waste disposal process.

4 Methodology

Due to time limitations, the study focused on applying specific primary and secondary research methods. For primary research, direct semi-structured and informal one-on-one interviews were conducted with at least one representative from the Provincial Environment Protection Agencies (EPAs), Manufacturers, Tanneries Association, and Academia. Further, recent monitoring reports were acquired where available, or sourced through previously published reports. Field visits were also conducted for industrial clusters and effluent treatment facilities. Secondary research methods such as a wider literature review have also been used, focusing on development assistance reports, academic journals, media reports, industry publications and relevant websites. Some issues were faced in accessing geographic areas and relevant personnel; however, these were circumvented by gaining relevant information from other sources.

Additional support was garnered via SW-AQA's participation in weekly calls with a Pure Earth and Asia Foundation team working on a separate SMEP project on tanneries in Bangladesh. SW-AQA liaised with a consultant from Asia Foundation, Mr. Sadat Sadruddin Shibli, on the kinds of research questions being investigated in the Bangladesh tanneries sector in order to inform the approach in Pakistan. The key areas of inquiry identified through this engagement (and incorporated into SW-AQA's investigation) encompassed the following: Chemicals Management; CETP Effectiveness; PPE Availability and Adherence; Worker Training; Industry Clustering; and Raw Hide Preservation Techniques.

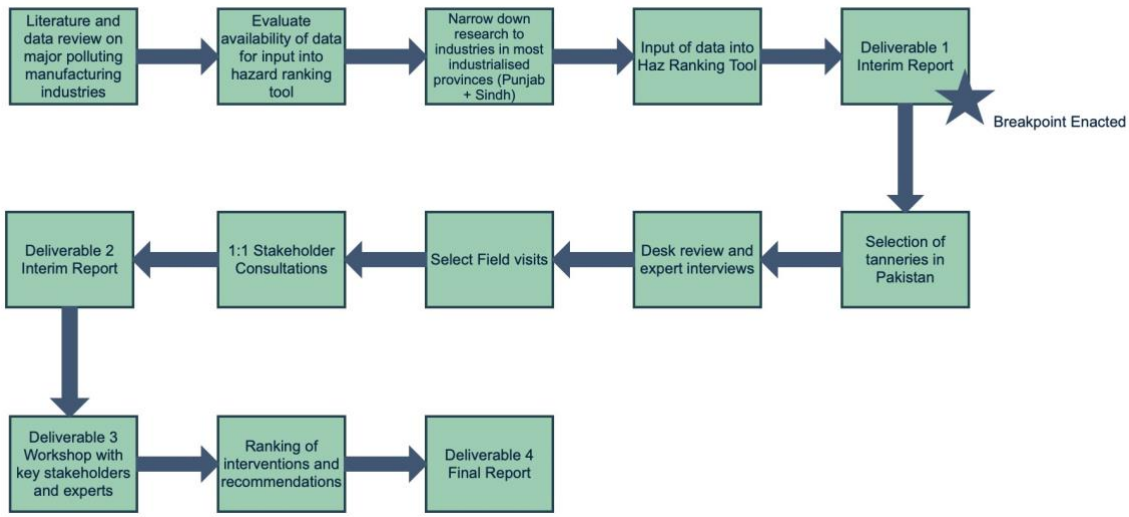


Figure 1: Methodology flow chart

4.1 Selected Sample

Study areas selected for this report are the three major Leather and Tannery industry clusters, which are further divided into North and South Zones by the Pakistan Tanners Association (PTA). Kasur (Punjab) and Sialkot (Punjab), and Korangi (Karachi) clusters are divided into the North Zone and the South Zone, respectively. Overall 700 to 800 tanneries are present among the two zones. Most of the findings are applicable for smaller clusters. Among the sample, care has been taken to differentiate between “formal” export-oriented manufacturers, and “informal” local manufacturers and single-stage processors, because of large variations in practices and standards between them.

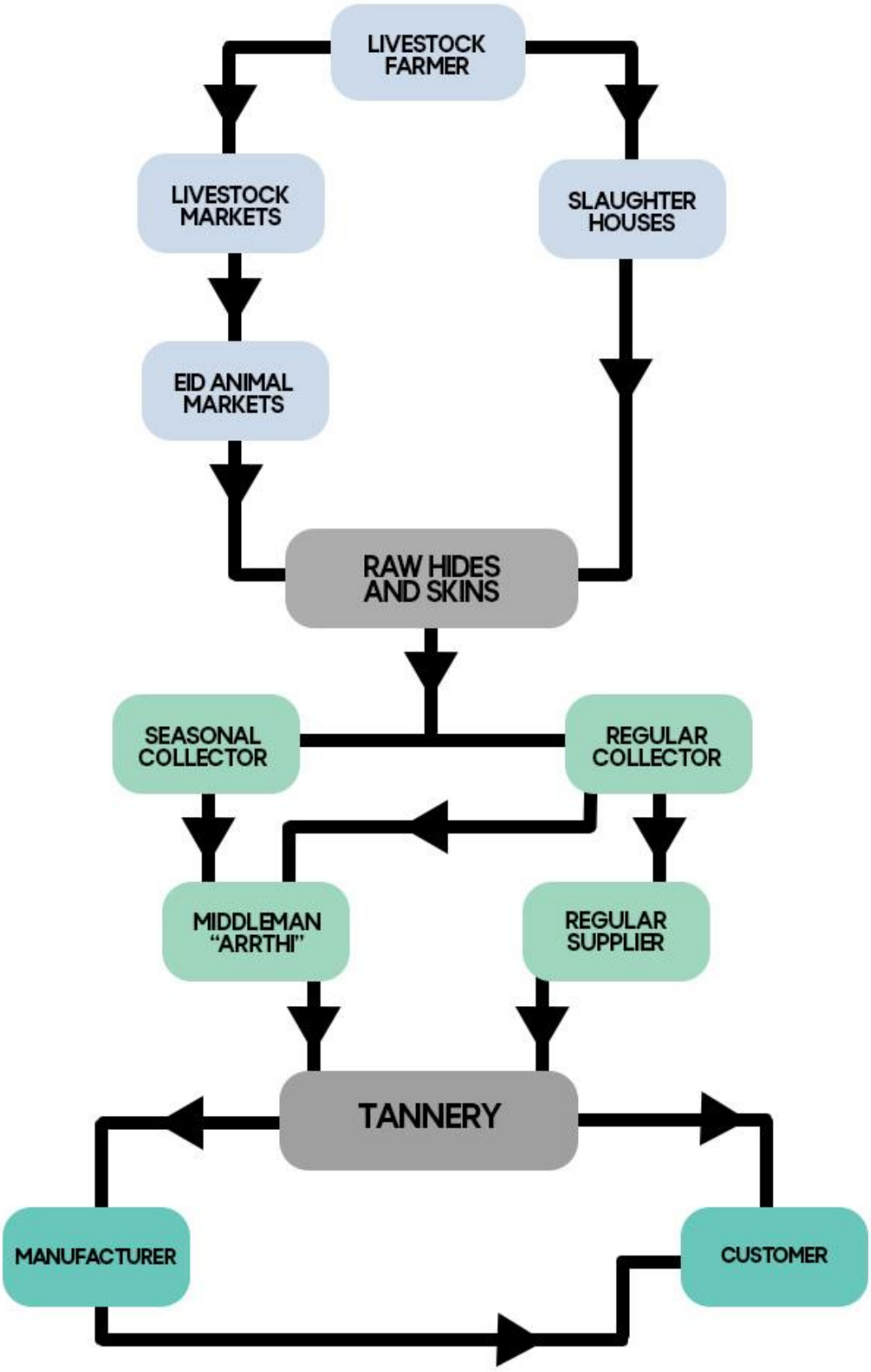


Figure 2: Key Actors in Pakistan's Tannery Industry Supply Chain
(Author's own research, and Strasser, Dannenberg, & Kulke, 2013)

5 Industry Mapping

5.1 Key Actors and Institutions

The Tannery industry in Pakistan is a complicated mix of formal, informal and seasonal actors, which has been outlined in Figure 2. These key actors are deeply entrenched and one is dependent on the other for effective functioning. This industry map covers various aspects of the entire industry, from initial procurement of raw hides to finished goods.

5.1.1 Suppliers of Raw materials

Animal Husbandry for 'Eid' season

Livestock and agriculture are a significant part of Pakistan's economy, particularly linked with the rural economy. Hides of various kinds, including goat, sheep, cow and buffalo hides are primarily sourced through animals reared in the rural areas. Every year, as a result of the Eid festival, a large number of animals are slaughtered and a very large influx of hides occurs in the immediate aftermath. The 3 to 4 months following the Eid festival are also considered as the peak season for procuring, storing and processing hides. Therefore, seasonal tanneries operate based on this cycle, during which most Beamhouse processing and Tanyard operations occur, along with the associated effluent discharges.

The seasonal nature of this supply itself is variable. The PTA estimated that 8 million hides were collected in 2018 on Eid.[8] However, in 2019, the number went down to 6.6 million hides and the supply was disrupted as a result of heavy monsoon rainfall which destroyed or affected the quality of hides in many cities.[9] In the current year, the purchase of animals for the Eid festival has continued to fall, as a result of inflation and declining purchasing power.[10]

Collection of hides is regulated by local administrations and performed by middlemen and non-profit organisations and charities. However, temporary storage does not follow strict protocols. Raw hides in far-off regions are often wasted as freight costs alone are higher than the sale prices per kilogram of hides. Reports of hides being smuggled in and out of Pakistan through its porous western border have also come to light, according to PTA officials.

Slaughterhouses

Slaughterhouses in urban areas regularly procure animals based on market demand. The hides from slaughterhouses are usually gathered by similar private players and sold to tanners. The variability of this supply depends on market demand for meat, which can fall because of inflationary pressures. Large slaughterhouse operations or those situated close to clusters also have direct access to tanneries. The slaughterhouses are a major contributor even beyond the average of 6 to 8 million hides collected on Eid. Figures from the Ministry of National Food Security & Research (MNFSR) suggest that based on animal slaughter estimates, on average, 16-18 million hides and 56-59 million skins are produced annually, inclusive of Eid season. However, these figures are based on potentially inaccurate estimates of the total livestock population. The last Livestock Census was done in 2006, and subsequent estimates simply adjust the population figure based on a calculated growth rate between the 1996 and 2006 censuses.

[8] "8m hides worth Rs6.5b collected on Eid." The Nation. Aug 26 2018. <https://nation.com.pk/26-Aug-2018/8m-hides-worth-rs6-5b-collected-on-eid>

[9] "Rainy Eid in Pakistan prompts 80 percent fall in value of sacrificial animal hides." Arab News. Aug 17 2019. <https://www.arabnews.pk/node/1541281/pakistan>

[10] "Tanneries see 20pc fall in number of hides collected during Eid." Dawn. Aug 01 2021. <https://www.dawn.com/news/1638096>

Imported Supply

According to the Federal Bureau of Statistics, in 2018-19, about 8.89 million kilograms of whole hides and finished leather were imported by manufacturers of various leather products. These hides are usually of non-native animals and are desired by niche consumers. The hides have special collagen (skin protein) patterns and properties, and are targeted at high-end consumers. Issues of traceability and variable quantity means that estimating the pollution footprint is very difficult.

5.1.2 Middlemen (*Arrthis*) and *Mandi*

In several big cities such as Lahore, Multan and Karachi, hide markets (or *Mandi*) are established by Middlemen (or *Arrthis*), who purchase hides at low prices during excess supply months and warehouse them. Middlemen, as in other segments of the livestock sector, profit by controlling the supply of raw materials. However, hides are only salted as a low-cost preservation method to keep costs low and may be warehoused with other raw materials and goods, depending on the region.

5.1.3 Single-stage Processors (SSPs)

Single-stage processing are small industrial units or workshops, which restrict their operations to only one or two processes in the overall manufacturing activity. It is estimated that about half of the 700-800 tanneries registered with the PTA are SSPs. These units also have no more than 2 drums for the tanning process. This structure is common in the North Zone clusters, where such units are also run as “family” businesses. The operations are also reflective of the conventional business ownership, as they follow outdated methods and partly manual labour.

The Kasur cluster, for example, is spread over four old neighbourhoods, which also have been historically mixed use areas. Hence, close proximity between residential and industrial units is quite common. The residents in these areas are consequently severely affected by the air and water pollution from these units. The pollution from these units has been linked to various diseases in Kasur city. A 2012 study also revealed that concentrations of heavy metals (i.e., Chromium, Manganese and Nickel) in areas in contact with the tannery industry were significantly higher than other parts of the city.[11]

SSPs are also present in the Sialkot sector, however, some progress has been made to formalize the industrial cluster with the creation of the Sialkot Tannery Zone (STZ). SSPs perform operations of the pre-tanning and tanning stages, which are then further supplied to manufacturers for producing finished leather and leather products.

[11] Abbas, Moneeza, et al. “Detection of Heavy Metals Concentration Due to Leather Tanning Industry and Prevalent Disease Pattern in Kasur, Pakistan.”

Figure 3: Workers at a Kasur tannery Photo credit © Muhammad Younis Zahid

5.1.4 Manufacturers

Manufacturers of finished leather can be categorized either as medium-size tanneries or as large, mostly export-oriented tanneries. Estimates from PTA indicate that there are 200-250 medium-sized tanneries, while the remaining 40-50 units are large factories that are also the leading exporters by volume and revenue. Other than manufacturers of finished leather, an estimated 1200-1500 manufacturing units of leather products such as gloves, apparel and footwear exist to cater to the export market. Among the manufacturing segment, 6 major firms are registered as "Rated members" of the Leather Working Group (LWG), which certifies and audits protocols for environmental and social compliance to encourage responsible manufacturing among leather exporters worldwide.[12]

The large manufacturers in Pakistan hold considerable influence in the functioning and funding of the Pakistan Tanners' Association, as well as dealings with Government representatives, policy-makers and regulatory agencies. The leadership positions of PTA and other pertinent associations and organisations such as Sialkot Tannery Association (Guarantee) Limited (STAGL) and Korangi CETP are held by manufacturers.

According to the Trade Development Authority of Pakistan (TDAP), during the July-June 2019-20 period, finished leather and leather goods worth $765 million were exported from the country, not including uses in the sports industry.[13] The earnings of major manufacturers therefore enable them to wield significant influence within the sector and over policymakers.

5.1.5 Pakistan Tanners' Association (PTA)

The Pakistan Tanners' Association (PTA) is a major trade body in the country dating back to the 1950s. It is officially licensed by the Federal Ministry of Commerce and has established By-laws to govern itself. It is also a significant player in the Federation of Pakistan Chambers of Commerce & Industries (FPCCI). According to the PTA, it has 213 members from which its

[12] Pakistan Rated Members, Leather Working Group. <https://www.leatherworkinggroup.com/leather-manufacturers-and-traders/leather-manufacturers/our-rated-members?ddl13=1;Pakistan>

[13] Trade Statistics for Jul-Jun 2019-2020, Trade Development Authority of Pakistan. <https://tdap.gov.pk/trade-statistics/#1618472558708-3b536759-16c5>

board and office-bearers are elected. The PTA is also bifurcated into North Zone and South Zone, as mentioned earlier, based on geographic location.

The PTA lobbies for favourable policies with the Trade Development Authority of Pakistan (TDAP) and has also engaged with the Export Development Fund (EDF) which is an autonomous wing of the Ministry of Commerce, to reduce tariffs on electricity, gas and imported raw materials such as chemicals as well as gain faster refunds and freight subsidies. The EDF was also approached for assistance in developing the STZ CETP.

Due to falling sales, the PTA has been increasingly lobbying for cheaper access to chemical inputs, including Chromium. Some of these demands such as reductions in Advance Customs Duty (ACD) and Advance General Sales Tax (AGST) on Chromium Sulphate and Formic Acid were approved in the Federal Budget for 2020-21. Similarly, the PTA is also lobbying for the inclusion of the 'Dyed or Finished Leather' category in the government's Drawback of Local Taxes and Levies (DLTL) scheme. These measures may lead to increased use of chemicals and discharge of resulting effluents, absent of better environment management practices and regulations. In the recently announced Finance Bill 2021-22, the import of raw hides, wet blue hides and finished leather has been given "Zero-rated" status if the importer is using these goods only for export-oriented manufacturing.[14]

However, the PTA also recognizes the increasingly stricter requirements of US and EU based clients for environmental compliance. Some large manufacturers have established Primary and Secondary Treatment plants for their own use, in order to comply with national and international regulations. Further, the PTA has requested a 75 percent matching grant from the Government for Tanneries willing to set up treatment plants and seeking membership of the Leather Working Group (LWG). The amount demanded by these manufacturers ranges from Rs. 700 million to Rs. 1 billion ($4.75 to $6.45 million) in total. They have similarly requested for a 75 percent subsidy for setting up an International-standard Leather Testing Lab for exporters.

5.1.6 Customers

The leather sector serves both local and international customers. However, accurate figures on local sales are unavailable, both at the industry and government levels. The PTA claims that this industry is 95 percent export-oriented. The export-oriented manufacturers of finished leather serve customers primarily in Europe and South-east Asia, while finished leather products serve customers in North America and Europe. The EU region in particular now requires leather products to be made using 'Best Available Techniques' (BAT).

> Based on BAT for Tanning of Hides and Skins, Pakistan-based manufacturers have to provide information and assurance to member states of the EU, by developing internal environment policies and implementing environment management systems (EMS) for their firms. BAT defines protocols for mitigating water and air pollution, and handling of solid waste. These include:
>
> 1) Reducing water use
> 2) Reducing pollutant load
> 3) Treatment of waste-water
> 4) Minimize VOCs and PM emissions into the air
> 5) Reduce solid-waste and reuse as by-products

[14] Finance Bill 2021-20, Finance Division, Govt. of Pakistan. (p. 249) <https://www.fbr.gov.pk/Budget2021-22/FinanceBill/Finance-Bill-Final-2021.pdf>

5.1.7 Federal and Provincial Government

Ministry of Industries & Production (MoIP), Federal Government

The Federal MoIP is tasked with developing and regulating the industrial base of the country. In particular, the Engineering Development Board (EDB) of the MoIP is linked to the setting up of new tanneries, factories and effluent treatment plants. The EDB regulates the standards of machinery and approves imports of capital goods, such as plant equipment, boilers, water-treatment machinery, etc., pertaining to the Leather sector. The MoIP can also decide on tariffs related to these imports, which are further finalized by the Ministry of Commerce.

Ministry of Commerce (MoC), Federal Government

As discussed earlier, the Federal MoC is instrumental in managing and promoting exports through various incentives and policies. The MoC also is the licensing authority for the country's apex industry bodies and is a direct forum for their interactions with the government and relevant policy-makers. The Export Development Fund (EDF), which functions under the MoC, under its plans to assist the Leather sector's compliance has also agreed to partly fund the CETP and Chromium Recovery Plant at the under construction STZ.

Due to its placement as a key institution of the State, which negotiates with the private sector directly, and also acts as an intermediary between industry and the government, the MoC is likely to be a key point of intervention to implement regulatory and market-based incentives for better environment and social compliance.

Sindh EPA and Punjab EPA, Provincial Governments

The sample selected for this study is geographically located in the Sindh and Punjab provinces, therefore, the provincial EPAs hold jurisdiction over devising, enforcing and monitoring Environment Quality Standards (EQS). The Sindh (SEQS) and Punjab (PEQS) rules are largely similar and have been defined for:

1) EQS for Municipal and Liquid Effluents
2) EQS for Ambient Air
3) EQS for Noise
4) EQS for Drinking Water Quality

There are two further relevant and similar Rules with different titles which have been notified in the respective provinces dealing with the same subject, namely 'Sindh Hazardous Substances Rules 2014' and 'Punjab EQS for Treatment of Liquid and Disposal of Biomedical Waste'. Lastly, whereas, Punjab EPA follows Self-Monitoring & Reporting by Industry (SMART) Rules 2001, Sindh EPA follows an amended version, SMART Rules 2014.

The Rules provide extensive powers to the EPA bureaucracy to conduct various inspections, and litigate, penalize, and issue fines for any violations. EPAs are also authorised to shut down and seal factories which are repeat offenders. However, in most cases, due to economic constraints among industry owners the violations are often lightly penalised. EPA officials realize the limitations of coercive action and express the need for better management. For example, the relevant Punjab EPA official in Kasur district is of the opinion that the Kasur tanneries should be provided land and resources to develop a formal industrial cluster instead of operating in a mix-use area, which makes it very difficult to monitor and enforce rules.

5.1.8 Researchers, Academia and Testing Facilities

While the overall Leather sector's interest in Research & Development appears very low, there is a newfound appetite for developing testing facilities due to external pressures on manufacturers, according to interviews with members of the PTA. This appears to be because

of increased demand for testing, particularly chemicals, effluents and product quality tests based on internationally accepted norms. Industry estimates suggest that less than a dozen such laboratories exist in Pakistan, and the PTA is now also lobbying for a government subsidy or grant to establish an International standard lab facility for its members.

Separately, the University of Veterinary and Animal Sciences (UVAS) Lahore has also recently established the 'Department of Leather and Fiber Technology' under a research collaboration with Sichuan University in China[15]. This department is also collaborating with PTA-NZ for developing a deeper, scientific understanding of locally available hides, as well as conducting research on Chromium recovery from Solid waste and leftover trimmings of finished leather.

The National Institute of Leather Technology (NILT), Korangi, which was co-founded by the PTA and TDAP in 1998, remains the primary educational institution for technical and skills training related to the Leather industry. Research centres and advocacy groups such as Sustainable Development Policy Institute (SDPI), WWF-Pakistan and Cleaner Production Institute (CPI) have also worked on themes relating to environmental and social compliance, and better energy management in the sector.

However, the role of researchers and academia remains limited, in the absence of any higher education programs related to the industry. Currently, no relevant tanneries-focused post-graduate or doctorate programs exist in Pakistan, which has resulted in a huge gap in publicly available data and information.

5.1.9 Non-Governmental & Development Organizations

Since the 1990s, the Tannery sector has received assistance and support from various non-governmental and development organizations. In particular, the United Nations Industrial Development Organization (UNIDO) and further UNIDO's Leather Panel have provided both financial and technical assistance to develop better effluent management systems. The Kasur CETP, which operates under the Kasur Tanneries Waste Management Authority (KTWMA), was executed by UNIDO and funded by the United Nations Development Program (UNDP).

Similarly, the Korangi CETP, which also serves industries in addition to the Leather cluster, was established through funding partly from the Dutch Government in cooperation with the Federal and Provincial Governments. The Netherlands is also a major market for finished leather and leather product exports from the Korangi cluster.

5.1.10 Labour Groups

While the Leather industry provides livelihoods to an estimated 500,000 Pakistanis, a large proportion of these are wage labourers who do not receive worker benefits or rights as formal employees of the firms do. No labour groups solely dealing with leather and tannery industry workers exist, and most activists are associated with region or industrial cluster based labour associations. Joining industrial unions is discouraged through risk of coercive action. Due to the absence of such lobbying or advocacy platforms, worker safety and social compliance are extremely poor in the industry. Contractors which provide wage labour have no mandatory requirements of paying minimum wage as set by the government and do not provide protective equipment. Kidney and liver diseases have been reported among workers who have spent long-periods working in the industry (see section 5.6.2).

[15] Department of Biomass and Leather Engineering, Sichuan University, Chengdu, China.

Some minor attempts have been made by Oxfam and the Netherlands-based Center for Research on Multinational Organizations to lobby for linking the EU's GSP+ status for exports from Pakistan with worker rights, safety and adequate compensation.

5.2 Procurement Supply Chain

5.2.1 North Zone

The North Zone covers a very wide part of the country, in terms of area. Other than Sialkot and Kasur clusters, a major cluster exists in the north of Lahore district. Separately, in the last two decades some tanneries and finishing units as well as seasonal SSPs have also emerged in Multan and Peshawar districts.

Due to the vast area covered by the North Zone, the tanneries have access to the major proportion of raw hides and skins produced in the country. Districts mentioned above anchor the regional supply with them at the centre, from where middlemen operate as market intermediaries.

In the Peshawar district, besides local supply, reportedly, preserved raw hides and skins from neighbouring Afghanistan are also entering through informal channels, largely due to increasing demand for cheap raw materials in Pakistan and lack of manufacturing facilities in Afghanistan. The country also celebrates the Eid festival and resultantly has an excessive seasonal supply.

The North Zone supply chain is heavily dependent on local freight transport and warehousing. Emissions, pollution and handling practices linked with this transport and storage have not been studied, but it can be assumed to be a contributing source as this part of the supply chain is largely unregulated.

Finally, the tanneries and leather manufacturers within the urban clusters have to source most of the chemicals, acids, salts and pigments required for processing either through import or a few chemical manufacturers based in the Central Punjab region. Because of stricter enforcement in urban areas by EPA and Transport authorities, this segment is considered to be largely compliant with regulations and safe.

5.2.2 South Zone

The South Zone is concentrated largely in the Karachi Division of Sindh province, where large tanneries and manufacturing units are operating in the Korangi and SITE industrial areas. Some smaller and seasonal units operate in Hyderabad and Sukkur districts, but these are negligible in comparison.

The South Zone has lower regional production of hides and skins, and is in part dependent on Northern districts to fill demand gaps. A few large manufacturers also import processed hides and finished leather for production of high-value apparel, footwear and other goods for the import market.

Due to direct access to Ports, the Korangi and SITE industries have easier access to chemical imports and transport distance is very short. The supply of chemicals solely for the Tannery sector, like in the North Zone, is difficult to disaggregate from the overall use of chemicals because of overlap with other industries. The only methods possible are to: (i) audit procurements of factories and/or (ii) estimate chemical inputs from pollution loads in effluents.

5.3 Processing & Manufacturing Value Chain

Figure 3: Flowchart covering the Leather Value Chain
(Adapted from "Trends in production and trade: Leather Products from Pakistan," Together for Decent Leather)

5.3.1 Tanning Stage

The tanning stage is known to be the most polluting stage of the leather value chain. At this stage, large amounts of water and chemicals are involved in transforming preserved hides into leather. Effluent discharge at this stage is largely responsible for the high amounts of water pollution associated with the sector.

The raw hides go through the following steps, resulting in various types of waste:

1. Soaking: Raw preserved hides are soaked in water to restore the water content of hides and to perform basic cleaning.

2. Fleshing & Trimming: Large amounts of chemical compounds, specifically sulphide and lime is added to chemically dissolve excess flesh and hair from hides. Because of the addition of this heavy chemical load, this stage causes the highest Chemical Oxygen Demand (COD).

3. Deliming: To neutralize the alkaline medium resulting from excessive lime, acid ammonium salts are added. While this neutralizes the entire medium, it also adds high amounts of ammonium to the wastewater, adding to the chemical load of the effluent.

4. Pickling: The hides are further processed by adding acid to the medium to pickle the hides. Pickling allows for the final stage i.e. addition of chromium which enters the hide due to the acidic pH levels.

5. Degreasing: Excessive grease in the processed hides is dissolved using organic solvents. The removed grease and solvents also further add to the COD.

6. Chrome Tanning: Chromium (III) salts are added into the acidic medium, which begins to bond with collagen in the hides. The end result is what is termed as 'Wet Blue hides' in the tanneries. About 2-3 percent of the hide consists of Chromium (III) by dry weight, while the excess flows into the wastewater.

5.3.2 Finished Stage

Wet Finishing: The tanneries can further process the 'Wet Blue hides' at this point to adjust quality, pigmentation and other properties as desired. Some of these processes require further addition of chemicals. Excessive water is removed and the tanned hide is dried to perform splitting, shaving and trimming, to acquire the final finished leather. Although some of these

steps increase the chemical load of effluent, this is only marginal compared to the Tanning stage.

Dry Finishing: The crust of the hide is dried to remove liquid weight. Further processing is done to modify the quality and softness of hides, which are finally treated with varnish to create the finished look. Some of the chemicals used at this stage become part of the final discharge.

5.3.3 Estimates of Water usage

According to estimates from various international studies, at least 30-35 cubic meters (m^3) of water are used per Tonne (t) of processed hides.

	Conventional (m^3/t)	Advanced (m^3/t)
Soaking	7-9	2
Liming	9-15	4.5
Deliming	7-11	2
Tanning	3-5	0.5
Post-tanning	7-13	3
Finishing	1-3	0
TOTAL	**34-56**	**12**

Table 2: Industry Averages on Water Consumption in each process[16]

The above estimates are widely used in Pakistan in industry and policymaking documents, as well as baseline assessments. However, in reality, these may not be applicable to local tanneries, because of the wide variations in size of the tanneries, regulatory compliance, and sources of water.

For example, reports acquired through the Punjab EPA, for a Tannery in the Kasur cluster[17] submitted in its EIA that in its operational stage it will be deriving water from both potable and non-potable sources. The Tannery had 3-4 drums, with an estimated capacity of 0.25 tonnes per drum per day. The amount of water reportedly used (~1.5 to ~2.6 m^3/t) is significantly less than the estimates provided in Table 2.

	Freshwater Used (m^3)
Winter (per/day)	2
Summer (per/day)	1.5
TOTAL (per year)	490

Table 3: Water usage by a Tannery in Kasur, Punjab

[16] GTZ GmbH, TBW GmbH, UNIDO, International Union of Leather Technologists and Chemists Society. (2002). Treatment of Tannery Wastewater.

[17] Environment, Social and Emergency Management Plan, Haji Maqsood Tanneries (Kasur)

5.3.4 Estimates on Characteristics Effluents

Based on reports received from Sindh EPA, the Korangi CETP discharge was well above SEQS limits. However, data on Chromium is missing. According to Director Regional Office Karachi, SEPA, the issue of repeated violations has also resulted in prosecution of industries and CETP management, however, they have remained non-compliant and neither have managed to upgrade the facilities since issuance of orders 4 years ago.

	Parameters	Units	Results	SEQS
1	pH	pH scale	7.76	6-9
2	TSS	mg/l	**280**	150
3	TDS	mg/l	**20,288**	3,500
4	5-days BOD @ 20C	mg/l	**382**	80
5	COD	mg/l	**866**	400
6	Chlorine (Residual)	mg/l	0.8	1.0
7	Chloride (Cl^-)	mg/l	**10,600**	1000
8	Ammonia (NH^{3+})	mg/l	**69**	40
9	Fluoride (FL^-)	mg/l	2.6	10
10	Sulphate (SO_4^{-2})	mg/l	**1,620**	600
11	Sulphide (S^-)	mg/l	0.82	1.0
12	Cyanide (CN^-)	mg/l	0.15	1.0
13	Oil & Grease	mg/l	**14**	10
14	Phenol Compound	mg/l	0.28	0.3
15	Surfactant	mg/l	0.64	20

Table 4: Chemical Analysis of Wastewater sample from Korangi CETP,
Korangi Industrial Area, Karachi (dated: 01/03/2018)

Another study, around the same period, found Chromium ions at 10.26 ppm and 13.05 ppm in May and June, respectively.[18]

Reports provided by the Punjab EPA revealed similar violations of PEQS by the Kasur Tanneries Waste Management Authority (KTWMA), which runs the Kasur CETP and is itself a designated authority of the Punjab government. In this cluster, older estimates suggest that 40,000 tonnes of basic chemicals and 15,000 tonnes of Chromium as chromium sulphate were being used, far in excess of the required amounts, and hence, leading to high levels of pollution as they have to be drained out as wastewater.[19]

[18] Omm-e-Hany, Asia N, Aamir A, Humaira K. Determination of Chromium in the Tannery wastewater, Korangi, Karachi.
[19] Abbas, Moneeza, et al. "Detection of Heavy Metals Concentration Due to Leather Tanning Industry and Prevalent Disease Pattern in Kasur, Pakistan."

	Parameters	Units	Results	PEQS
1	pH	pH scale	8.8	6-9
2	TSS	mg/l	**543**	200
3	TDS	mg/l	**13,118**	3,500
4	BOD @ 20C	mg/l	**563**	80
5	COD	mg/l	**1152**	150
6	Chloride (Cl^-)	mg/l	**5,498**	1000
7	Ammonia (NH^{3+})	mg/l	**184**	40
8	Sulphide (S^-)	mg/l	**126**	1.0
9	Chromium (III & VI)	mg/l	**1.199**	1.0
10	Copper	mg/l	0.067	1.0
11	Lead	mg/l	0.011	0.5
12	Selenium	mg/l	<0.010	0.5
13	Mercury	mg/l	<0.001	0.01
14	Nickel	mg/l	0.008	1.0
15	Silver	mg/l	0.829	1.0
16	Total Toxic metals	mg/l	**2.926**	2.0
17	Zinc	mg/l	0.098	5.0
18	Arsenic	mg/l	0.011	1.0
19	Barium	mg/l	0.057	1.5
20	Iron	mg/l	0.928	8.0
21	Manganese	mg/l	0.086	1.5
22	Boron	mg/l	0.744	6.0

Table 5: Chemical Analysis of Wastewater sample from final drain of Kasur CETP, Kasur district (dated: 18/10/2017)

The Punjab EPA also provided a similar sample report for an export-oriented tannery operating in Lahore district. The lower chemical load in the effluent discharge implies better management, however, data was incomplete.

	Parameters	Units	Results	PEQS
1	pH	pH scale	**9.1**	6-9

2	TSS	mg/l	**394**	200
3	TDS	mg/l	**2108**	3,500
4	BOD @ 20C	mg/l	**348**	80
5	COD	mg/l	**811**	150
6	Chloride (Cl^-)	mg/l	542	1000
7	Ammonia (NH^{3+})	mg/l	**Not given**	40
8	Sulphide (S^-)	mg/l	**Not given**	1.0
9	Chromium (III & VI)	mg/l	**Not given**	1.0
10	Copper	mg/l	**Not given**	1.0
11	Lead	mg/l	<0.010	0.5
12	Selenium	mg/l	<0.010	0.5
13	Mercury	mg/l	<0.010	0.01
14	Nickel	mg/l	0.005	1.0
15	Silver	mg/l	0.005	1.0
16	Total Toxic metals	mg/l	**3.694**	2.0
17	Zinc	mg/l	0.158	5.0
18	Arsenic	mg/l	0.017	1.0
19	Barium	mg/l	0.131	1.5
20	Iron	mg/l	0.845	8.0
21	Manganese	mg/l	0.872	1.5
22	Boron	mg/l	0.778	6.0

Table 6: Chemical Analysis of Wastewater sample from final drain of Permair Leather Pakistan Private Limited (dated: 14/06/2017)

5.3.5 Estimates on Local Air Pollution

Available data on Air Quality in and around the study clusters was sparse. In the absence of in-situ measurements, satellite data for Nitrogen Dioxide (NO_2) and Sulphur Dioxide (SO_2) has been obtained through European Space Agency (ESA) Sentinel 5P TROPOMI instrument. The period selected for this imagery is August 2020 to December 2020, which is when industrial activities had resumed after initial COVID-19 lockdowns, and corresponding to the peak season as the Eid festival and subsequent hide processing occurred in the same period.

The imagery does not offer deep insight, but reveals differences between the NZ (Sialkot and Kasur clusters) in comparison to SZ (Korangi cluster); the former has tanneries spread over multiple areas in and outside the cities, while the latter shows heavy concentration alongside Textile and Chemical industry resulting in very high emissions there.

Some on-ground Air Quality data for Korangi (Karachi) and Kasur district has been obtained by study of Baseline data provided in Environment Impact Assessments (EIAs) of new developments in the area. Averages (in µg/m^3) of Sulphur Dioxide, Oxides of Nitrogen and Particulate Matter taken from these reports are provided:

Pollutant	SO_2	NO	NO_2	SPM	PM10	PM2.5
Korangi	26	20	30	350	105	50
Kasur	10	30	40	420	n/a	n/a

Table 7: Air Quality Data for Korangi and Kasur districts

These averages, however, cannot accurately depict conditions inside tanneries. Such measurements may have been performed during Government or Industry's own monitoring, but no such information exists in reports or academic literature. Anecdotally, during discussions with Punjab EPA inspectors in Kasur, they revealed that presence of noxious gases is observable in the tannery neighbourhoods, and during their inspections various smells "are absorbed into their clothing". The inspectors are unable to pinpoint which gas is responsible for the odors, but it is likely to be Ammonia generated from excessive use during the pre-tanning stages. Another reported observation is the taste of metal, which is likely due to the presence of dust aerosol carrying heavy metal species.

Other than noxious gases from chemicals, heating in the industry is dependent on coal, diesel and fuel oil, which are linked to SO_2, CO, and PM emissions. The use of these fuels inside the closed premises of poorly maintained tanneries, in the absence of proper ventilation and masks, adversely affects workers' respiratory health. No data, however, exists regarding indoor air quality. Information on disease prevalence is available, only through published academic articles, which is discussed later.

The local, daily meteorological conditions also strongly influence Ambient Air data. Therefore, averages in the SZ cluster do not indicate any information about NZ clusters.

The satellite data for Sialkot, Kasur and Korangi (Karachi) districts, from the *Sentinel 5-P TROPOMI* instrument is provided below:

Figure 4: Satellite imagery of NO_2 and SO_2 concentrations in Sialkot

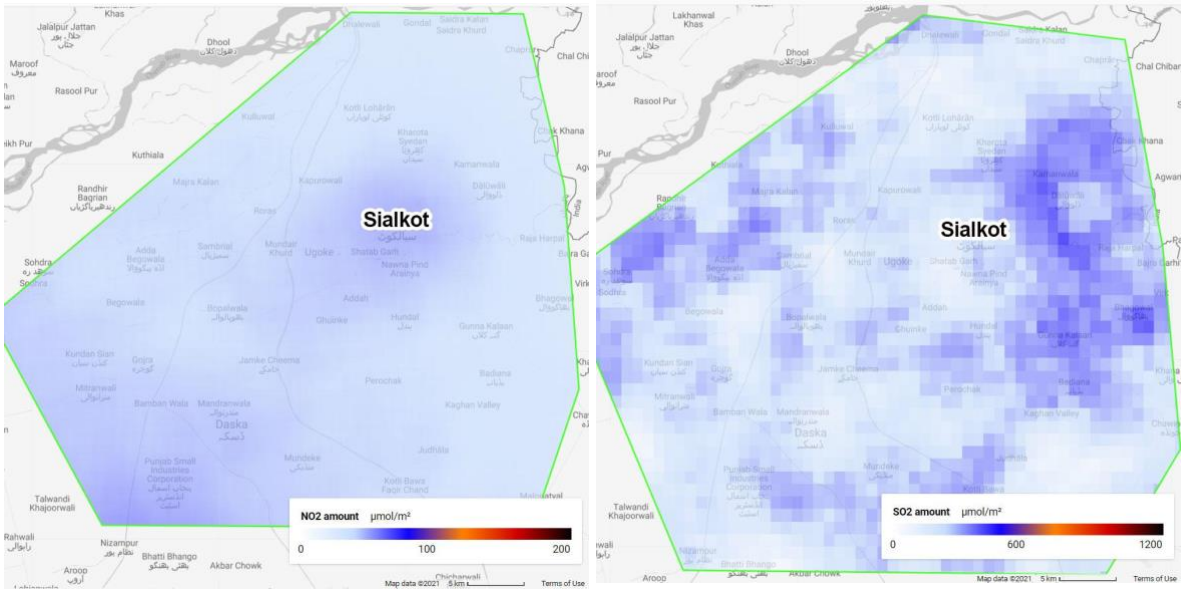


Figure 5: Satellite imagery of NO_2 and SO_2 concentrations in Kasur

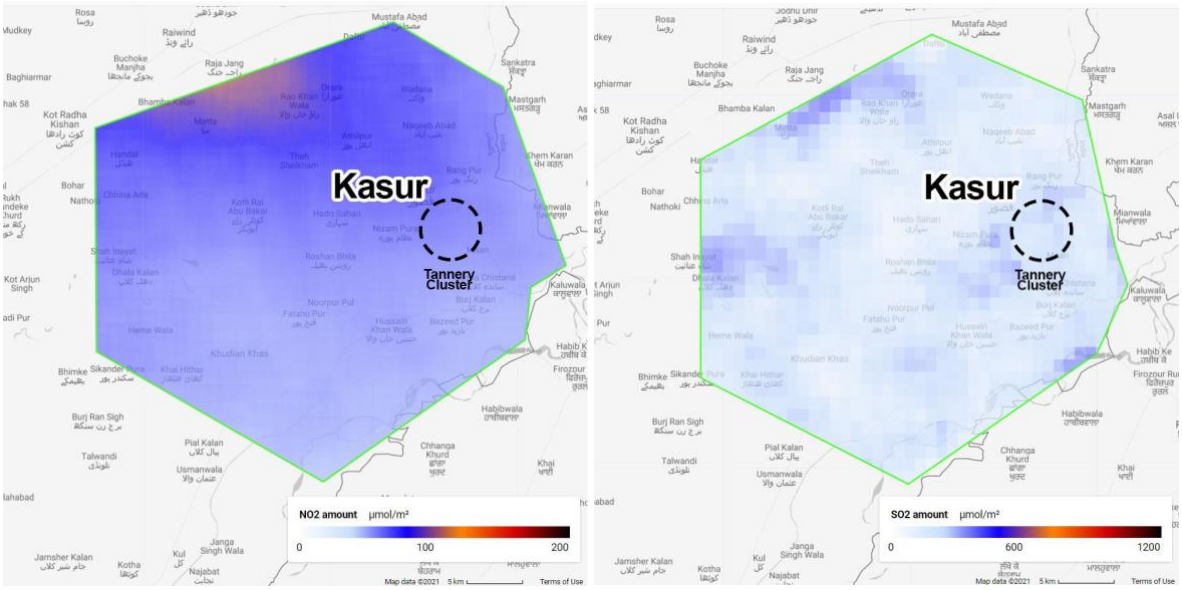
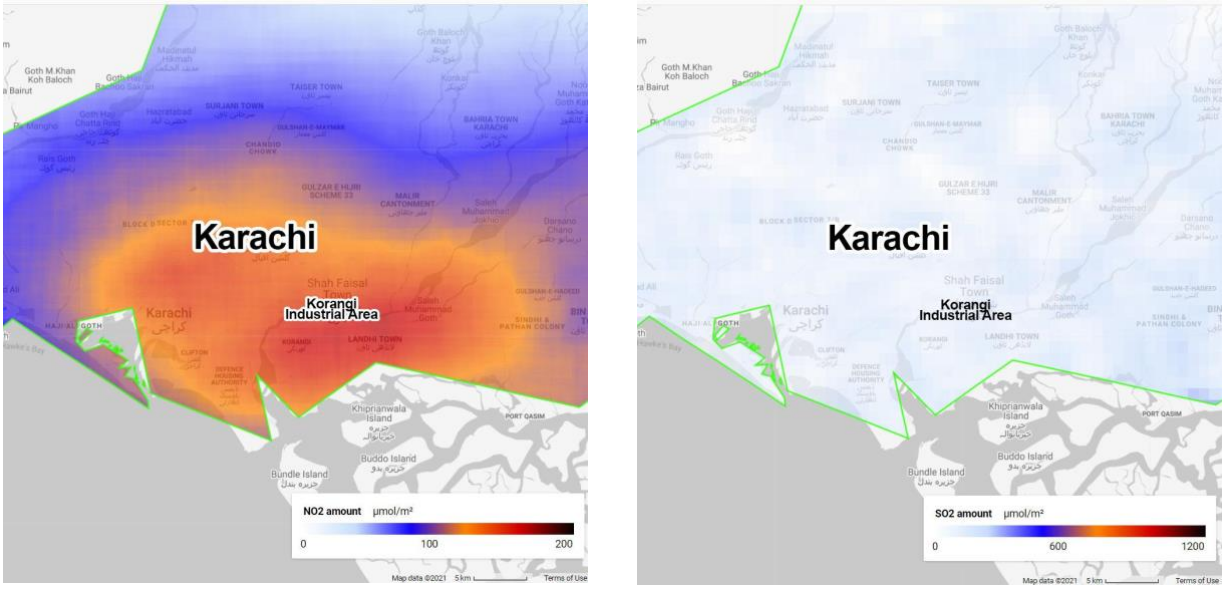


Figure 6: Satellite imagery of NO_2 and SO_2 concentrations in Karachi



5.4 GIS analysis – Raw hides to finished goods

This GIS analysis covers:

(i) Direction of flow of supply of Raw or preserved hides;

(ii) Areas where Middlemen Markets are present, and temporary warehousing and Single-stage processing occurs;

(iii) Location of Tannery clusters;

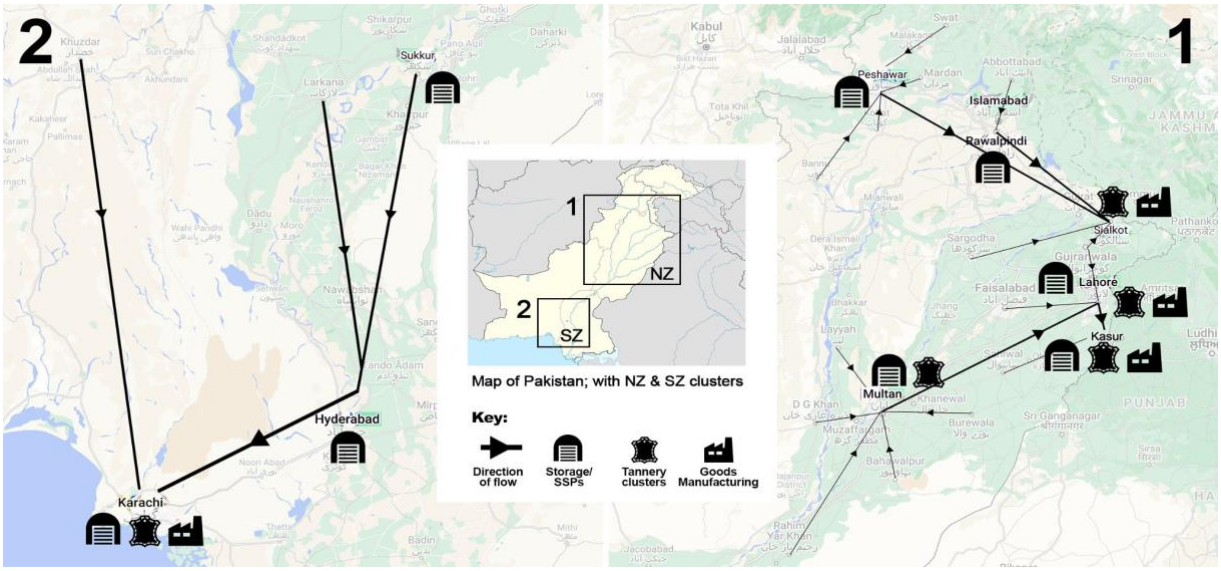


Figure 7: Map of NZ and SZ industry clusters

5.5 Status of Combined/Common Effluent Treatment Plants (CETPs) and Chromium Recovery Units (CRUs)

5.5.1 Kasur CEPTP

The Kasur CETP became operational in 2001. Although it was conceived originally in 1996, and assistance was provided by UNDP/UNIDO, its execution was delayed due to extensive Federal government approval protocols. While the plant is simply called the Kasur CETP, it is actually a Common Effluent Pre-Treatment Plant (CEPTP). The plant, in addition to handling discharge from the Tannery cluster, also deals with municipal sewage of the area. To manage these operations, the Kasur Tanneries Waste Management Authority (KTWMA) was also established in 1994.

As already mentioned, this is a "Pre-Treatment" plant, which is largely outdated now and does not serve all the tanneries in the cluster. The max handling design capacity of the CEPTP is 12,600 m^3 per day, however, on-ground conditions during a visit conducted revealed that deposition, siltation and other build-ups as well as old, corroding machinery can hardly manage this quantity. The estimated daily discharge from tanneries is 17,000 m^3 per day, which increases during peak season to 22,000 m^3 per day. Assistant Director EPA for Kasur District confirmed that at least about half of the discharge is now entirely by-passed into the external drain. Therefore, chemical analysis of the by-passed effluent is equally important as the treated effluent. A report for the untreated effluent was provided by the Punjab EPA, which shows that the untreated effluent had 8 times as much Chromium, 5 times as much BOD and COD, and more than 20 times as much Ammonium ions, which was passed directly into the drainage canal.[20]

According to present plant officials, about 400 metering devices are installed to measure which tanneries use the treatment service, and for many years they were charged Rs. 5 per m^3 of effluent. This price was set in 2002, and was not revised till a few years ago to Rs. 7 per m^3, and currently to Rs. 11.5 per m^3. Due to low revenues, the plant has been unable to maintain its daily operations, let alone upgrade or expand. The CEPTP also has an attached Chromium Recovery Unit, which has largely remained unoperational in recent years, while a Fat Extraction Unit set up in 2010 has never been operational. The original plan included a solid waste dumping site, but it is also treated as a general landfill.

[20] Chemical Analysis of Wastewater sample from Western drain, partially taken into CEPTP, Kasur (dated: 18/10/2017)

Figure 8: Manual separation of solid waste

Figure 9: Mechanical separator (UNIDO logo seen)

Figure 10: Inlet Channel
(About half the effluent is by-passed before entering)

Figure 11: Two large Aeration ponds
(Depends on old motors installed several years ago)

Figure 12: Two mechanical mixing vats
(Operational)

Figure 13: Settling ponds at the CEPTP
(One of 8 pictured, some are completely silted now)

Photos 8-13 credit © Dawar H. Butt / SW-AQA / GAHP

5.5.2 Korangi Industrial Area CETP

Information on the Korangi CETP is less transparent. Initial meetings with Sindh EPA and PTA officials described its basic design features, anecdotal performance reports and opinions on its future. However, as this particular CETP is managed by PTA South Zone, the bureaucracy within the Association was unwilling to openly discuss problems revealed in the literature

review. Further, various PTA officials directed the questionnaire or interview requests to their colleagues who were not relevant to the research.

The Korangi CETP was built under cooperation between the Governments of Pakistan and Netherlands, while the Sindh Provincial government provided a land grant for the project. The plant became operational in 2004, and since then has been managed by the same team of officials from PTA South Zone. The plant has a design capacity of 42,000 m^3 per day. Although, media reports indicate that it only treats about 40-50 percent effluent from the tanneries. It serves some other industrial clusters as well, besides Tanneries. It must be added that several tanneries are also present in Karachi's SITE industrial area, where no CETP is present. The CETP also does not have a functional Chromium Recovery Unit.

However, as evident from the chemical analysis report, as well as prosecution by Sindh EPA, the plant does not function effectively. The elevation of the Korangi industrial area is also such that pumping stations are required to move effluent towards the plant, and capacity utilization is variable. The EPA officials have been informed by PTA-SZ that they are exploring options of upgradation and expansion, for which they are seeking government and international assistance.

5.5.3 Sialkot Tannery Zone (STZ) CETP

The Sialkot Tannery Zone project is currently under execution, over a specified area of 394 acres in Sialkot district. However, since 2018, only the basic work of land acquisition, utilities and roads provision is on-going. The Zone operates under Sialkot Tannery Association (Guarantee) Ltd (STAGL), which has membership from major Sialkot based exporters. The STZ CETP feasibility was completed in 2019.[21]

The Export Development Fund (EDF) and STAGL are cooperating on the financing of the project, while UNIDO is providing technical assistance. It is estimated that 200 tonnes of raw hides will be processed in the zone, and CETP will reduce costs of treatment by 80 percent, in comparison to the existing model. The proposal also envisages a CRU and a designated landfill alongside the CETP.

5.5.4 Solid Waste Management in Sample Clusters

Solid waste generated in the Leather value chain consists primarily of trimmings of excess leather at various stages. Theoretically, this waste can be used in by-products and a study for chromium recovery from trimmings is also under progress at UVAS, Lahore, to provide insights to PTA. But, generally speaking, Solid Waste Management (SWM) is in a poor state in urban Pakistan, and in particular, the industrial districts. Few municipal landfill sites have ever been developed and operationalized. The situation is largely the same in the Leather and Textiles sector.

In Kasur and Korangi, along with the construction of CETPs, landfill sites were also designated. However, they have been mismanaged, and do not cater to the needs of the cluster. In Kasur, the site is also treated as a municipal landfill, besides its purpose as an industrial landfill. However, necessary design elements of a landfill site are missing. In Sialkot, there is currently, no designated landfill site. Some tanneries, however, have contracted out Solid Waste collection, while they do not audit what eventually happens with it. Some entrepreneurs have established by-product related businesses in both Kasur and Sialkot. Trimmings of leather are

[21] Technical Specifications of proposed Sialkot Tannery Zone CETP, UNIDO. <https://www.unido.org/sites/default/files/files/2019-02/APPENDIX%201%20-%20ANNEX%20C%20-%20GENERAL%20TERMS%20OF%20REFERENCE.pdf>

used for various “recycled” products such as bags, purses, mats, etc. The proportion of solid waste handled by them is unknown.

Separately, in the rural areas around Kasur and Sialkot districts, informal agents use the trimmings which are processed under conventional pyrolysis to produce glue. This process itself is highly polluting and causes harmful gaseous and PM emissions into the surrounding air.

Another small by-product industry, which is also informally practiced next to agricultural areas is the mixing of leftover fatty tissue and skin protein into poultry feed. This method introduces several chemical and heavy metal traces into the food system, which can potentially have deep public health impacts for localities linked to these poultry markets.

In Korangi, the Sindh EPA officials did not confirm the presence of any such contractors or by-product processing. However, it may also be an admission of mismanagement; an admission which they were unwilling to make.

Reports indicate that soil leaching is occurring in these places and soil samples indicate the presence of heavy metals. For the past few years, the peak tanning season coincides with Monsoon rains. In discussions with an academic based in UVAS, Lahore, he pointed out that Chromium from trimmings dumped as solid-waste is likely being converted from Trivalent to Hexavalent species and is being absorbed onto the soil during the rainy season. Without timely and efficient management of solid-waste, existing pollution issues are further exacerbated.

Methane emissions are also likely due to mixing and piling up with municipal waste. Significant amount of dumped solid waste was visible, in some instances also being burnt, during visits conducted to Kasur CEPTP and Korangi industrial areas.

Figure 14: Dumped garbage and waste burning observed outside Kasur CEPTP
Photo credit © Dawar H. Butt / SW-AQA / GAHP

5.6 Social, Health and Safety (SHS) Compliance

5.6.1 Worker Safety issues

5.6.1.1 Major instances of industrial accidents

In the past 2 decades, multiple instances of accidents have been reported in the Tannery industry. These are mostly linked to the Tanning stage. However, some major accidents have also occurred at the CETPs, as a result of Hydrogen Sulphide (H_2S) gas poisoning.

In 2006, 3 workers were killed while inspecting a blockage in a water tank at the Kasur CEPTP.[22] During a visit to the plant, the Laboratory manager shared that the incident happened because the water tank was several meters deep, and it lacked a ladder to climb down or up; the workers had to manually descend and ascend for maintenance, which left no emergency exit route. The tank was also left uncovered. After the accident and a government inquiry, these gaps were rectified.

Figure 15: Water tank at CEPTP where accident occurred; remains poorly maintained
Photo credit © Dawar H. Butt / SW-AQA / GAHP

Similarly, in 2009, 4 workers died at the Korangi CETP from H_2S poisoning while performing maintenance of a desludging valve.[23] The inquiry report revealed very lax protocols and monitoring, as well as a complete lack of protective equipment.

[22] "Three killed, five injured in toxic waste water tank incident." The News. Apr 29, 2006. <https://www.thenews.com.pk/archive/print/4148-three-killed-five-injured-in-toxic-waste-water-tank-incident>
[23] "KARACHI: Effluent plant deaths reveal lack of planning, legal compliance." DAWN. Apr 1, 2009. <https://www.dawn.com/news/976154/karachi-effluent-plant-deaths-reveal-lack-of-planning-legal-compliance>

5.6.1.2 Personal Protective Equipment (PPE)

As discussed earlier, worker health and safety protocols are not implemented seriously. PPE, such as rubber gloves, hazard suits, goggles, and masks are necessary to protect from various occupational health risks associated with the tannery industry, including various respiratory diseases, cancers, and inflammations. Only export-oriented tanneries comply with these standards and provide basic Personal Protective Equipment (PPE) to their workers. However, these protocols rarely ensure full compliance and might have been counterproductive. For example, tanneries outsource processes which do not require skilled technicians, especially at the tanning stage, which is also the most polluting stage. Contractors employ wage labourers, removing responsibility from the business owner to provide PPE. A study conducted by the Center for Research on Multinational Organizations (SOMO) in the Korangi Leather cluster revealed that 39 percent workers were not provided PPE and among the remaining 61 percent it was unclear if training to use PPE had been formally provided.[24]

Separately, where PPE is provided, it does not have a notified standard such as NIOSH standards in the US. Workers avoid use of substandard PPE which causes discomfort during long work shifts.

Lastly, it is believed that provision of PPE, where present, was done so only on occasion of inspection or to receive a certification. The owners do not necessarily provide PPE around the year or replace it in case of damage or loss.

5.6.1.3 Worker literacy

The issue of worker literacy was highlighted by Secretary PTA North Zone, who was of the opinion that employers are not adequately training their workforce, and often the only form of safety training conducted were for supervisors that PTA itself organizes. The impact of this training has not been measured either. The vast majority of workers do not have enough knowledge about chemicals and associated hazards, as well as the necessity of PPE while working in such environments.

5.6.2 Disease Burden and Occupational Health Risks

Besides poor working conditions, and high-risk for physical injuries and gas poisoning, the industry's high-dependence on heavy metal compounds, such as chromium salts, causes long-term harm to workers employed in tanneries. Surveys have also revealed higher proportions of disease prevalence in areas near effluent-carrying drains.

A study published in 2012 sampled soil and groundwater around the Kasur Tannery cluster and recorded high-levels of heavy metals in samples.[25] Mean values from both groundwater and soil analysis are given below:

Metal	Cr	Fe	Ni	Cd	Pb	Zn	Co	Mn
Soil (mg/kg)	2443	136.9	34.2	26.3	18.2	14.3	22.5	9.4
Water (mg/L)	1.32	0.55	0.11	0.04	0.14	0.13	0.15	0.07

Table 8: Groundwater and soil analysis from Kasur Tannery cluster

[24] Kiezebrink, Vincent, and NOWCommunities. "Hell-Bent for Leather." SOMO, 10 Feb. 2017. (p. 17)

[25] Afzal, M., et al. "Assessment of Heavy Metal Contamination in Soil and Groundwater at Leather Industrial Area of Kasur, Pakistan."

These pollutants have been linked to the prevalence of various fatal diseases throughout areas in close proximity to the tanneries in Kasur. Another study, also published in 2012, found that according to the District Health authority records citizens living in Kasur district were suffering from Asthma, Acute (upper) respiratory infections, diarrhea/dysentery among children under age of five years as well as Typhoid, Hypertension, Dermatitis, neuro-psychiatric diseases, eye diseases, Nephritis and prolonged cough; both as a consequence of contaminated soil dust as well as consumption of polluted groundwater.[26]

Due to the absence of reports and academic studies on indoor pollution at tanneries in Pakistan, it has been assumed that conditions will be largely similar to those at tanneries in neighbouring India and Bangladesh. For example, the Kanpur (North India) tannery cluster is comparable in size and conventional practices to the North Zone (Pakistan) cluster.

A study published in 2012 linked "DNA damage and oxidative stress" from Chromium handling in the Tannery industry in North India by comparing 100 male workers employed in tanneries with a control group of 100 males, concluding that the former was significantly more affected.[27]

Another study, published in 2008, specifically dealing with occupational health risks in tanneries at Kanpur reveals other morbidities among tannery workers. As opposed to the control group, exposed workers had significantly higher respiratory, ocular and dermal morbidities (19.6% vs 40.1%), with incidence of respiratory symptoms being the most common; among them the reported prevalence was higher in exposed group for Chronic Bronchitis, Occupational Asthma, Allergic Bronchitis, Sinusitis and Pulmonary Tuberculosis.[28]

Chromium toxicity, particularly hexavalent Chromium (VI; Cr6), from inhalation via aerosol transport can cause lung cancer, irritation or burning on direct contact, and severely affect the liver.[29]

Workers in Pakistan anecdotally share that up to 75 percent were suffering from various illnesses, including heart issues, skin rashes, jaundice and allergic reactions because of chemical exposure inside tanneries and lack of any safety protocols.[30]

5.6.3 Existing Legislation

Both Sindh and Punjab have legislated comprehensive Occupational Safety laws, under assistance from the UN's International Labour Organization (ILO). Sindh passed the Occupational Safety and Health Act in 2017[31], while Punjab passed its law in 2019[32].

These legislations provide for significant worker safety protocols, including health benefits and PPE, and in line with internationally accepted norms. However, these laws are weakly implemented, and are not applicable to some designated industrial and export processing zones.[33]

---

[26] Abbas, Moneeza, et al. "Detection of Heavy Metals Concentration Due to Leather Tanning Industry and Prevalent Disease Pattern in Kasur, Pakistan."

[27] Ambreen, Khushboo, et al. "Genotoxicity and Oxidative Stress in Chromium-Exposed Tannery Workers in North India."

[28] Rastogi, Subodh Kumar et al. "Occupational health risks among the workers employed in leather tanneries at Kanpur."

[29] "Chromium (Cr) Toxicity: What Are the Physiologic Effects of Chromium Exposure?" Centers for Disease Control and Prevention, Centers for Disease Control and Prevention.

[30] Kiezebrink, Vincent, and NOWCommunities. "Hell-Bent for Leather." SOMO, 10 Feb. 2017. (p. 16)

[31] "Sindh Occupational Safety and Health Act 2017." <http://assp.org.pk/wp-content/uploads/2019/03/The_Sindh_Occupational_Safety_and_Health_Bill_2017.pdf>

[32] "Punjab Occuptational Safety and Health Act 2019." <http://punjablaws.gov.pk/laws/2726.html>

[33] "PILER bemoans lack of labour inspection." Express Tribune. Apr 29, 2021. <https://tribune.com.pk/story/2297312/piler-bemoans-lack-of-labour-inspection>

5.6.4 Problematic Practices in Industry

5.6.4.1 Wage Labour & Temporary Contracts

As mentioned above, wage labour and lack of permanent contracts remains a big issue for worker rights. Many of the laws and regulations that do exist only apply to the contractual workforce. The study conducted by SOMO also found that only 5 percent of workers had a written contract.[34]

Lack of contracts means that in the event of injury or sickness arising from the workplace the workers do not receive any assistance, and in fact they are likely to lose wages as the number of productive work hours is greatly reduced. The high costs of medical treatment can put workers under debt or force them to continue working in an injured state. Testimonies from workers claim that workers have lost hands or arms while working with presses and cutters without proper training, but did not receive any compensation from employers.[35]

Many workers reportedly develop serious illnesses at the end of their productive work years, but do not receive any form of retirement benefits to cater to treatment costs. One particular testimony reveals that an old worker, who started suffering from acute Kidney failure 14 years ago, which he links to dehydration due long work hours in particularly hot indoor conditions, does not receive any benefits from the tannery and also has to schedule his dialysis appointments outside of work hours.[36]

5.6.4.2 Outsourcing to Single-Stage Processors (SSPs)

The SSPs, as discussed earlier, perform one or two tasks of the tanning stage, and hence are important players of the value chain. However, these units are not well-regulated, while many operate seasonally or informally. During conversations with PTA officials and some export-oriented manufacturers, it was shared that in the North Zone large finished leather and leather product makers have begun outsourcing work to SSPs within the overall cluster. For example, a manufacturer in Sialkot outsources the initial preparation of hides to a SSP in Kasur, and offers payment on credit; as many operators in Kasur are seasonal this also allows them to remain operational over a longer period. The SSP is paid after the manufacturer is able to sell products to a customer.

While this model has made business more convenient for both parties, it results in under-reporting or misreporting of effluent quantities. If the more polluting task is occurring in Kasur, while the finishing is happening in Sialkot, the accurate measurement and/or disaggregation of data is very difficult. This arrangement may also allow manufacturers to escape from stricter environment standards such as Best Available Techniques (BAT) for exports to the EU.

5.6.5 Trainings and skills development

Occupational Safety and Health (OSH) trainings are an important tool for responsible business and social compliance. The PTA as its role for the industry's leading body has attempted to develop a platform for regular trainings for supervisors working at various tanneries. However, PTA also faces resource constraints and is dependent on donor or member funding to conduct these regularly. In discussions with the Secretary of PTA North Zone, the lack of training as well as little incentive to undergo training was highlighted. The OSHA Acts in Sindh and Punjab provinces mandates the appointment of a Safety Officer, but it does not provide for an effective

[34] *ibid.*
[35] Kiezebrink, Vincent, and NOWCommunities. "Hell-Bent for Leather." SOMO, 10 Feb. 2017. (p. 17)
[36] *ibid.*

mechanism for safety practices to be regularly checked and adequate awareness to be provided to all employees.

Skills development is also limited to technical courses provided through the National Institute of Leather Technology (NILT). Workers involved in labour intensive stages of the value chain only receive basic guidance on performing tasks, while training is dependent on informal experiential learning under senior workers, termed as the '*Ustaad-shaagird*' (teacher-student) model. A survey found that about half of the workers do not receive training for operating machines.[37]

Because of the absence of mandatory OSH training, the likelihood of occupational accidents is significantly higher. The oversupply of unskilled labour allows employers to find replacements instead of catering to injured workers, hence, tanneries have not voluntarily offered such training to employees.

6 Stakeholder Consultation Process

6.1 One-on-One Interviews and Discussions

As envisaged under the objectives of this study, the stakeholder consultation process was designed to update existing knowledge on the Leather industry and gain insight into the contributing factors responsible for poor environmental management linked to it. This process necessitated interactions with Industry bodies, Government departments, Leather producers and relevant researchers – actors which had also been highlighted in the Industry map. Considering this, as well as time limitations, a sample of key informants or stakeholders was selected, and one-on-one interactions were organized to consult them. Furthermore, sets of specific questions were posed to them, depending on their roles, while a significant part of the interactions was also informal discussions for building rapport with the stakeholders, before posing questions, formally.

Following is a summary of these interactions[38]:

Mr. Chaudhry Zulfiqar Hayat, Owner, M/s Leatherfield (Sialkot) & Member STAGL

This interaction was organized in regards to the Sialkot Tannery cluster. Mr. Hayat is a former Board member of the PTA and is currently on the Board of the STAGL, which is the management body for STZ. The STAGL was largely an Industry-led effort to formalize the Tanneries of Sialkot into a cluster, and provide a CETP for all relocated tanneries to the zone. Mr. Hayat shared that the industry is being forced to improve its environmental standards in order to earn certifications and secure export market share. Much like the Kasur region, Sialkot tanneries are spread around the district making waste management difficult. The move towards a specified Zone is encouraging, but according to him various roadblocks exist in its implementation. Particularly, release of funds, from the Export Development Board and approvals of machinery import, which are dependent on the Federal government, were mentioned. On the industry side, he believed that Sialkot Tanneries will be able to fulfil its share of the costs, especially if export orders recover and tariffs affecting the industry are lowered. On questions of Occupational safety, his answer was that his own business fulfils the relevant government guidelines and those required by international clients – most of which were EU based.

[37] Kiezebrink, Vincent, and NOWCommunities. "Hell-Bent for Leather." SOMO, 10 Feb. 2017. (p. 16) <https://www.somo.nl/hell-bent-for-leather/>

[38] Due to confidentiality reasons, the personal contact information for these persons has not been provided. Contact information may be provided to subsequent SMEP contractors upon request.

Mr. Fahim Ahmad, Secretary, Secretary, PTA (North Zone)

This interaction was organized to fully understand and capture the extent of the Leather industry in Pakistan. Mr. Ahmad is a veteran of the industry and has deep knowledge of the industry, particularly the North Zone. He was acutely aware of the environmental challenges within the industry and shared information regarding some incidents where lapses of supervision resulted in fatalities. He further shared that the PTA has been trying to build capacity and provide trainings for the Tanners registered with it. However, lack of resources has limited these activities to once or twice per annum. Mr. Ahmad also skepticism of the industry's own ability to deal with these challenges, largely because of falling profits. The leather sector has been facing a contraction, even before the Coronavirus pandemic. The industry has not been able to accurately diagnose the cause of this retreat, however, it blames an array of reasons. The rise of synthetic leather is one, along with requirements of higher standards, and perhaps also the increasing international competition. With a fall in export earnings, and increase in costs of production, some manufacturers have even shutdown Tannery units, while others are reluctant to spend on regulatory compliance. He also pointed out that these reasons have contributed to the Single-Stage processing model, which is used as a cost-cutting approach.

Dr. Sadaqat Ali Chattha, Department of Leather & Fiber Tech, UVAS Lahore

This interaction was organized by Mr. Fahim Ahmad of the PTA at their office. Dr. Chattha is one of the very few academics in Pakistan who are directly working with the Leather sector. He has research experience both in Pakistan and China. He provided insight into the current practices for environmental management in the industry, and highlighted gaps in effluent treatment and solid waste management. He further highlighted the need for investments in Chromium recovery. According to him, chromium bonded with trimmings which are dumped as waste, is a hazard that is largely ignored. During rainy season, which is particularly long in the North Zone, such Chromium waste may also be converted into toxic Chromium (VI) and leech into the groundwater. Within the academia's own constraints, only limited work has been done on this. Supporting such researchers, through collaborations between Higher Education authorities and Industry may further help build capacity locally, and contextual to the on-ground realities.

Mr. Noman Younis, Assistant Director, EPD Punjab

This interaction was organized as a field-visit to Kasur district, which has been an important region for leather production for many decades. Mr. Younis, who was posted in the District at the time of the visit, also invited two Environment Inspectors who were involved in enforcement of standards for the various Tanneries. Mr. Younis shared that the department is often forced to fine and shutdown certain tanneries because of non-compliance, but eventually has to relent because of court orders or non-cooperation of owners. The tanneries are also so widely spread that it is a huge enforcement challenge to monitor them, with limited resources. Further, the inspectors repeatedly mentioned the presence of pungent gases within the tannery units, but have been unable to pinpoint the source. After this meeting, Mr. Younis arranged for a visit to the Kasur CEPTP, which is managed by the KTWMA. On location, the Lab Director of the CEPTP guided the tour and discussed the limitations and reduced capacity of the plant. The overall conditions of the facility did not appear satisfactory; there were noticeable machinery damages while safety protocols were lagging.

Mr. Waqar Hussein Phulpoto, Additional Director General, EPA Sindh

This interaction was organized as a field-visit to Korangi Industrial Area of Karachi. Much of the tannery and leather goods manufacturing industry in Karachi is situated in a few sectors of the Korangi district, making it the only actual "cluster" of tanneries. The EPA office is also situated

in this district, largely as the needs of the Industrial area require close operations. During the interaction, Dr. Ashique Ali Langah, Regional Director, Karachi, was also invited, along with an Environment Inspector, to provide field related information. The enforcement related issues seemed to be more serious, particularly owing to the influence of industry lobbies linked to the area. The area also houses a vary array of other industries such as textile, chemical, pharmaceutical, auto-motive, electronics and more. Depending on the no. of units, each of these sectors are also a source of pollution. The CETP meant for the Leather sector also deals with their effluents, in part. The EPA officials also shared that there is litigation against major polluters, but units cannot be simply shutdown because they are large employers of labor and exporters. Similarly, there are some disputes with the CETP management, which blame EPA for not facilitating pumps and outflow channels. However, this is a jurisdictional grey area, as EPA does not directly control municipal or waste-management infrastructure. A visit to the CETP could not be conducted as the management, under PTA South Zone, was not forthcoming.

6.2 Stakeholder Workshop

To finalize the draft report, the team undertook a comprehensive Stakeholder consultation, by bringing together representatives of key institutions as highlighted in the Industry map. The consultation was organized under a collaboration between Sustainable World – Air Quality Asia (SW-AQA) and the Pakistan Institute of Development Economics (PIDE), and held on 6th July, 2021. Copies of the workshop agenda, presentations and workshop summary are included in Annex 7 and 8.

	Name	**Designation, Affiliation**
1	Dr. Nadeem Ul Haque	Vice Chancellor, PIDE
2	Mr. John Keith	Technical Consultant, Global Alliance on Health and Pollution
3	Dr. Imran Saqib Khalid	Director, Governance and Policy, WWF-Pakistan
4	Mr. Azhar-uddin Khan	Managing Director, Cleaner Production Institute
5	Mr. Fahim Ahmad	Secretary, PTA (North Zone)
6	Mr. Noman Younis	Assistant Director, EPD, Punjab
7	Ms. Shazia Rafi	President, SW-AQA
8	Mr. Ahmad Rafay Alam	Senior Advisor, SW-AQA
9	Mr. Asif Nawaz Shah	Research Associate, SW-AQA
10	Mr. Dawar Hameed Butt	Consultant, SW-AQA
11	Mr. Henrique Pacini	UNCTAD
12	Ms. Faith Gara	SMEP PMA, SSN – Observer
13	Ms. Amanda Dinan	SMEP PMA, SSN – Observer
14	Mr. Ali M Rezaie	SMEP PMA, ICCCAD – Observer
15	Ms. Sophia Huda	GAHP
16	Mr. Waqar-uddin	EPD, Punjab
17	Ms. Lorraine Dimairho	SMEP PMA, SSN – Observer
18	Mr. Nabeel Anwar	PIDE
19	Mr. Agha Saiddain	PTA-NZ

Table 9: Participants list from stakeholder workshop

The discussion was formatted to act both as a presentation of key information surrounding the SMEP program as well as a platform to gain actionable feedback surrounding the highlighted challenges. The following stakeholders participated during the session:

6.2.1 Discussion

The Stakeholder consultation enabled direct interaction between Industry representatives and Government officials, along with Market and Environment experts. An overwhelming view among the stakeholders was that there are inefficiencies and resource constraints for both compliance within the industry and enforcement by the state departments. Furthermore, the experts suggested that significant gaps existed because of mistrust between industry and government, and lack of collaborative action aimed at environmental management. The Tanneries, because of their localized impact, often have not been on the agenda of Provincial and Federal governments, where environment policymaking looks at the macro-level. In contrast, the industry heavily takes its direction based on Export-market forces, including international customers and Commerce departments.

The most significant cause of concern highlighted by the stakeholders was the poor state of effluent treatment facilities. There was a frank acceptance of the ineffectiveness of the Kasur CEPTP, largely because of the disorganized nature of land-zoning and poor finances of the plant. The representative of EPD Punjab suggested that a cluster model must be adopted for Tanneries based in Kasur district; currently, the tanneries exist in mix-use neighborhoods, where mushrooming urban growth has added residential compounds. The Kasur CEPTP, which also performs the role of a municipal sewage treatment plant, therefore, is virtually incapacitated. Because of the significant capacity constraint, it was disclosed that “nearly half of the effluent simply has to be by-passed instead of entry into the CEPTP inlet.” The suggested intervention has been based on the model being implemented in Sialkot district, with the creation of the Sialkot Tannery Zone (STZ). However, the STZ itself is also behind implementation targets because of poor finances. This issue was noted earlier, before the consultation, in Korangi (Karachi), where the CETP was functioning lower than its capacity because of non-availability of funds. The operational funding for CETPs is dependent on the plant’s management and schedule of charges for treatment. Poor recovery of charges over the years has added to the troubles of the Kasur CEPTP and Korangi CETP.

The SW-AQA team also presented its findings on the Occupational Health and Safety (OSH) record of the industry, which has remained very poor. While the findings were dependent entirely on secondary research, they are the first such collation of various news reports, surveys and studies pertaining to the industry in Pakistan. The stakeholders showed awareness of these issues, but lacked comprehensive understanding of the deep occupational health and public health impacts. The representative of Pakistan Tanners’ Association (PTA) accepted the lack of understanding and capacity among the industry, which has limited any further progress on this end. There remain large gaps in monitoring of facilities, in terms of indoor gaseous and chemical emissions, which restricts the extent of analysis that can be done. Hence, any further study should also look into providing a time-series analysis of indoor pollutant monitoring, as well as of liquid effluents discharged by tanneries. Based on these data-points, a much more detailed and insightful public health impact assessment can be produced, which can feed into capacity building and OSH requirements for the industry. The suggested intervention in this regard was a capacity building program over the medium-term, whereby improved practices are both implemented and their impact is studied to compare with the baseline. The PTA Secretary showed willingness to provide their offices and network for such a program to be implemented in collaboration with them.

7 Interventions for Sustainable Management

7.1 Interventions in Supply chain and Process Stages

7.1.1 Formalize Single-Stage Processors (SSPs) into SMEs

The role of SSPs, and the potential for misreporting on compliance under the outsourcing arrangements, have been highlighted in this report. This segment is largely informal, and does not exactly fit in the categories defined both by the industry associations and the government departments. They operate beyond the regulated market, and as a significant portion of these are seasonal in nature, the threat of shutting down operations is not a significant risk for their operators, who can simply switch to other trades or warehousing.

Neither the PTA nor EPAs have figures on SSPs, and all information is anecdotal based on industry insiders. The Sialkot Tannery Zone (STZ), which is currently in its initial implementation stage, is aiming to also include the SSPs based in the district formally into the value chain through partnerships and provision of facilities. However, these proposals are yet to be seen in action.

SSPs can be assumed to be very lax or completely unaware of environmental and OSH compliance. Therefore, a significant risk to public health as well as for daily-wagers employed in the industry. The PTA or STAGL alone do not provide a strong enough pull mechanism to enable formalizing SSPs. The first step in this cycle must be the inclusion of the Tannery sector related SSPs as Small-and-Medium Enterprises (SMEs) as long as they remain engaged in the same business. As SMEs, these units will become eligible for accessing various incentives including financing for expansion and growth. The informal nature of these units is tied to their negligible scale when assessed individually, although collectively they are many such units. By incentivizing growth in scale, the SSPs will require more structure and possibly at this stage may partner readily with tanneries. With access to formal credit, the dependency of SSPs on outsourcing arrangements with large product manufacturers can also be reduced. This restructuring and conglomeration will benefit in regulatory compliance, and with a shift to environmental management systems it will enable sustainable handling of effluents and solid-waste. Besides this, it will allow for implementation for OSH laws, worker safety protocols, and reduce public health impact.

7.1.2 Unsalted, Cold-Storage Preservation

The first stage in the procurement supply chain is the collection and storage of raw hides and skins. Traditionally, hides are informally gathered together and salted for preservation. This process involves high amounts of salt, as has been the conventional practice. When these hides are soaked to initialize the tanning process, the excess salt is washed off and flows into the wastewater, with consequences for soil and groundwater. Labour intensive salt handling may also cause skin irritation.

The salting requirements are greatly reduced by introducing temporary cold-storage instead of depending entirely on salting for preservation. By reducing salt use, the wastewater generated from soaking and washing results in far lower TDS levels. This is further appropriate as storage requirements usually precede the peak tanning season months, which do not necessitate long-term preservation. Beyond the three months of peak tanning season, routine supply of hides occurs on a weekly basis from slaughterhouses and does not require preservation. As a private Middlemen market or ‘mandi’ has already developed, incentivising a shift to cold-storage is possible and may formalize this procurement channel, perhaps enabling better enumeration of yearly stocks and industry planning. This intervention, however, is still costlier than salting, and may not be readily accepted by most tanneries without financial support.

7.1.3 Hair-save Unhairing

The first process in the tanning stage is the removal of hair from hides. The process involves the heavy use of Lime and Sulphide to dissolve away the hair, while the liquid sludge generated from this is directed into the wastewater as effluent. Conventionally, both the chemicals are added in large amounts to perform this process quickly. The lime makes the hair loose, while the sulphide dissolves keratin. This dissolution leads to the introduction of organic compounds into the effluent, increasing BOD.

“Hair-save Unhairing” introduces filtration into the process. Instead of relying on excess chemical washes and draining of dissolved hair, the filter captures the organic matter, while chemicals can be drained. The organic matter can be used as fertilizer. But the real benefit is lowering BOD of wastewater, while also marginally reducing chemical use by ending the need to “inundate” pelts with chemicals. This method has immediate benefits for worker safety, while also reducing water pollution. Two major incidents of industry related accidents highlighted earlier were caused due to Hydrogen Sulphide poisoning, caused due to excess use of chemicals at this stage.

7.1.4 Water Measurement and Metering

Most processes in tanneries are extremely water intensive. In the presence of easily available freshwater, especially in the North Zone, through tube wells, there is little incentive to manage water sustainably. Where each stage should ideally use the minimal water required, due to being virtually free-of-charge many tanneries follow a “visual measurement” approach rather than using accurate scales. This simply means that different tanneries use varying amounts of water, depending on the discretion of the drum or mixer foreman.

Furthermore, as observations of the KTWMA CEPTP suggest, the plant intake depends on the total cubic meters of effluent flowing in the inlet, while excess has to be bypassed; the effluent has to ‘stay’ inside aeration ponds, mixing vats and settling lagoons for a specified period of time before the next intake can be allowed.

By regulating the overall amount of water used by a tannery, based on metering, with limits decided in coordination with industry experts, and municipal and environment authorities, water usage can be reduced in each tannery. While inside the tannery, workers handling specific tasks involving water intake must be provided with and technically trained to operate tools such as flow meters.

Metering water use and measuring it at process level will enable sustainable water management, as well as lower the volumes of wastewater treatment plants have to process, increasing their overall efficiency. This can potentially reduce the volume of effluent which has to be bypassed and lower overall local pollution.

7.1.5 Solar Water and Air Heating

An encouraging shift towards use of solar energy has been witnessed in Pakistan in recent years. Among the export-oriented tanneries and manufacturers, solar energy has been deployed to make facilities more energy-friendly. However, the vast majority of this sector continues to use fossil fuels for heating of water and drying hides before coating or spraying.

Solar energy can suitably replace coal or oil based heating. The NZ and SZ clusters are both located in regions which have 250 plus sunny days. Thermal solar energy derived under this method can be used to heat water, which is needed especially during curing, dyeing and tanning processes.

Similarly, solar air heating systems can provide hot air (80-100 degrees Celsius) which can be used for the multiple drying processes and inside tunnel dryers. The systems collect ambient air in rooftop chambers and heat via sun exposure, and later force the hot air where required using blowers.

After initial capital costs, the thermal solar energy heating systems and solar air heating systems help reduce overall cost of operations. Furthermore, it completely ends gaseous and PM emissions linked to coal and oil, which deeply affect workers' respiratory health inside facilities. The soot generated from burning can also act as carriers for delivery of heavy metal dust into the respiratory system. These systems can similarly minimize air pollution and carbon footprint of tanneries.

7.2 Interventions at Institutional and Zonal level

Due to stark differences between the two zones of the leather sector, as elaborated earlier, some interventions must be specific to the zonal level. These relate to industry structure and hierarchy, and variations in regulatory and compliance requirements.

7.2.1 Development of Clusters and Advanced CETPs

In the North Zone, the informal nature of the market has emerged as a major problem for both Government authorities and Industry bodies, to implement and comply with regulations, respectively. EPA Officials view the creation of the Sialkot Tannery Zone as a good step, which they believe offers a suitable model for the intervention required in Kasur. The Kasur cluster could be similarly moved to a specified zone in the district, and an improved or new CETP can cater to the combined effluents of the tanneries, instead of the existing sharing arrangement under KTWMA for treatment of both municipal sewage and tanneries effluent. Furthermore, CETPs should ideally include Secondary Treatment and Chromium Recovery Units.

In the South Zone, the Korangi Industrial Area has grown at a very fast pace and houses multiple types of industries. The CETP, which now functions well-below its capacity, requires upgrades. The CETP further needs a designated Industrial Waste landfill, and incentives for utilization of solid-waste from tanneries and manufacturers.

7.2.2 Better Management Models for CETPs

The Govt-run model at KTWMA and the Private-sector led model at STZ and Korangi may not be the most appropriate management modes for efficient operations of the Effluent Treatment Plants. At KTWMA, the Managing Director is the Deputy Commissioner of Kasur district, a Civil Servant who is entrusted this responsibility as an additional charge. In Korangi, the CETP is managed by members of the PTA South Zone, who have Leather industry linked businesses of their own.

Any newly developed CETPs are likely to fall into disrepair and suffer similar performance disruptions as the existing ones, unless the mode of management introduces accountability and financial incentives linked to performance for the operators. These facilities should be managed by specialized waste-management firms, which should be allowed to competitively bid for Public-Private contracts, where payment recoveries can fund the contracts, maintenance and expansion plans.

7.2.3 Tannery Sector Census and Database

A commonly observed issue during the investigation for this report was the non-availability of accurate and up-to-date industry numbers. Different figures for the number of Tanneries exist among Government and Industry bodies. While numbers for Single-Stage Processors, Leather

Product Units and other actors in the Industry map did not exist. In order to illustrate the whole Leather sector, a census needs to be conducted, which takes into account all aspects of the Industry, and can feed into relevant policy-making. The census should further use GIS to geo-locate units, and involve ground-level monitoring to record key machinery numbers, such as number of boilers and drums. The Ministry of Industries and Production is rightly placed to conduct such a census, but should ideally do so in collaboration with Provincial authorities and the PTA Zonal offices. The resulting Database should also be available to industry bodies and all enforcement agencies.

7.3 Recommendations for SMEP

7.3.1 Prioritization Matrix

The above discussed interventions have been gathered after a detailed literature review, an in-depth investigation of the industry in Pakistan, and an instructive Stakeholder discussion. However, for the purposes of the SMEP program, and particularly to recommend future courses of action under SMEP Stage 2, a prioritization matrix has been employed.

The Prioritization Matrix breaks down the proposals into the type of action, mainly *Intervention* in the operations and structure of the industry, and *Investigation* to build evidence for filling knowledge gaps. The following factors are considered: (i) Public Health & Occupational Safety and Health benefits; (ii) OSH benefit only; and (iii) Financial costs of proposed intervention.[39]

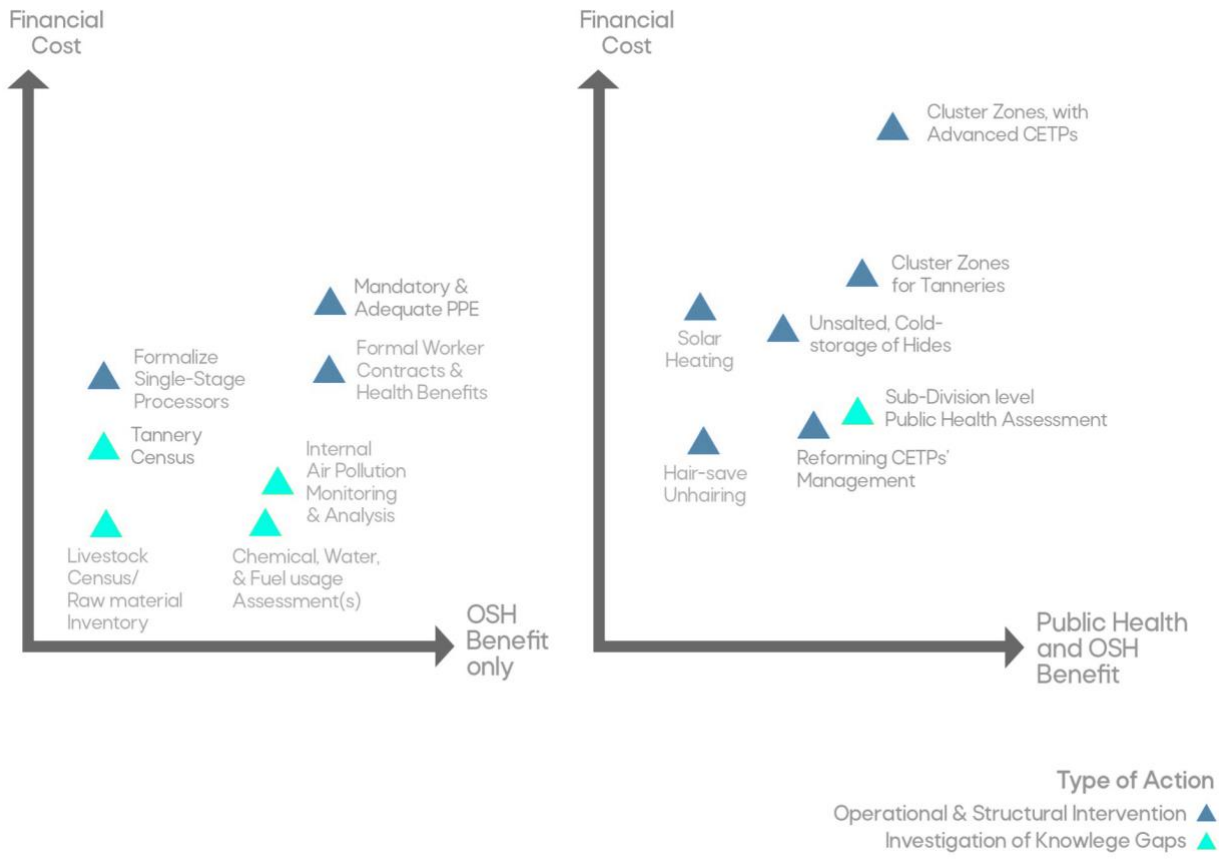


Figure 16: Prioritization Matrix

[39] Prioritization scoring sheet (Annex 6).

Two actions are being recommended for the SMEP program Stage 2 considering financial limitations, while also providing a proportionally higher priority to Public Health & OSH benefit from the proposals.

7.3.2 Final Recommendations

Operational & Structural Intervention:

Tannery Cluster Zones and Improved Combined Effluent Treatment Plant Management

The Tannery Cluster Zone model appears to be the most cost-effective approach, with the widest returns in terms of public health impact. With accelerated urbanization towards previously peri-urban and rural zones, the close proximity of city populations to tanneries has increased pollution exposure. Groundwater pollution and diseases linked to tannery effluents cannot be practically prevented, unless the source points are removed[40]. This is possible by designating new Cluster zones in districts with Leather sector presence. This model is currently being implemented in the Sialkot Tannery cluster. Therefore, it is suitable that such a Zone also be established in the south-western part of Lahore Division, which would allow relocation of Kasur cluster and tanneries from the Lahore-Sheikhupura industrial belt.

Provision of cheap land and basic infrastructure is dependent on the Provincial Government. The creation of such a zone may also incentivize small operators and SSPs to set up their units, by provision of free land and temporary tax amnesties.

These Tannery Cluster Zones will also require modern CETPs. The CETPs are large one-time investment, which may require raising capital, seeking donor grants, or cost-sharing arrangements between Tanneries, and the Provincial and/or Federal Government. The CETPs need not be highly advanced, however, to ensure long-term viability, the CETPs should ideally be leased to experienced, private waste-management operators, for 5-10 year periods under and Open-bidding process. The selected operator should be allowed to charge market-based rates for treatment, ensuring revenue for operations, maintenance and future improvements.

Investigation of Knowledge Gaps:

Tannery Sector Census (inclusive of internal Air Pollution assessment)

Sub-division level Public Health surveys

Knowledge and data gaps are evident in the Tannery industry and further evidence gathering is warranted. The current investigation encountered multiple knowledge-gaps, which prevented more in-depth Public Health and OSH impact assessment. These knowledge-gaps need to be addressed in order to establish a baseline in order to assess medium-term improvements of any interventions.

A Tannery Sector Census, including number of employees and GIS mapping of units in various districts, along with an assessment of air quality impacting Tannery workers will allow for assessing the OSH performance of the industry. It will also enable better monitoring from the regional EPAs.

[40] A low cost stop-gap measure successfully used by Pure Earth in Kanpur, India to reduce the toxicity of hexavalent chromium (Cr6) in groundwater involved addition of molasses into the effluent to convert Cr6 into trivalent chromium (Cr3). https://www.pureearth.org/project/kanpur-groundwater-pollution/.

Furthermore, conducting Public Health surveys in Sub-divisions of districts where clusters and/or effluent discharge channels exist is recommended, to establish an overall Public health baseline linked to the Tannery industry. Morbidities linked to the Tannery industry are, anecdotally, affecting local populations, but require evidence to substantiate.

8 References

Abbas, Moneeza, et al. “Detection of Heavy Metals Concentration Due to Leather Tanning Industry and Prevalent Disease Pattern in Kasur, Pakistan.” Environment and Urbanization ASIA, vol. 3, no. 2, Sept. 2012, pp. 375–384, doi:10.1177/0975425312473233.

Afzal, M., Shabir, G., Iqbal, S., Mustafa, T., Khan, Q.M. and Khalid, Z.M. (2014), Assessment of Heavy Metal Contamination in Soil and Groundwater at Leather Industrial Area of Kasur, Pakistan. Clean Soil Air Water, 42: 1133-1139. https://doi.org/10.1002/clen.201100715

Ambreen, Khushboo, et al. “Genotoxicity and Oxidative Stress in Chromium-Exposed Tannery Workers in North India.” Toxicology and Industrial Health, vol. 30, no. 5, June 2014, pp. 405–414, doi:10.1177/0748233712457447.

“Chromium (Cr) Toxicity: What Are the Physiologic Effects of Chromium Exposure?” Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 10 Dec. 2013, www.atsdr.cdc.gov/csem/chromium/physiologic_effects_of_chromium_exposure.html.

Kiezebrink, Vincent, and NOWCommunities. “Hell-Bent for Leather.” SOMO, 10 Feb. 2017, www.somo.nl/hell-bent-for-leather/.

Omm-e-Hany, Asia N, Aamir A, Humaira K. Determination of Chromium in the Tannery wastewater, Korangi, Karachi. Int J Environ Sci Nat Res. 2018; 15(4): 555920. DOI: 10.19080/IJESNR.2018.15.555920.

Rastogi, Subodh Kumar et al. “Occupational health risks among the workers employed in leather tanneries at Kanpur.” Indian journal of occupational and environmental medicine vol. 12,3 (2008): 132-5. doi:10.4103/0019-5278.44695

Skolnik, Meike. “Trends in Production and Trade: Leather Products from Pakistan.” Together for Decent Leather, Meike Skolnik Https://Togetherfordecentleather.org/Wp-Content/Uploads/2020/10/Decent-Leather_weblogo-1.Png, 3 May 2021, togetherfordecentleather.org/trends-in-production-and-trade-leather-products-from-pakistan/.

9 Annex

9.1 Annex 1: Theme Selection Scoring

ISIC Code	Industry	No. Factories	Workers/ Factory	Total Score	Health Range	% of GDP	GDP score	Ability to Work with Stakeholders during timeframe	Security Issues	Industry Willingness	Significant Other Ongoing Work (Partners)	Feasibilty Score	FINAL RANKING
151	Tanneries	1,313	200	633.95	very high	5%	very high	1	0	1	1	3	1
2393	Brick Kilns	25,000	180	577.38	very high	1.50%	high	1	0	1	0	2	3
131	Textiles	12,606	500	515.2	very high	8.50%	very high	1	0	1	0	2	2
2432	Used lead acid battery recycling	1,000	40	194.49	high	n/a	low	0	-1	0	1	0	4

9.2 Annex 2: List of Stakeholders Interviewed

S. n.	Name/Title	Designation
1	Fahim Ahmed	Secretary, PTA North Zone
2	Dr. Sadaqat Ali Chattha	PhD Scholar, UVAS
3	Chaudhry Zulfiqar Hayat	Leather Manufacturer and Member STAGL
4	Noman Yusuf	Asst. Director, Kasur, Punjab EPA
5	Nisar Ahmad	Director Lab, KTWMA
6	Field Inspectors	Kasur District, Punjab EPA
7	Waqar Hussain Phulpoto	Additional Director General, Sindh EPA
8	Dr. Ashique Ali Langah	Director Regional Office, Karachi, Sindh EPA
9	Field Inspectors	Korangi District, Sindh EPA
10	Sunil Dahiya	Analyst, Center for Research on Energy & Clear Air

9.3 Annex 3: List of Stakeholders contacted for Interviews but unavailable/unresponsive

S. n.	Name/Title	Designation
1	Rayan Muhammad	PTA South Zone
2	Muhammad Sultan	Secretary, Environment Society, PTA South Zone
3	Gulzar Firoz	President, Environment Society, PTA South Zone
4	Ivan Kral	Industrial Development Officer, UNIDO

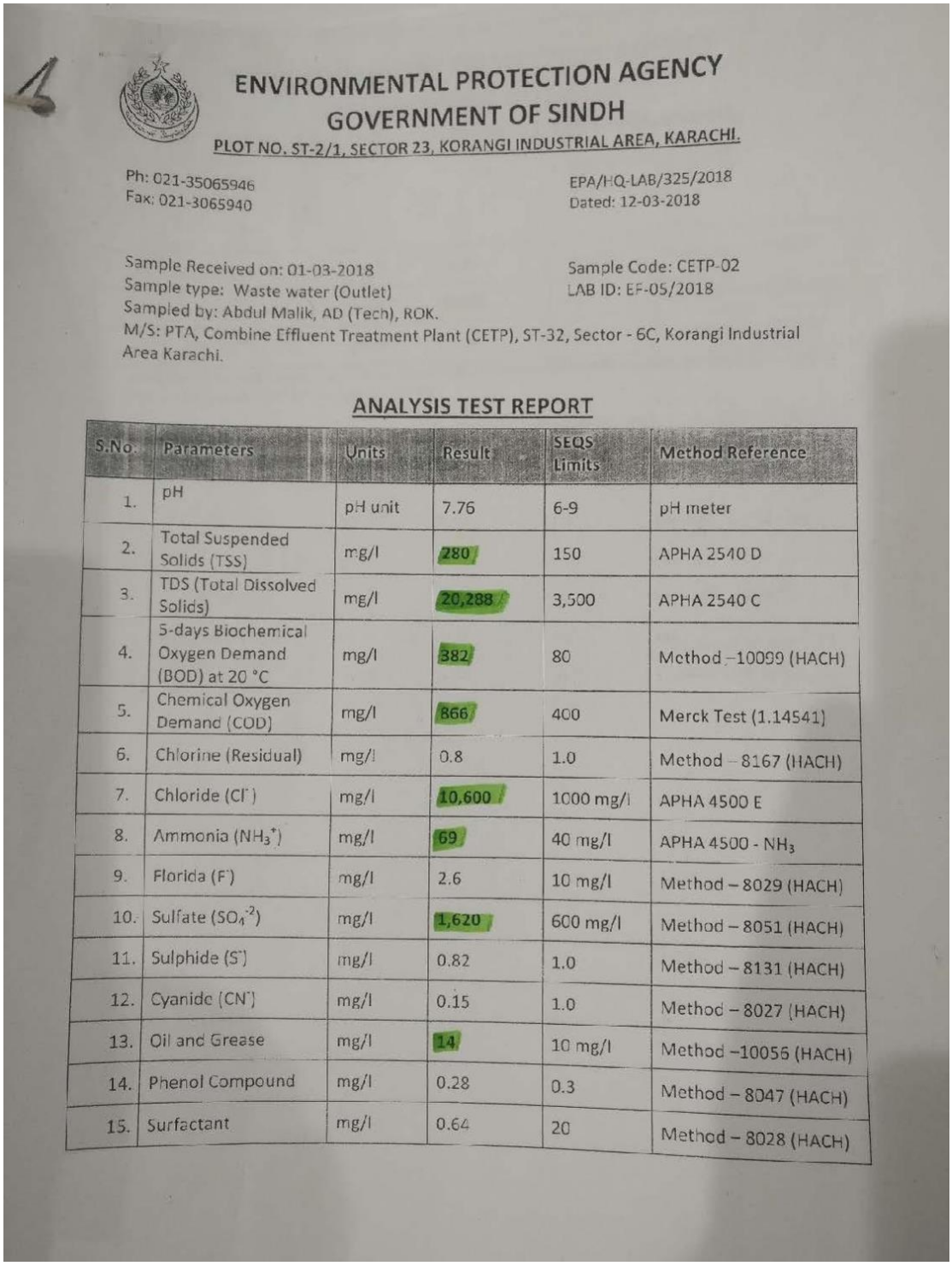
9.4 Annex 4: List of Stakeholders invited to the Consultation (Deliverable 3)

Attended	Name	Affiliation
Yes	Fahim Ahmed	PTA-NZ
Yes	Ahmad Rafay Alam	SW-AQA
Yes	Dawar Butt	SW-AQA
Yes	John Keith	Global Alliance on Health and Pollution

Yes	Azheruddin Khan	CPI
Yes	Shazia Z Rafi	SW-AQA
Yes	Imran Khalid	WWF-Pakistan
Yes	Dorota Piotrowska-Pelka	SW-AQA
Yes	Agha Saiddain	PTA-NZ
Yes	Noman Younis	EPD, Punjab
Yes	Nadeem Ul Haque	PIDE
Yes	Henrique Pacini	UNCTAD
Yes	Faith Gara	SSN
Yes	Amanda Dinan	SSN
Yes	Ali M Rezaie	ICCCAD
Yes	Sophia Huda	GAHP
Yes	Waqar Din	EPD, Punjab
Yes	Sadaqat Chattha	Uvas
Yes	Lorraine Dimairho	SSN
Yes	Nabeel Anwar	PIDE
No	Hina Lotia	Independent
No	Idrees Khawaja	PIDE

9.5 Annex 5: List of monitoring reports cited in the report

(i) Chemical Analysis of wastewater from Korangi CETP



ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF SINDH
PLOT NO. ST-2/1, SECTOR 23, KORANGI INDUSTRIAL AREA, KARACHI.

Ph: 021-35065946
Fax: 021-3065940

EPA/HQ-LAB/325/2018
Dated: 12-03-2018

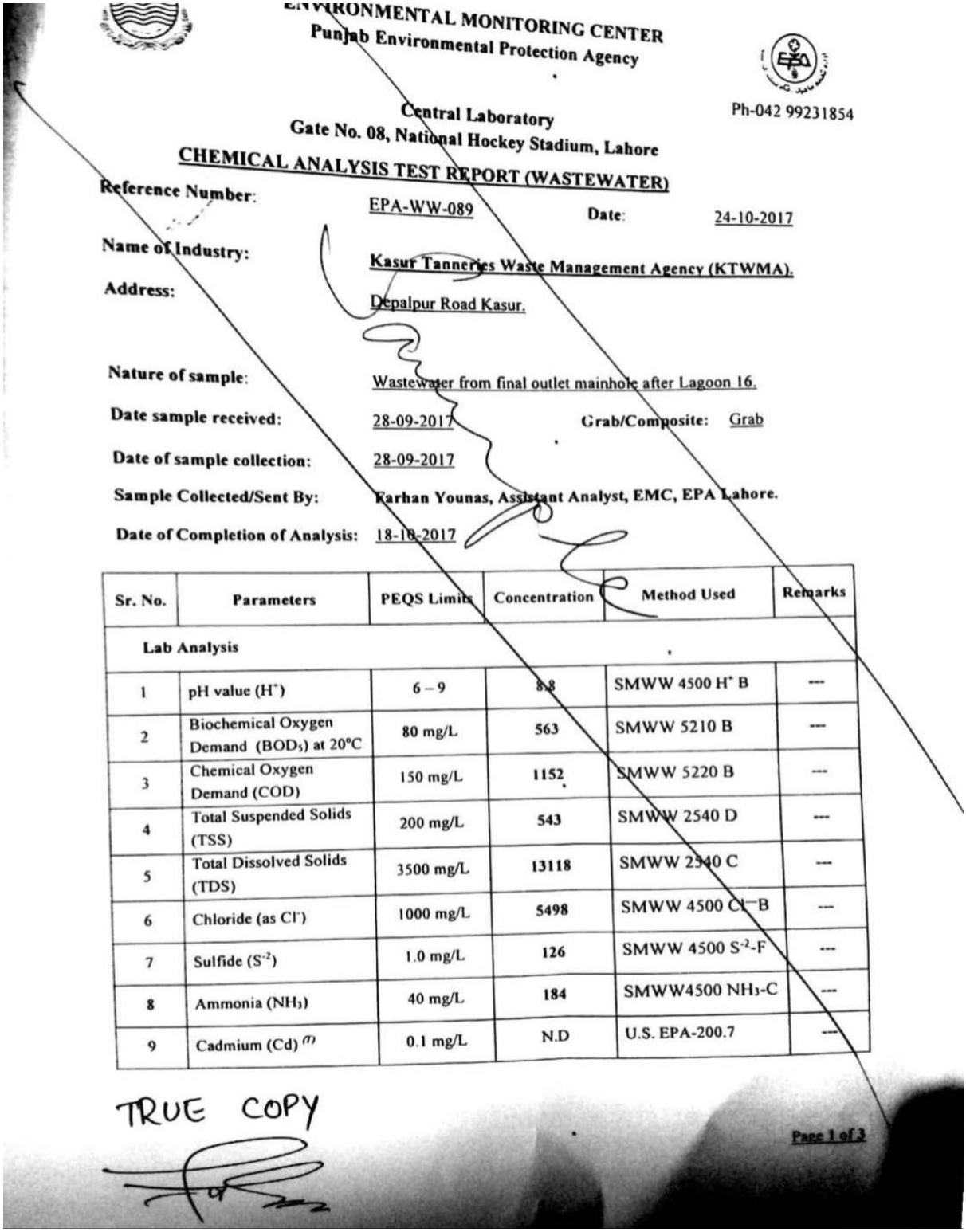
Sample Received on: 01-03-2018
Sample type: Waste water (Outlet)
Sampled by: Abdul Malik, AD (Tech), ROK.
M/S: PTA, Combine Effluent Treatment Plant (CETP), ST-32, Sector - 6C, Korangi Industrial Area Karachi.

Sample Code: CETP-02
LAB ID: EF-05/2018

ANALYSIS TEST REPORT

S.No.	Parameters	Units	Result	SEQS Limits	Method Reference
1.	pH	pH unit	7.76	6-9	pH meter
2.	Total Suspended Solids (TSS)	mg/l	280	150	APHA 2540 D
3.	TDS (Total Dissolved Solids)	mg/l	20,288	3,500	APHA 2540 C
4.	5-days Biochemical Oxygen Demand (BOD) at 20 °C	mg/l	382	80	Method –10099 (HACH)
5.	Chemical Oxygen Demand (COD)	mg/l	866	400	Merck Test (1.14541)
6.	Chlorine (Residual)	mg/l	0.8	1.0	Method – 8167 (HACH)
7.	Chloride (Cl^-)	mg/l	10,600	1000 mg/l	APHA 4500 E
8.	Ammonia (NH_3^+)	mg/l	69	40 mg/l	APHA 4500 - NH_3
9.	Florida (F^-)	mg/l	2.6	10 mg/l	Method – 8029 (HACH)
10.	Sulfate (SO_4^{-2})	mg/l	1,620	600 mg/l	Method – 8051 (HACH)
11.	Sulphide (S^-)	mg/l	0.82	1.0	Method – 8131 (HACH)
12.	Cyanide (CN^-)	mg/l	0.15	1.0	Method – 8027 (HACH)
13.	Oil and Grease	mg/l	14	10 mg/l	Method –10056 (HACH)
14.	Phenol Compound	mg/l	0.28	0.3	Method – 8047 (HACH)
15.	Surfactant	mg/l	0.64	20	Method – 8028 (HACH)

(ii) Chemical Analysis of wastewater from Kasur CEPTP



ENVIRONMENTAL MONITORING CENTER
Punjab Environmental Protection Agency

Central Laboratory
Gate No. 08, National Hockey Stadium, Lahore
Ph-042 99231854

CHEMICAL ANALYSIS TEST REPORT (WASTEWATER)

Reference Number: EPA-WW-089 **Date:** 24-10-2017

Name of Industry: Kasur Tanneries Waste Management Agency (KTWMA).

Address: Depalpur Road Kasur.

Nature of sample: Wastewater from final outlet mainhole after Lagoon 16.

Date sample received: 28-09-2017 **Grab/Composite:** Grab

Date of sample collection: 28-09-2017

Sample Collected/Sent By: Farhan Younas, Assistant Analyst, EMC, EPA Lahore.

Date of Completion of Analysis: 18-10-2017

Sr. No.	Parameters	PEQS Limits	Concentration	Method Used	Remarks
Lab Analysis					
1	pH value (H^+)	6 – 9	8.8	SMWW 4500 H^+ B	---
2	Biochemical Oxygen Demand (BOD_5) at 20°C	80 mg/L	563	SMWW 5210 B	---
3	Chemical Oxygen Demand (COD)	150 mg/L	1152	SMWW 5220 B	---
4	Total Suspended Solids (TSS)	200 mg/L	543	SMWW 2540 D	---
5	Total Dissolved Solids (TDS)	3500 mg/L	13118	SMWW 2540 C	---
6	Chloride (as Cl^-)	1000 mg/L	5498	SMWW 4500 Cl^-B	---
7	Sulfide (S^{-2})	1.0 mg/L	126	SMWW 4500 S^{-2}-F	---
8	Ammonia (NH_3)	40 mg/L	184	SMWW4500 NH_3-C	---
9	Cadmium (Cd) (T)	0.1 mg/L	N.D	U.S. EPA-200.7	---

TRUE COPY

Page 1 of 3

10	Chromium (T) (trivalent and hexavalent)	1.0 mg/L	1.199	U.S. EPA-200.7	---

(iii) Chemical Analysis of wastewater from Permair Leather Pvt Ltd

ENVIRONMENTAL MONITORING CENTER
Punjab Environmental Protection Agency

Ph-042 99231854

Central Laboratory
Gate No. 08, National Hockey Stadium, Lahore

CHEMICAL ANALYSIS TEST REPORT (WASTEWATER)

Reference Number: EPA-WW-031 **Date:** 29-06-2017

Name of Industry: **Permair Leather Pakistan Private limited**

Address: 22KM Off Ferozpur Road Lahore

Telephone No. 042 35271851

Nature of sample: Waste Water from main effluent outside the Factory draining into Hudira drain

Date sample received: 14-06-2017 **Grab/Composite:** Grab

Date of sample collection: 14-06-2017

Sample Collected/Sent By: **Javed Iqbal, Inspector Environment Lahore**

Date of Completion of Analysis: 22-06-2017

Sr. No.	Parameters	PEQS Limits	Concentration	Method Used	Remarks
A. Field Analysis					
1	Temperature or Temperature Increase	≤3 °C	35**	Thermometer	---
B. Lab Analysis					
2	pH value (H^+)	6 – 9	9.1	SMWW 4500 H^+ B	---
3	Biochemical Oxygen Demand (BOD_5) at 20°C	80 mg/L	348	SMWW 5210 B	---
4	Chemical Oxygen Demand (COD)	150 mg/L	811	SMWW 5220 B	---
5	Total Suspended Solids (TSS)	200 mg/L	394	SMWW 2540 D	---
6	Total Dissolved Solids (TDS)	3500 mg/L	2108	SMWW 2540 C	---
7	Chloride (as Cl^-)	1000 mg/L	542	SMWW 4500 Cl^-B	---
8	Cadmium (Cd) (*)	0.1 mg/L	< 0.001	U.S. EPA-200.7	---

9.6 Annex 6: Prioritization scoring sheet

	Type	Description	A. Public Health & OSH Benefit (graded)	B. OSH Benefit Only (graded)	C. Financial Costs	Score	Recommended
1	Intervention	Cluster Zones for Tanneries	High	Medium	Medium	8	Y
		Cluster Zones for Tanneries, with Advanced CETPs	High	Medium	High	5	
		Reforming CETPs' management	Medium	Medium	Low	9	Y
		Formalize SSPs	Medium	Medium	Medium	6	
		Mandatory & Adequate PPE	Low	High	Medium	6	
		Formal contracts and benefits	Low	High	Medium	6	
		Hair-save Unhairing	Medium	Medium	Medium	6	
		Solar Heating	Medium	Low	High	3	
		Unsalted, cold-storage	Medium	Low	High	3	
2	Investigation	Internal Air Pollution Monitoring & Analysis	Medium	High	Medium	8	Y
		Tannery Census and Database	High	Medium	Medium	8	Y
		Sub-division level Public Health Survey	High	Medium	Medium	8	Y
		Livestock census / raw-material stocktake	Low	Low	High	-1	
		Chemical, water, fuel use assessment	Medium	High	High	5	

Notes: 1) Factors A + B receive a grading (high=5, medium=3, low=1), where impact has been assumed on the basis of literature, investigation, and stakeholder input.

2) Factor C is expected cost, based on estimates derived from project documents and literature, which is graded (low = 3, medium = 0, high = -3)

9.7 Annex 7: Workshop Agenda

See attached PDF via this link.

9.8 Annex 8: Workshop Presentations and Summary

See attached PDF via this link.