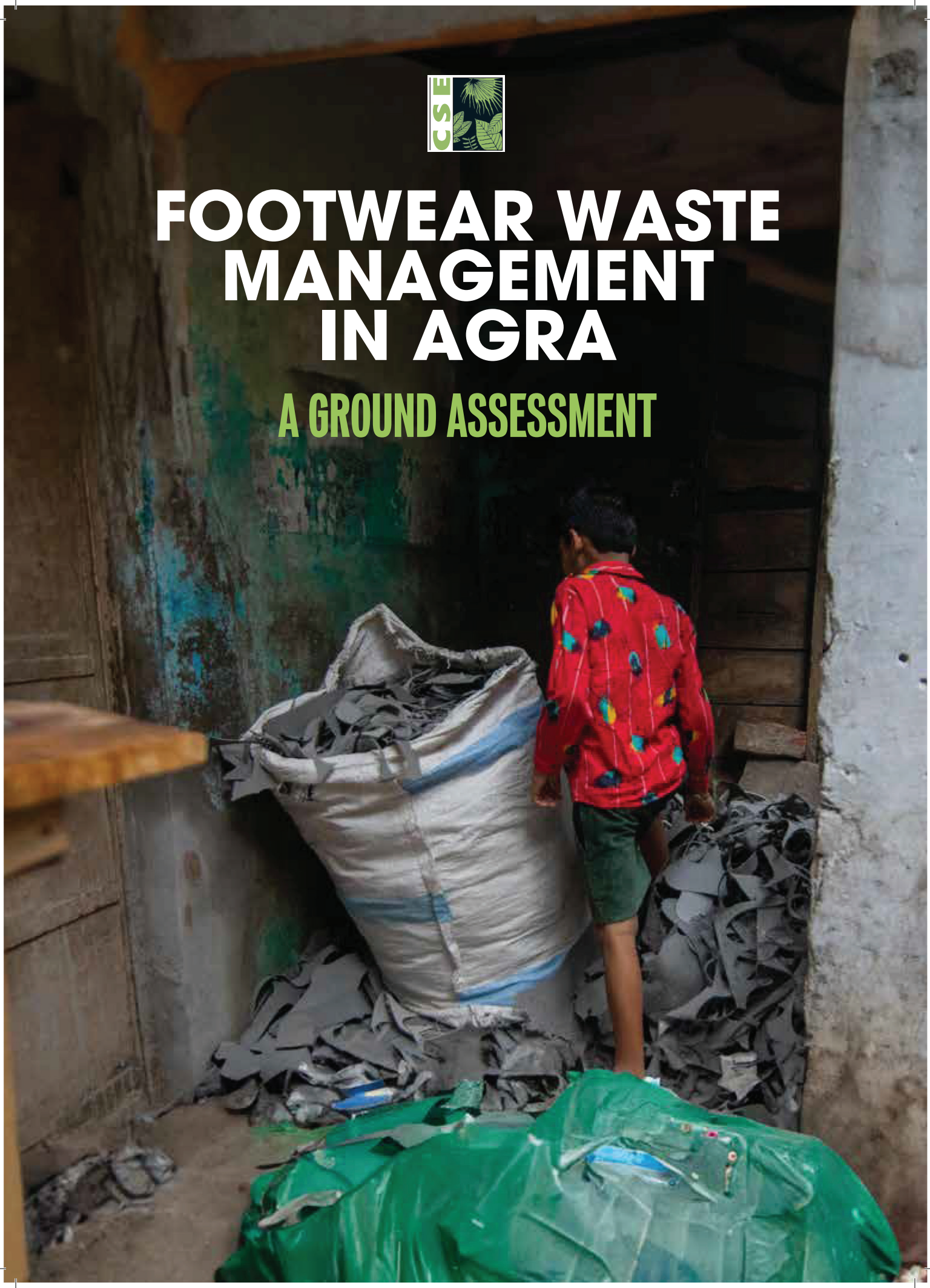

FOOTWEAR WASTE MANAGEMENT IN AGRA

A GROUND ASSESSMENT

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New Delhi

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Maps in this report are indicative and not to scale.

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LIST OF ABBREVIATIONS

AFMEC	Agra Footwear Manufacturers Export Chambers
AFR	Alternative fuel resource
ASMA	Agra Shoe Manufacturers Association
ANN	Agra Nagar Nigam
CFTI	Central Footwear Training Institute
CLE	Council of Leather Exports
CV	Calorific value
DIC	District Industries Centre
EVA	Ethylene vinyl acetate
GDP	Gross domestic product
HBB	Home-based business
JDF	Juta Dastkar Federation
KPMG	Klynveld Peat Marwick Goerdeler
MSME	Ministry of Micro, Small & Medium Enterprises
MSW	Municipal Solid Waste
NSIC	National Small Industries Corporation
PICUP	Pradeshiya Industrial and Investment Corporation of UP Limited
PPP	Public–private partnership
PU	Polyurethane
PVC	Polyvinyl chloride
RDF	Refuse-derived fuel
SC	Supreme Court
SIDBI	Small Industries Development Bank of India
SHG	Self-help groups
TPD	Tonne per day
TPU	Thermoplastic polyurethane
UPFC	Uttar Pradesh Finance Corporation
UPSDM	Uttar Pradesh Skill Development Mission
UPSIDC	Uttar Pradesh State Industrial Development Authority
WtE	Waste-to-Energy
ZSOs	Zonal Sanitary Officers

1. Introduction

About the city

Agra, a city steeped in history, is nestled along the banks of the Yamuna River in the state of Uttar Pradesh. Located approximately 230 km southeast of the national capital New Delhi and 330 km west of the state capital Lucknow, Agra is renowned for its rich heritage. It is home to many iconic monuments, with the Taj Mahal standing out as one of the New Seven Wonders of the World, making Agra a globally recognized destination.

Agra city, spread over 120 sq. km area, has a population of about 1.58 million people residing within the municipal limits.[1] However, as per Agra Nagar Nigam (ANN) official records, the city has a current population of approximately 1.9 million and an additional floating population of 0.3 million. Notably, Agra is a significant destination for international tourists. Agra Smart City Limited (set up to implement development work at the city level) estimates that about 17 per cent of India's total international tourists—nearly 1.15 million people—visit the city annually.

Agra is divided into four administrative zones: Hariparvat, Chhatta, Lohamandi and Tajganj (see *Map 1: Map of Agra under Agra Municipal Corporation*). Each zone comprises 25 wards, with a total of 100 wards in the city. According to a 2020 study by the Centre for Science and Environment (CSE), Agra generates approximately 796.3 tonnes per day (TPD) of municipal solid waste (MSW), with a per capita waste generation in the range of 0.37–0.45 kg.[2] However, recent records from the local government body Agra Nagar Nigam (ANN), as part of the city's solid waste action plan submitted to the state, indicate that the current municipal solid waste generation in Agra has risen to 978 TPD, with a per capita waste generation of 0.48 kg.

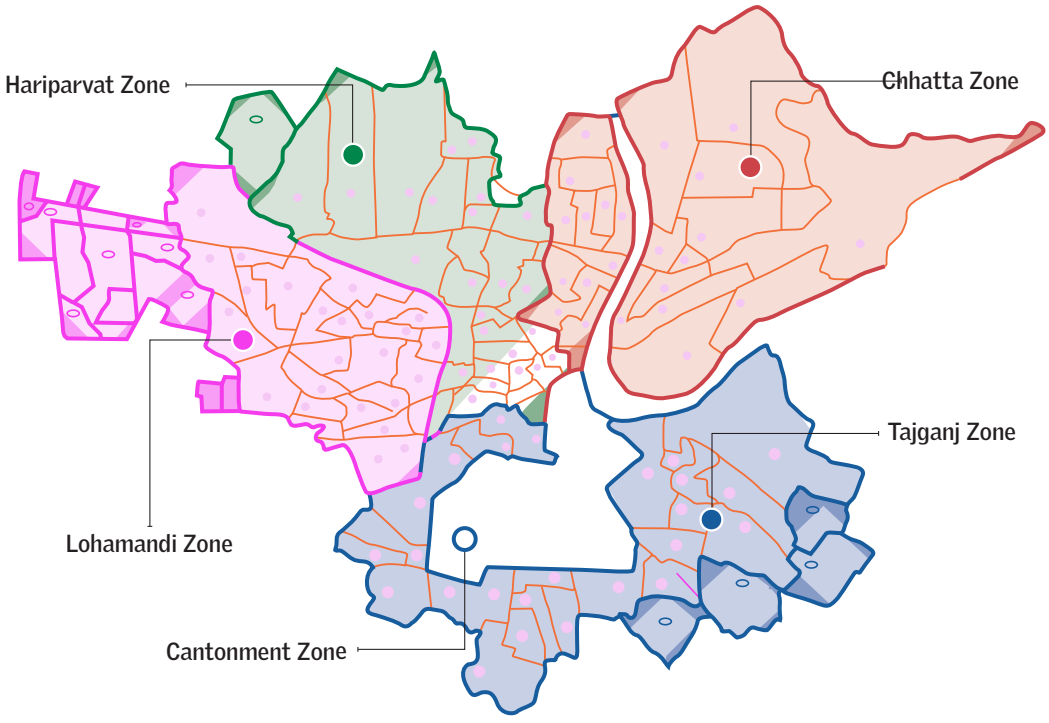
Agra boasts of a longstanding reputation as a major centre for both formal and informal footwear manufacturing, a legacy dating back to the Mughal Era. As a significant hub for footwear production and related industries in the country, the city has played a pivotal role in shaping the sector's growth.

Alongside its economic contributions, however, Agra faces pressing environmental challenges stemming from waste generated by footwear manufacturing, which

contributes to the city's pollution concerns. These challenges manifest in various ways, such as clogged drains due to improper waste disposal; burning of waste for warmth in winters or energy recovery, which impacts the city's air quality; and unauthorized dumping in open areas, leading to increased greenhouse gas emissions. These issues underscore the urgent need for proper solid waste management and plastic waste management practices. Further, improper disposal of waste has resulted in river pollution, exacerbating marine pollution and disrupting the marine ecosystem, thereby posing additional environmental challenges.

Disclaimer: Within this document, the term 'footwear waste' refers to the waste generated during the manufacturing of footwear using materials such as leather, synthetic leather, textile etc. and not post-consumer waste. Our focus is on manufacturing shoes in Agra as almost all the units are engaged in the shoe manufacturing business, and our work scope is limited to the boundaries of Agra Nagar Nigam.

Map 1: Map of Agra under Agra Municipal Corporation



Source: Agra Nagar Nigam

History of the footwear industry

After the establishment of Mughal rule in India in 1526, Agra was one of the important centres of trade and commerce, as were Delhi, Srinagar and Lahore. Given the Mughal fondness for food and a long heritage of cuisines, it was no surprise that the Mughals sourced ingredients from far-off places. Hing (asafoetida), for instance, was imported from Afghanistan and Iran and packed in leather containers called mushak. These mushak were discarded once their purpose was served. The artisans of Agra soon realized that these leather bags could be reused for making footwear. Thus began the footwear industry in Agra. Even today, one of the leading markets for footwear in the city goes by the name Hing ki Mandi, with over 5,000 establishments dealing in footwear.[3]

The market reflects the dynamic evolution of footwear as lifestyles shift to meet consumer needs. Agra caters to a diverse range of footwear, addressing the preferences of people across various income groups. This encompasses durable synthetic footwear and high-quality premium leather options. Representatives of different associations have highlighted that Agra's strength in swiftly adapting to changing buyer demands regarding seasonality and fashion.

With 25 markets selling finished footwear in Agra, of which 15 are located in Hing ki Mandi, the city serves as a hub for footwear manufacturing, supported by an extensive raw material base. Gagan Das Ramani, President of the Market Association of Hing ki Mandi, underscores the robust network of input suppliers in the area.

Agra's growth is significantly attributed to the dynamics of its cluster, featuring interfirm linkages, technological advancements, and specialization to enhance competitiveness among key industry players. This cluster has gained recognition for these characteristics, attracting renowned foreign brands such as Clarks, Salamander, Reebok, Walmart, C&A, Marshall, Benetton, Marc, and Max52, all sourcing footwear from Agra.[4]

2. Objective of the study

Agra Nagar Nigam (ANN) has grappled with the ongoing challenge of managing footwear waste, especially evident in the accumulation of waste around manufacturing units, especially in the vicinity of the Mantola and Tajganj East sewage and storm-water drains, where manufacturers dump their waste in open drains when no one watching. ANN therefore wanted to understand the problem on the ground.

This study is thus designed to comprehensively examine the challenges and opportunities associated with footwear waste, encompassing both its generation during manufacturing and subsequent disposal. It seeks to explore the current practices employed by footwear manufacturing units in handling their waste, as well as evaluating the efficacy of ANN's existing mechanisms for the collection, transportation and treatment of footwear waste.

The specific objectives of the study are as follows:

1. Identify the number of footwear manufacturing units located within the boundaries of ANN, with particular focus on micro-level manufacturing units or home-based businesses (HBBs) units.
2. Analyse the approximate quantity of raw materials used, the number of pairs manufactured, and the volume of waste generated by these units.
3. Identify key challenges associated with the management of footwear waste.
4. Provide suitable recommendations for effective footwear waste management, catering to the needs of ANN and other pertinent stakeholders in the sector.

Footwear waste piled up after cleaning of Mantola drain near Red Fort, Agra

Source: CSE 2024

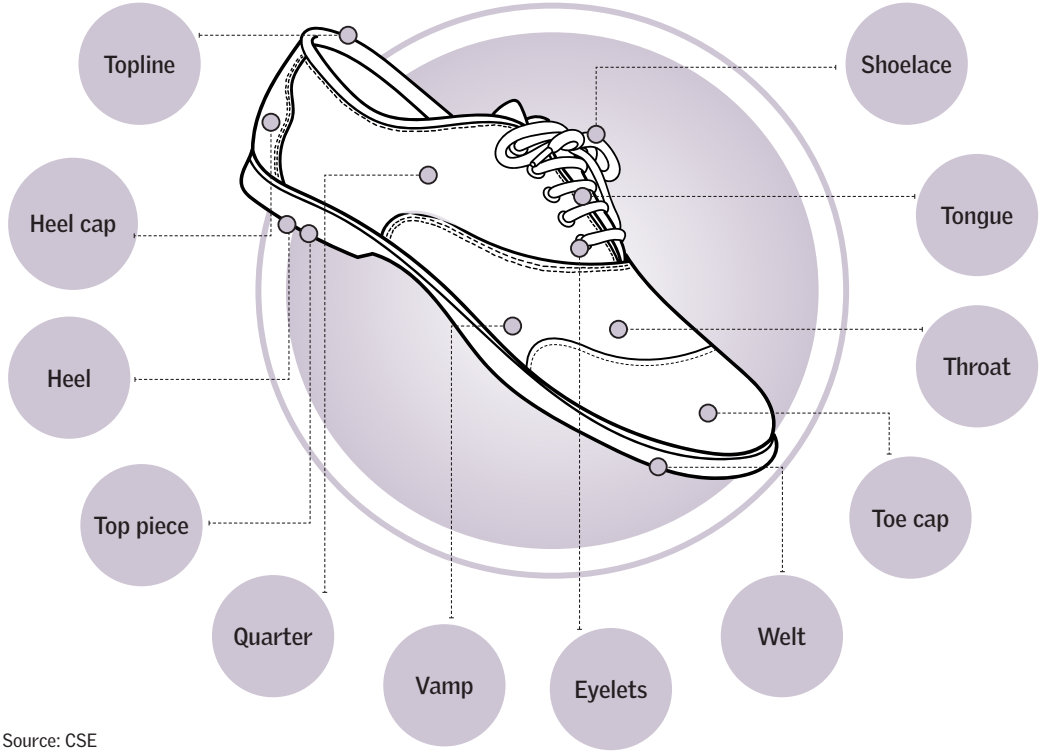
3. Footwear components and process of manufacturing

This section aims to provide an understanding of the diverse components essential for footwear manufacturing and the intricate processes involved in manufacturing of footwear. It examines the various elements integral to footwear, including but not limited to the upper, insole, midsole, outsole, heel, lining, eyelets, laces, tongue, pull tab and toe cap, along with adhesive applications and stitching techniques. Further, the discussion extends to cover an array of manufacturing techniques, materials and technologies employed in the production of footwear.

Footwear components

The composition of footwear components exhibits variation across different types of footwear. Nevertheless, most footwear designs include the following elements (see *Figure 1: General components of a shoe*).

Figure 1: General components of a shoe



Source: CSE

- **Upper:** The upper envelops the foot and is crafted from materials such as leather, synthetic blends or a combination of both, offering both style and functionality.
- **Insole**: The insole serves as the foundation for the foot, and is constructed from diverse materials such as foam, leather or synthetic materials to ensure a comfortable and supportive base.
- **Midsole:** Nestled between the insole and outsole, the midsole provides essential cushioning and support. Typically fashioned from materials such as ethylene vinyl acetate (EVA) foam or polyurethane, it enhances the overall comfort of the footwear.
- **Outsole:** Positioned at the base and directly in contact with the ground, the outsole delivers traction and safeguards the foot from sharp objects. Materials such as rubber, leather, or synthetic blends are commonly used in crafting durable outsoles.
- **Heel:** Elevated beneath the heel of the foot, the heel component can be an extension of the outsole or a distinct element, offering additional support and design versatility.
- **Lining:** This inner layer, in direct contact with the foot, is crafted from materials such as leather or synthetic blends. It is engineered to provide both comfort and effective moisture management.
- **Eyelets:** Small holes strategically placed in the upper through which laces pass, ensuring secure and adjustable fastening.
- **Laces:** Cords employed to fasten and secure the footwear around the foot, contributing to both functionality and aesthetics.
- **Tongue:** Positioned beneath the laces, the tongue shields the top of the foot from potential irritation, enhancing overall comfort during wear.
- **Pull tab:** A small loop of material located at the back of the footwear, facilitating ease of wearing by assisting in pulling the footwear onto the foot.
- **Toe cap:** The reinforced section of the toe box that ensures the safety of the toes offers protection from impact,.

Process of footwear manufacturing

The process of footwear manufacturing can vary depending on the type of footwear manufactured, materials used and manufacturing process. The general steps involved in the process, however, are as follows:

Step 1—Design and pattern-making: The first step in the footwear manufacturing process is designing the footwear and creating a pattern for it. This involves creating a technical drawing or computer-aided design (CAD) of the footwear, and then creating a physical pattern for the various components of the footwear.

LEATHER OR SYNTHETIC SHEET

A leather or synthetic sheet is the main part of the footwear. Leather sheets can be from a variety of skinhides but the most common are sabar, nubuck, milt and softy. Synthetic sheets can be either made from cloth or plastic or a composite of the two. Other materials required for upper part are jaali cloth, aster lining, aster rubber, aster cloth, cushion cloth etc.

A footwear of sample size 7 is prepared as per the details received from the client, and post verification of the design a lot of certain quantity is prepared.

Equipments required: Micro-level units depend mainly on the internet and fashion magazines when creating new designs, while semi-mechanized units, due to quality compliance requirements, rely on designs from buyers or enlist the help of professional designers.

Step 2—Clicking or cutting: Once the pattern is made and approved by the vendor, the various components of the footwear are cut from the chosen materials. Home-based businesses (HBBs) normally use a hand-clicking machine while small- or medium-scale industries use machine or press clicking.

WHAT IS AN UPPER?

The upper is the part of the footwear that covers the foot, from the toe box to the heel. It is typically made of one or more pieces of material such as leather, synthetic fabric or a combination of both. It is meant to protect the foot, provide a comfortable fit, and determine the style of the footwear. It may also include additional components such as the tongue, lacing system and various reinforcements to provide additional support and protection. The upper can be designed in various shapes and styles to accommodate different foot shapes and sizes as well as different fashion trends.

Materials required: leather or synthetic leather material sheet

Step 3—Skiving: Skiving is an operation to reduce the thickness of edges in upper components to facilitate treatments of edges. It improves the appearance of concerned upper and reduces the bulkiness of leather components. It is done on both sides of upper, i.e. on the grain side as well as on the flesh side. HBBs use a skiving machine while small and medium industries use an upper edge skiving machine.

Step 4—Closing: Pieces of upper are marked and joined, sewed, prepared, printed, stitched and inspected.

Stitching the upper part of shoes

Cutting a synthetic upper

Source: CSE, 2024

HBBs use a stitching and eyeleting machine while small and medium units use a flat post bed machine and eyeleting machine.

Lasting of footwear

Pasting the sole with the upper of a shoe

Source: CSE, 2024

Materials required: stitching thread, nectous milk, adhesive solution, uplate ripit, steaker and screenprint

Step 4—Lasting: The footwear is moulded into its final shape using a device called a last. The upper is stretched and attached to the last, and then the sole is attached to the bottom of the last. The completed upper is covered over the last to give the exact shape. In HBBs units, lasting is done manually by hand while in small and medium units it is done by a toe lasting machine.

Materials required: sole, polyvinyl chloride (PVC) foam, adhesive-PVC solution

Step 5—Pasting or pressing: The desired quality of the sole is then attached at the bottom to complete the footwear (see *Figure 2*).

WHAT IS A LAST?

A last is a three-dimensional model or mould in the shape of a foot used to manufacture footwear. It serves as the foundation for building the footwear around, and it determines the size, shape and fit of the footwear.

Traditionally, lasts were made from wood, but modern lasts can also be made from materials such as plastic and metal. The shape of the last is based on the measurements of the human foot, and it is available in a range of sizes and shapes to accommodate different foot sizes and shapes.

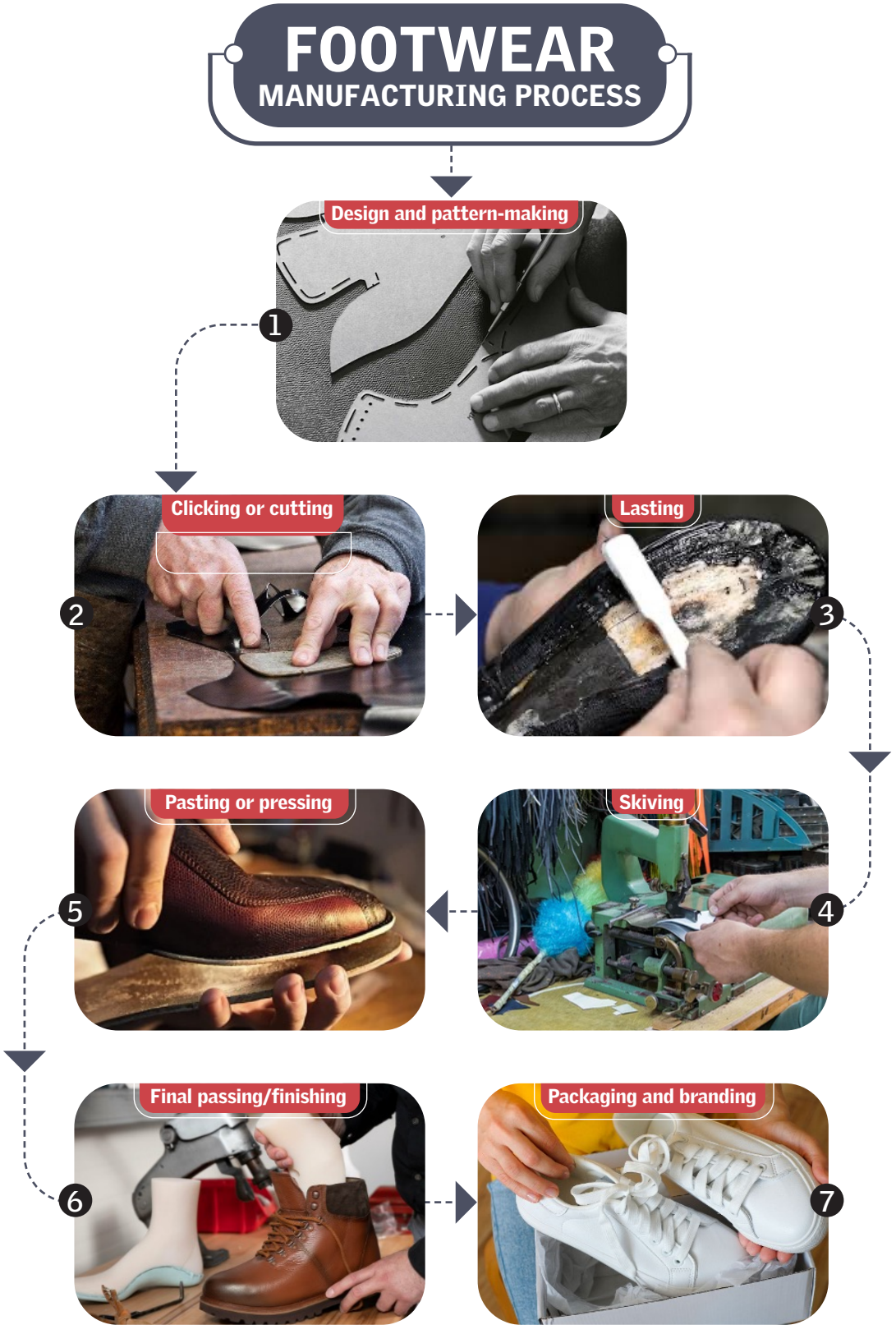
Photograph of a last

Source: CSE 2024

To create a footwear, the upper material is stretched and fitted over the last and attached to the sole. The last is used to shape the footwear and ensure that it fits properly and comfortably on the foot. Once the footwear is assembled and the upper material has been fastened to the sole, it is removed from the last and can be finished with various decorative elements.

The use of a last in footwear-making is essential to the process as it ensures that each footwear is consistent in size, shape and fit. Without a last, it would be difficult to create shoes that are comfortable and supportive, and properly fit the foot.

Figure 2: Footwear manufacturing process



In HBBs, pasting or pressing is done by a roughening machine and a sole press machine, while in small and medium scale units it is done by a roughening machine, heat setter, stuck on press, air-compressor, stamping and embossing machine, upper setting machine and sole press machine.

Materials required: insole, tingle (keel) and solution

Final passing or finishing of a pair of shoes

Packaging of shoes

Source: CSE, 2024

Step 6: Final passing/finishing: Once the footwear is removed from the last, any excess material is trimmed, and making the footwear is completed with any necessary embellishments such as stitching, eyelets or decorative elements. It is checked finally from every angle, and after it is passed it goes for finishing where it is cleaned and all the stains on leather are removed. In HBBs it is done manually with a spray gun, and in small- and medium-scale units it is done using a finishing machine and spray gun.

Materials required: lace, powder washing and polish

Step 7—Packaging and branding: The footwear is then finally packed as per brand requirements such as brand packaging, tags, labels etc. Finally, the footwear is packaged and shipped to retailers or customers. This is done manually in HBB units as well as in small- and medium-scale units.

Materials required: polythene or carry bag, cardboard box, tag

SOURCES OF RAW MATERIALS

The primary raw materials used in footwear manufacturing in Agra includes finished leather—which is sourced primarily from Kanpur in Uttar Pradesh, Kolkata in West Bengal, and Chennai in Tamil Nadu—and synthetic materials that mainly come from Delhi and Jalandhar in Punjab, and also imported from China.

Footwear manufacturing units, both formal and informal, typically purchase large quantities of raw materials, with synthetic products being sourced primarily from two major markets: Hing ki Mandi and Chakkipaat market. The Hing ki Mandi market is a hub for footwear components, soles and other materials used in footwear manufacturing. Additionally, there is a bi-weekly (Monday and Friday) market in Chakkipaat for leather and synthetic products.

Chakkipaat bi-weekly market

Source: CSE, 2024

4. Working of footwear manufacturers

A representative of AFMEC and a government spokeperson from District Industries Centre (DIC) stated that the footwear manufacturing industry contributes to about Rs 26,000 crore to the economy of Agra city. The industry is supported by associations such as Agra Footwear Manufacturers and Exporters Chamber (AFMEC), Juta Dastkar Federation (JDF), Bhim Yuva Vyapaar Manda (BYVM), Agra Shoe Manufacturing Association (ASMA) etc. whose aim is to enhance the scalability of manufacturing units, both formal and informal, at the national and global levels.

A detailed explanations of working of each stakeholder is as follows:

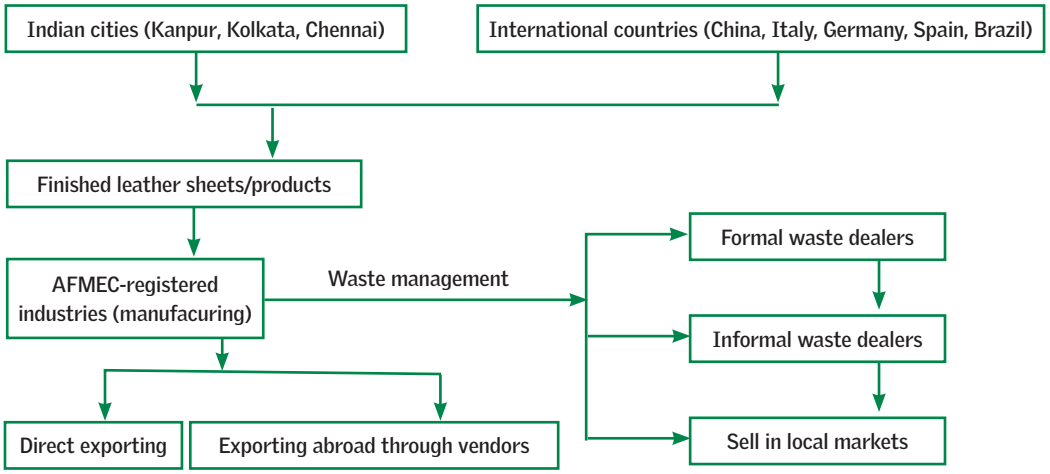
Medium-scale manufacturers

AFMEC-registered and other international export units

The Agra Footwear Manufacturers and Exporters Chamber (AFMEC) was established in 1998 to promote manufacture and export of Agra's footwear. AFMEC's main objective is to adopt modern technology as well as the highest standards of quality in footwear manufacturing so as to compete in the European, American and other markets outside India. AFMEC serves the footwear industry in Agra in active association with the Council for Leather Export (CLE) and other government departments.

As per discussions with a representative of AFMEC, AFMEC sources finished-leather and required raw materials are procured from various parts of India, primarily Kanpur, Kolkata and Chennai. Additionally, materials are sourced from other countries such as China, Italy, Germany, Spain, Brazil, etc., depending on client requirements (see *Figure 3: AFMEC working structure*). The leather undergoes manufacturing processes in India to produce footwear, which is then distributed to numerous countries worldwide, depending upon received orders. Footwear production is tailored to orders received from foreign brands, whether directly or indirectly through vendors.

Figure 3: Working structure of AFMEC



Source: CSE, 2024

Small-scale manufacturers

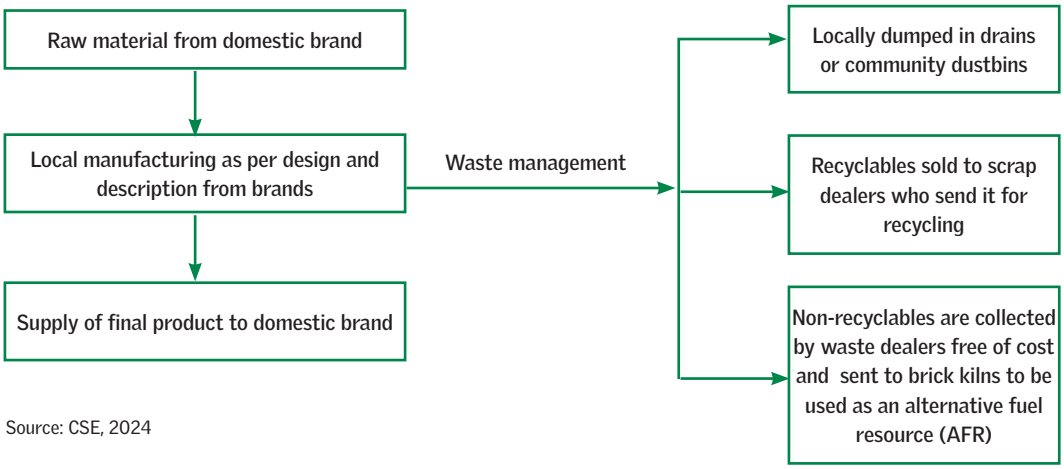
Agra Shoe Manufacturers' Association (ASMA) and registered domestic manufacturers

ASMA is an association of footwear manufacturers that cater to domestic demand and mainly focus on manufacturing for domestic brands in India. Around 500 manufacturing units come under its umbrella which it supports by providing government subsidies, schemes, etc.

Manufacturers under ASMA receive orders from domestic brands such as Bata India, Liberty, Lakhani and Relaxo etc. and provide necessary raw materials required for making the footwear. Brand companies mainly seek local manufacturers that can provide skilled workers, semi-mechanized machinery, and space for production of footwear. Post production, the final finished product is delivered to the brand.

Waste generated from manufacturing of footwear is in some cases handled by informal waste collectors—small- or large-scale scrap dealers—who recover recyclables such as white PVC sheets, PU bottoms, metal nails etc. Recyclable footwear-waste is generally sold to local scrap dealers (see *Figure 4: Working of domestic manufacturers*) while the remaining non-recyclable waste is either sent for energy recovery in brick kilns or is disposed of by dumping in nearby empty plots, disposing of in community bins or dhalao, or throwing it in drains.

Figure 4: Working of domestic manufacturers



Source: CSE, 2024

Micro-scale manufacturers

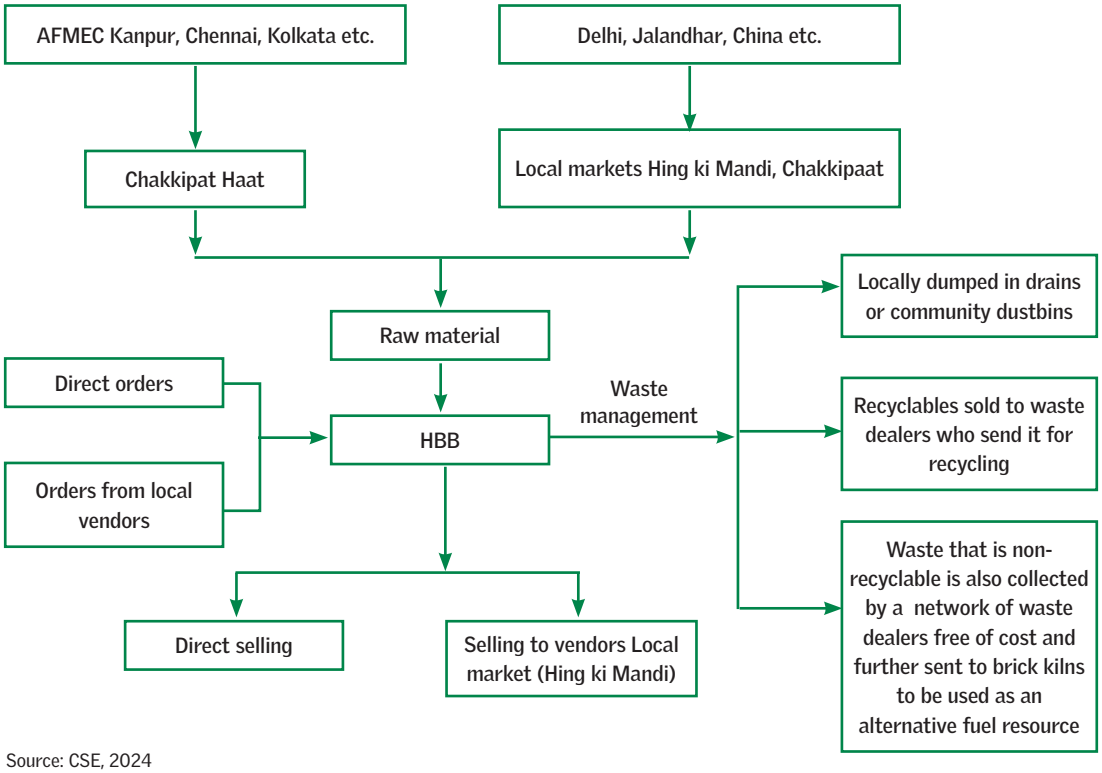
Home-based business

There are several associations for the welfare of home-based businesses (HBBs) in Agra. Juta Dastkar Federation (JDF), located in Chakkipaat market in Agra city, has around 750 members engaged in the shoe-making business. It is registered as a society, and helped identify issues and data with respect to this study.

As per discussions with representative of JDF, HBBs procure raw material from Chakkipat Haat and local markets, mainly Hing ki Mandi. Orders are usually received from local market traders (middlemen). An association of traders in Agra, situated in Hing ki Mandi, travel to different cities seasonally with samples of shoes from local HBB manufacters and procures orders. Some HBB units get direct orders from different states (Assam, Maharashtra, Delhi etc.) through their personal networks. The CSE team also found that some of the waste generated by AFMEC industries reaches the Chakkipaat bi-weekly market through various network of local informal traders of waste. The recovered waste material is used as raw material for the smaller home-based businesses.

Post-production, HBBs deliver finished footwear to vendors. Some of the waste generated is recyclable, such as white and black rexin, PVC sheets, nails etc., but mostly generated waste, comprising EVA and PU foam, cloth and aster cuttings are not recyclable in nature and end up either dumped in nearby empty plots, disposed of in community bins or dhalao, or thrown in drains (see *Figure 5: Working of home-based businesses*).

Figure 5: Working of home-based businesses



Source: CSE, 2024

Status of informal recycling in Agra

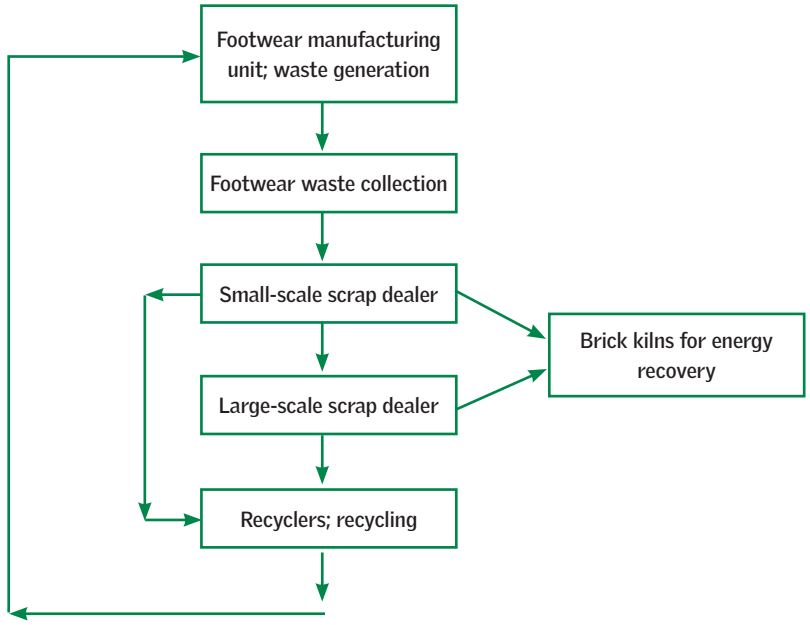
In Agra, informal recycling plays a significant role in managing footwear waste. Local associations and informal recyclers estimate around 500 such units in the city. While their contribution is important, these units are not registered and found to be indulging in unethical practices. Workers in these units are often found working in dire conditions such a limited working area, no ventilation, and no use of personal protective equipements. They are therefore at the risk of facing higher health problems, particularly lung ailments due to exposure to toxic gaseous emissions while melting footwear waste into third-grade bottoms.

Informal recyclers primarily have to work with materials like polyvinyl chloride (PVC), thermoplastic polyurethane (TPU), styrene butadiene rubber (SBR) and thermoplastic rubber (TPR), commonly used for low-grade and inexpensive footwear soles. However, many materials used in footwear production are not easily recyclable, such as ethylene vinyl acetate (EVA) and polyurethane (PU) due to higher cost for investment for machineries for recycling, often diverted through informal networks for energy recovery in poorly regulated small industries like brick kilns.

The informal recycling of footwear waste is very similar to general municipal waste management (see *Figure 6: Informal recycling of footwear*).

Local waste dealers play a crucial role in facilitating the flow of materials to informal recyclers. They either provide the necessary materials directly to recyclers or sell it either to large-scale scrap dealers or sell it for use for energy recovery in brick kilns.

Figure 6: Informal recycling of footwear



Source: CSE, 2024

5. Status of footwear waste generation in Agra

Footwear-making has been an integral business activity of Agra and has been in practice for centuries. Due to the city's massive supply of skilled labour and strong local markets, Agra has been a hub for footwear manufacturing and able to compete for fast-paced consumerism and the demand for different designs.

Various stakeholders give different numbers of footwear manufacturers, including both formal and informal entities. Home-based businesses (HBBs) were seen to be managing footwear waste the generate irresponsibly.

During the study, the research team from CSE had an overview of the network of footwear manufacturing units in Agra city. Although there are other associations working within the city limits, the CSE team interacted with four major associations but there are a few more associations with whom we were not able connect. In addition to proving the number of manufacturers in their network, they also offered an estimated number of the informal footwear manufacturers in the city (see *Table 1: Major associations with formal and informal entities in Agra*).

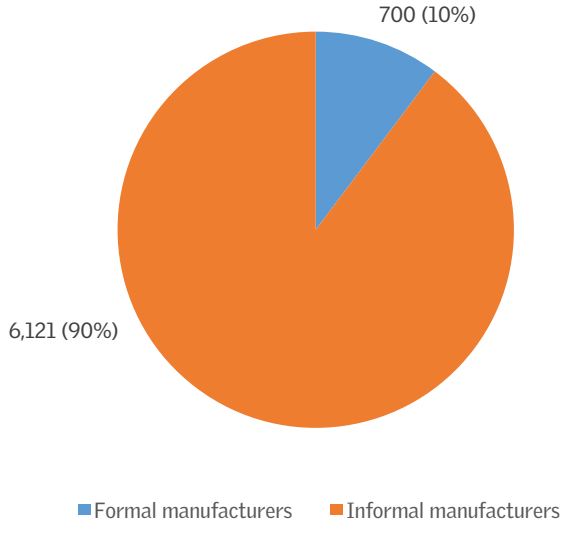
As per the 2019 report titled *Cluster Diagnostic Report and Action Plan Leather Footwear Cluster, Agra* by global professional services organization KPMG (Klynveld Peat Marwick Goerdeler), it is estimated[5] that 90 per cent of the total footwear production is consumed by the domestic Indian market and remaining 10 per cent by the export market.

The table depicts that the estimated number of formal footwear manufacturers in Agra under AFMEC and ASMA could be in the tune of 650 units. Based on the estimation provided by all the four associations, we may say that the average number of informal manufacturing unit in Agra city who mostly operate from their home could be in a range of 5,000–6,000 units. It is noteworthy that out of this estimation, about 900 informal manufacturers are members under JDF and BYVS (see *Graph 1: Number of informal and formal manufacturers in Agra*).

Table 1: Major associations with formal and informal entities in Agra

Name of association	Brief description of association	Number of footwear manufacturers under the association	Number of total informal footwear manufacturers estimated by the association
Agra Footwear Manufacturing Export Chambers (AFMEC)	An association of mostly leather-based footwear manufacturers that work for international brands and export most of their products to other countries. All the members are large and formal business entities.	150	5,000
Agra Shoe Manufacturers' Association (ASMA)	An association of both leather- and non-leather-based footwear manufacturers who work for domestic brands in India.	500	5,000
Juta Dastkar Federation (JDF)	JDF is an association of informal or home-based footwear manufacturers in Agra who manufacture both leather and non-leather products and selling in local as well as domestic markets across the country. They receive orders through various channels and Agra-based traders to manufacture footwear and supply them accordingly.	750	7,500
Bhim Yuva Vyapar Mandal (BYVM)	An association of informal footwear manufacturers who produce leather and non-leather footwear for selling in local as well as other markets based on the order received from various channels and Agra-based traders and supply them accordingly.	150	2,500

Graph 1: Number of informal and formal manufacturers in Agra



Footwear production and waste generation in Agra

Medium-scale manufacturers

Production capacity and waste generation by AFMEC-registered and other international export units

Manufacturers under the umbrella of AFMEC are connected to large exporters that work for international brands in the UK, USA, EU and Dubai. According to AFMEC, each manufacturing unit under their umbrella can produce about 2,500 pairs of footwear everyday. Therefore their maximum cumulative daily production capacity is about 500,000 (0.5 million) pairs of footwear. In the process of production about 0.05 kg of waste is generated per pair of footwear. AFMEC claim to have their own authorized waste collection and management agency that takes care of most of the waste while a fraction of their waste is also collected and processed by local market traders.

During the course of the study, the CSE research team visited Dawar Industry, a registered unit under AFMEC. Dawar Industry claims that its recycling partner Bharat Oil and Waste Management Pvt. Ltd manages the waste they generate. Waste generated by Dawar Industry in the process of manufacturing 4000–5,000 pairs of footwear per day is in the range of 400–500 kg per day while using approximately 4,500 kg of raw materials daily. This means that in order to manufacture one pair of shoe raw material required is 0.88 kg, or approximately 100 gram of footwear waste is generated from manufacturing every pair of footwear by Dawar Industry. Waste generated by Dawar Industry is twice the amount of waste generation claimed by AFMEC representatives (100 gram generation as against claimed generation of 50 gram).

Dawar Industry was unable to provide information on how Bharat Oil and Waste Management Pvt. Ltd manages footwear waste after collection. The CSE team tried to get in touch with Bharat Oil Waste Management Pvt. Ltd to understand the waste management practices followed by the recycling partner who despite several attempts failed to facilitate a visit or share data related to their operations (see *Table 2: Cumulative production capacity and waste generated by footwear manufacturers under AFMEC*).

Table 2: Cumulative production capacity and waste generated by footwear manufacturers under AFMEC

Name of association	No. of units (A)	Production capacity per day per unit (B) (in pairs)	Total production capacity per day (A x B = C) (in pairs)	Waste generation per pair of footwear (D) (in kg)	Total footwear waste generated by all units under AFMEC per day (C x D) (in tonne)
AFMEC	150	2,500	375,000	0.05	18.75
Independent	50	2,500	125,000	0.05	6.25
Total	200		500,000		25

Small-scale manufacturers

Production capacity and waste generation by Agra Shoe Manufacturers' Association (ASMA) registered domestic manufacturers

There are about 500 domestic brand manufacturers located in various part of Agra city who are members of the Agra Shoe Manufactureres' Association (ASMA). They produce both leather and non-leather-based items. Apart from the units under their umbrella, ASMA also connects to a much larger supply chain network encompassing more than 5,000 workers. According to ASMA, the average waste generated in the process of manufacturing one pair of footwear is about 0.025 kg, which is 50 per cent of what AFMEC units generate per pair while raw material consumption is roughly around 0.65 kg per pair.

ASMA's per pair waste generation is less than AFMEC's primarily because the range of products they offer is extremely wide. The CSE team learned that the waste generated in the manufacture of one type of product (footwear) is partially used in producing another category of product (belts, purse, smaller sized footwear, etc.). AFMEC did not engage in practices such as reuse due to lower demand of products and hence weaker markets for product categories other then footwear (see *Table 3: Cumulative production capacity and waste generated by the footwear manufacturers under ASMA*).

Table 3: Cumulative production capacity and waste generated by footwear manufacturers under ASMA

Number of footwear manufacturering units under ASMA (A)	Production capacity per day per unit (B)	Total production capacity per day (A x B = C) (in pairs)	Waste generation per pair of footwear (D) (in kg)	Total footwear waste generated by all units under AFMEC per day (C x D) (in tonne)
500	500	250,000	0.025	6.25

Micro-scale manufacturers

Production capacity and waste generation by home-based businesses

The footwear industry provides livelihood to about 6,000 families in Agra where residents manufacture footwear at home. Almost all the members of these families engaged in the manufacture of footwear contribute to the business. As per the CSE team's estimate, over 6,121 home-based businesses (HBBs) in Agra contribute significant amounts of business in footwear manufacturing through interaction with various stakeholders in the value chain of informal manufacturers. The cummulative production of HBB units in four zones is 195,872 pairs, by using 85.7 tonne per day (TPD) raw material in the production of footwear every day and generating around 13.71 TPD of waste. Waste generated is 0.07 kg for a pair of footwear and 0.44 kg of raw material is used (see *Table 4: Waste generation, production of footwear and raw material consumption in each ward*).

Table 4: Waste generation, production of footwear and raw material consumption in each ward

S. no.	Zone	No of units	Footwear production @32* pair per unit per day	Waste generation (In tonnes/day) @0.07 kg per pair
1	Tajganj	1,885	60,320	4.22
2	Lohamandi	1,588	50,816	3.56
3	Hariparvat	515	16,480	1.15
4	Chhatta	2,133	68,256	4.78
	Total	6,121	195,872	13.71

* This is an average estimation this number may vary from 24-200 units depending upon scale of operations.

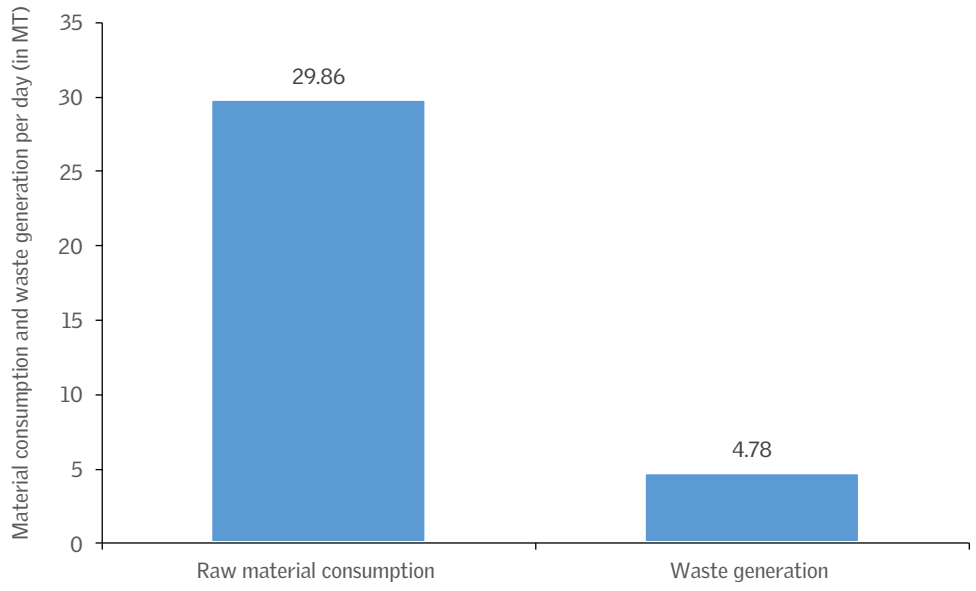
The following section gives zone-wise details of manufacturing units, production capacity, raw material consumption and waste generation.

Zone-wise distribution of footwear manufacturing units and waste generation

Chhatta Zone

Around 2,133 footwear-making units were operational in 35 locations spread across 13 (out of 25) wards of Chhatta Zone. All the units altogether use around 29.86 tonne per day of raw material for footwear manufacturing and produces around 68,256 pairs of footwear per day (see *Annexure 1: Location of footwear manufacturers in Chhatta Zone*).

Graph 2: Footwear waste generation in Chhatta Zone from home-based businesses



Source: CSE, 2024

Waste generation in Chhatta Zone is approximately 4.78 tonne per day.

Hariparvat Zone

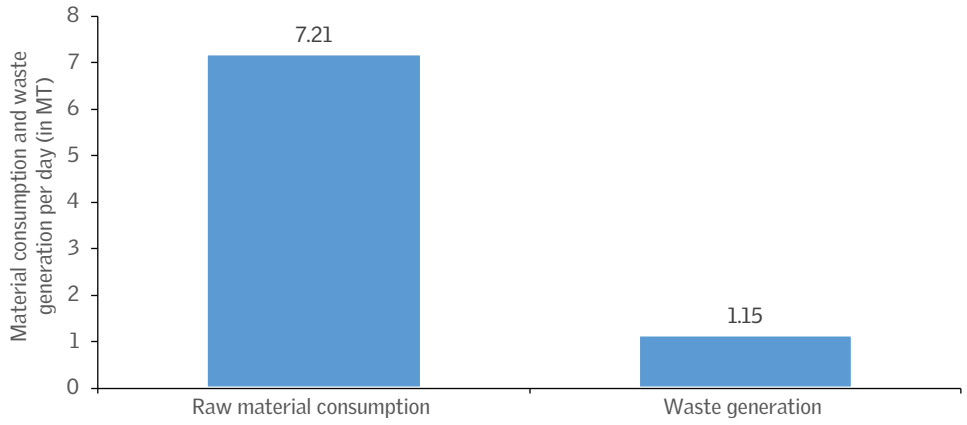
Around 515 footwear-making units operated in 13 different locations spread across eight (out of 25) wards in Hariparvat Zone. The units use a total of around 7.21 tonne per day of raw material for footwear manufacturing and produces around 16,680 pairs of footwear per day (see *Annexure 2: Location of footwear manufacturers in Hariparvat Zone*).

Waste generation in Hariparvat Zone is approximately 1.15 tonne per day.

Lohamandi Zone

Around 1,588 footwear-making units operate in 43 locations spread across 16 out of 26 wards in Lohamandi Zone. The units use a total of approximately 22.23 tonne per day of raw material and produce around 50,816 pairs of footwear per day (see *Annexure 3: Location of footwear manufacturers in Lohamandi Zone*).

Graph 3: Footwear waste generation in Hariparvat Zone from home-based businesses



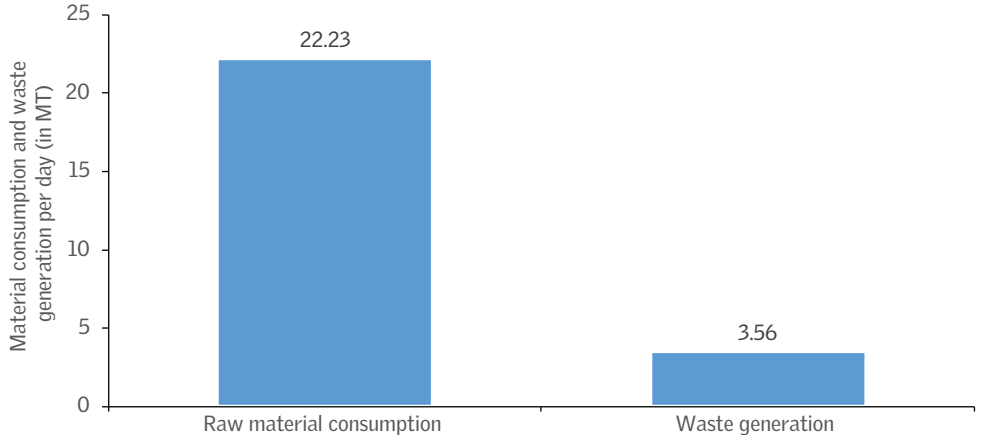
Source: CSE 2024

Waste generation in Lohamandi Zone is approximately 3.56 tonne per day.

Tajganj Zone

Around 1,885 footwear-making units operated in 51 locations of 20 (out of 25) wards in Tajganj Zone. The units used a total of around 26.39 tonne per day of raw material for footwear manufacturing and produced around 60,320 pair of footwear per day (see *Annexure 4: Location of footwear manufacturers in Tajganj Zone*).

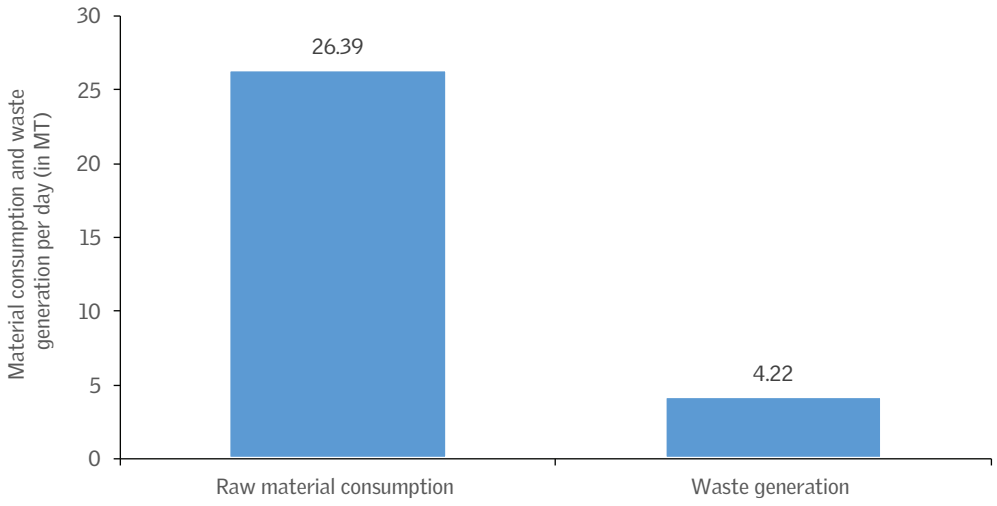
Graph 4: Footwear waste generation in Lohamandi Zone from home-based businesses



Source: CSE, 2024

Waste generation in Tajganj Zone is approximately 4.22 tonne per day.

Graph 5: Footwear waste generation in the Tajganj Zone from home-based businesses



Source: CSE, 2024

Overall waste generation

It can be established that a total of 6,821 footwear manufacturing units are operating in Agra—including home-based businesses (HBB), domestic market and exporters—and producing about **9–10 lakh pairs of footwear per day**, with approximately **45 tonne per day** (TPD) **of footwear waste generated**. Of the total footwear waste of 13.71 TPD generated by informal household-based business units, about 21 per cent, i.e. 2.87 TPD, was found to return for reuse and recycling. The remaining quantity of waste—79 per cent (10.84 tonne)—is presumably disposed of in drains or dhalaos, leaked to the Yamuna River or collected and disposed of to Kuberpur dumpsite in Agra.

6. Footwear waste composition and calorific value

The CSE team collected three samples from each zone, i.e. a total of 12 samples were collected. All the samples were collected from home-based businesses (HBBs). The samples were brought to CSE's environmental laboratory facility at the Anil Agarwal Environment Training Institute (AAETI) in Nimli, Rajasthan, where a footwear waste characterization study was conducted in February 2023. Samples from each zone were heterogenous in nature and mixed to represent a zone sample. They were further sorted into different categories as per their characteristics to simplify the main objective, i.e. to identify leather, synthetic leather, textile waste and other.

The CSE team was able to identify seven types of different materials during the waste composition study (see *Table 5: Composition of footwear waste*). Elastic band was also found in Lohamandi Zone although elastic band is not a byproduct of footwear manufacturing.

About 40.46 per cent of leather waste—ranging from 7.69 per cent in Chhatta Zone to 74.68 per cent in Lohamandi Zone—was identified as leather waste. About 36.27 per cent of the waste was identified as synthetic polymers waste, ranging from 14.25 per cent in Lohamandi Zone to 67.44 per cent in Chhatta Zone. About 1.92 per cent of the waste was identified as textile—including torn clothes, cut clothes, thread etc.—ranging from 0.97 per cent in Chhatta Zone to 2.58 per cent in Lohamandi Zone. While there is a significant difference between waste quantities of different categories generated in different zones as waste collected from each zone is heterogenous in nature, it is similar within units in zones. This is a limitation of this characterization study.

Characterization of footwear waste by the CSE team

Source: CSE, 2024

Table 5: Characteristics of footwear waste

S. no.	Type of waste material	Chhatta (%)	Hariparvat (%)	Lohamandi (%)	Tajganj (%)	Overall (%)
1	Leather	7.69	50.07	74.68	13.41	40.46
2	Textile (polyester, viscose)	0.97	2.19	2.58	1.62	1.92
3	Synthetic polymers (polyvinyl chloride (PVC), ethyl vinyl acetate (EVA), styrene butadiene rubber (SBR), polyurethane (PU) and thermoplastic elastomers)	67.44	15.01	14.25	62.93	36.27
4	Hazardous waste (foam soaked in adhesive solution)	4.96	3.67	7.09	10.21	6.37
5	Footwear cardboard	17.51	28.47	1.24	11.69	14.43
6	Metal	0.09	0.06	0.04	0.00	0.05
7	Fines (less than 5 mm)	1.36	0.51	0.12	0.15	0.50

Source: CSE, 2024

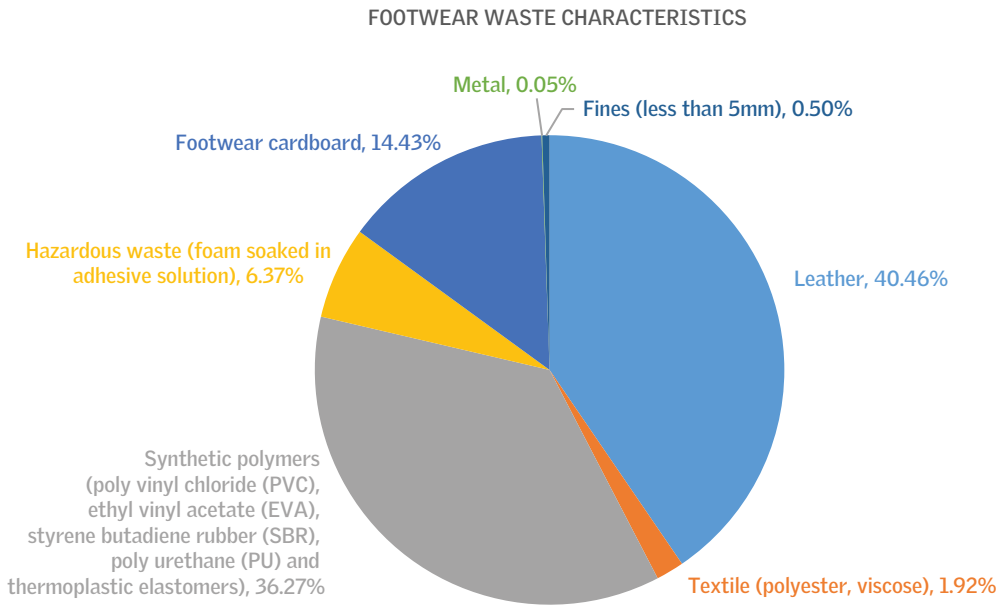
According to CSE estimates, approximately 13.71 tonne per day (TPD) of footwear waste is generated from home-based businesses (HBBs) in Agra. Of this, 5.55 TPD is leather, 4.97 TPD is synthetic polymer, 1.98 TPD is footwear cardboard waste, and 0.87 TPD is hazardous waste (foam soaked in adhesive solution) (see *Table 6: Quantities of different types of footwear waste*).

Table 6: Quantities of different types of footwear waste

S. no.	Footwear waste type	Quantity (TPD)
1	Leather	5.55
2	Textile	0.26
3	Synthetic polymer	4.97
4	Hazardous waste (foam soaked in adhesive solution)	0.87
5	Footwear cardboard	1.98
6	Metal	0.01
7	Fines (less than 5 mm)	0.07
	Total	13.71

Source: CSE, 2024

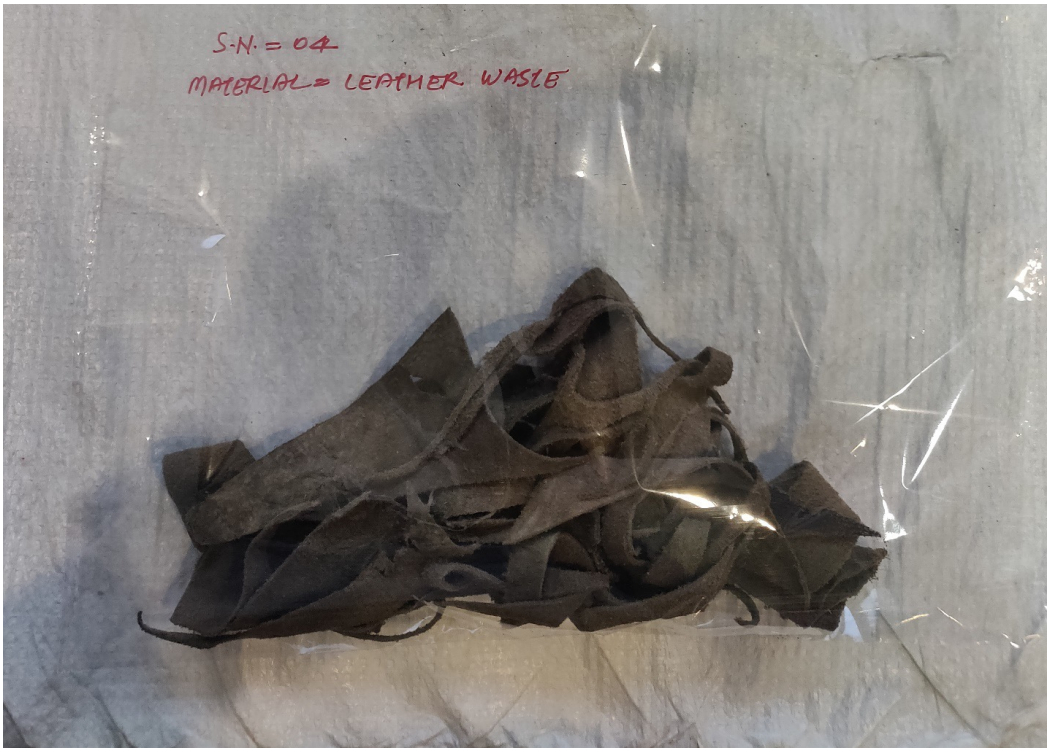
Graph 6: Composition of footwear waste in Agra



Source: CSE, 2024

Calorific value

Samples were sent to CSE laboratory in AAETI, Nimli, where the different types of waste were analysed using a bomb calorimeter, which determines the calorific value or heat of combustion of solid and liquid fuels (see *Table 9: Calorific values of footwear waste samples*). It can be estimated that the samples of footwear waste have very high calorific values that can be used to generate energy which can further be converted into electricity (see *Table 7: Calorific values of footwear waste samples*).



Leather waste sent for identification of calorific value

Source: CSE 2024

Table 7: Calorific values of footwear waste samples

S. no.	Sample type	Calorific value (KCal/kg)
1	Textile	5,172.0
2	Footwear cardboard	3,662.3
3	Leather waste	4,128.9
4	Hazardous waste (foam soaked in adhesive solution)	7,948.9
5	Synthetic leather	3,281.8

Source: CSE, 2024

7. Challenges and opportunities in footwear waste management

Representatives of AFMEC-registered manufacturing units assert that their facilities do not engage in waste dumping. Instead, they ensure that waste is either recycled or scientifically disposed of through authorized waste management panels. A small portion of the footwear waste, especially leather, is repurposed for manufacturing other items or diverted for reuse in the local market (Chakkipaat Market) through the channel of informal traders.

Similarly, footwear manufacturing industries associated with ASMA have stated that they've enlisted local scrap dealers to manage waste generated from their registered units. The management of footwear waste in Agra by home-based businesses (HBBs), however, paints a starkly different picture due to inadequate storage facilities and the absence of waste collection services.

The following sections describe some of the major challenges in managing footwear waste in Agra city by HBBs.

a) Indiscriminate disposal of footwear waste due to lack of space for storing at the manufacturing units

More than two-thirds of the footwear manufacturing units in Agra are home-based business and informal in nature. These places are small to very small dwellings with inadequate space for manufacturing and very little space to store footwear waste. As a result, home-based manufacturers generally dispose of the waste generated either outside their house's doors, in nearby dustbins (if available) or in drains. The local authority was seen to have very limited formal collection systems in place.

b) Collection and transportation

About 58 per cent of all the footwear waste is directly or indirectly collected by the fleet of Agra Nagar Nigam (ANN) from the doorstep or community bins or even from drains (ANN usually clean drains on irregular intervals to avoid blockage of drains).

Footwear waste inside a household-based business unit

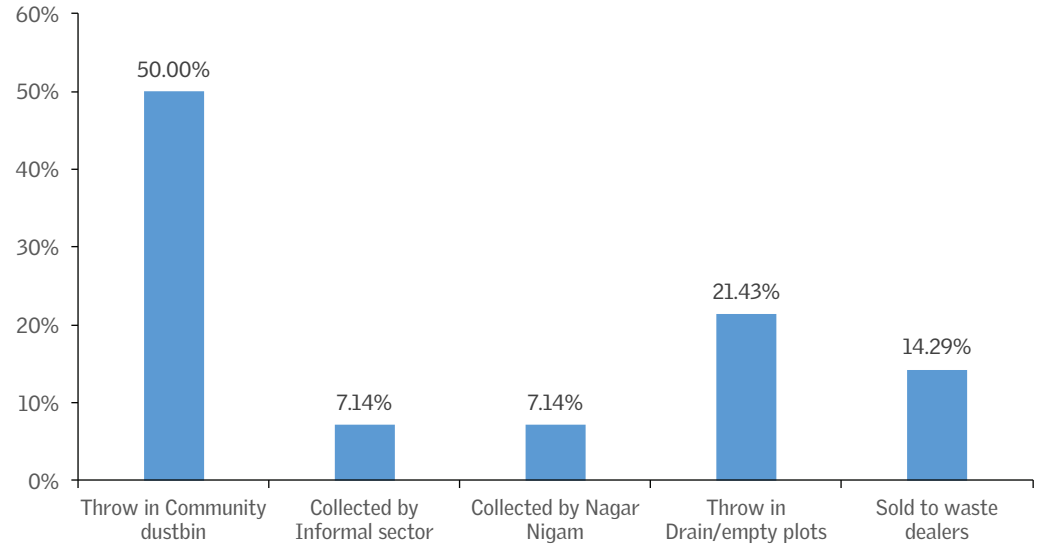
Source: CSE 2024

The CSE team observed the following in the existing collection and transportation system for footwear waste:

About 50 per cent of footwear manufacturers of HBBs interviewed during the study said that they disposed of their waste in nearby ANN community bins. The waste is then collected by ANN's collection fleet designated for collecting waste from community bins.

- 7.14 per cent of the respondents said that informal waste collectors collect footwear waste from their doorsteps, and most often discard it in nearby dustbins or dhalao ghar. Some of the recyclables are recovered and and sold to local waste dealers, generating earnings in the process.
- 7.14 per cent claimed that footwear waste is getting collected by ANN's fleet right from their doorstep daily.
- 21.43 per cent conceded that they disposed of footwear waste in drains or in open plots nearby. The waste is collected by ANN during cleaning of drains to avoid blockage.

Graph 7: Current status of footwear waste management (current status)



Source: CSE, 2024

- 14.29 per cent of respondents claimed that workers who needs extra money often recover and store recyclables such as white synthetic sheets etc. out of the total waste generated and sell it to local waste dealers. But a point to be noted here is that only the part of the waste that has some market value is recovered.

  Informal or home-based units produce 13.71 tonne per day (TPD) of footwear waste, a part of which is collected by the ANN fleet. About a quarter of this—i.e. **1.87** TPD—ends up in drains or open areas and creates all sort of problems, including clogged drains and burning of waste, leading to marine litter.

c) Processing and treatment

There is no formal system in place for processing and treatment of footwear waste in Agra city. It is important to note that footwear waste mostly comprises components such as leather or synthetic sheets, rubber, foam, plastic, paper, metal, etc. The study team observed that hazardous waste (foam soaked in adhesive solution) with strong chemical odour was also used in footwear manufacturing. It is therefore critical for the State Pollution Control Board to test such samples with the help of the local authorities for traces of hazardous substances, which may call for a different set of management protocol to deal with or store for final disposal in appropriate facilities.

Footwear waste strewn on a street in Kazipada

Footwear waste dumped in the Mantola drain

Source: CSE 2024

d) Disposal

ANN collects nearly 57 per cent of the footwear waste from community dustbins or direct collection every day, which accounts for around 7.81 tonne per day (TPD) (of which manufacturers disposed of 50 per cent of their waste directly and ANN's fleet collection is 7.14 per cent). The waste is regularly transported to the Kuberpur dumpsite, 14 km from the city centre along with other municipal solid waste streams. A potential resource that is dumped at the Kuberpur dumpsite along with municipal solid waste could have been directed to reuse or recycling or used for energy recovery.

Traces of footwear waste at Kuberpur dumpsite

Source: CSE 2024

e) Integration of informal sector

It was found in a discussion with some of the home-based footwear manufacturers that they are being sensitized by the District Industries Centre (DIC) and the Central Footwear Training Institute (CFTI) for government welfare schemes. These institutions also help them get loans and subsidies, but we were not able to get details of total beneficiaries. This also represents that most of the informal manufacturers are not getting any benefits despite there being several social and credit schemes by the Government of India and the state government.

Kuberpur dumpsite

Source: CSE, 2024

The integration of the informal sector in the government's credit and social scheme is a crucial step for the betterment of informal manufacturers in Agra.

1. Government's credit schemes: These credit schemes are provided assistance by DIC and CFTI under the Ministry of Micro, Small & Medium Enterprises (MSME) (see *Table 8: Government's credit schemes for marginalized sector*).

Table 8: Government's credit schemes for marginalized sector

S. no.	MSME scheme name	Objective	Key benefits
1.	Prime Minister's Employment Generation Programme (PMEGP)	• To provide financial assistance to set up self-employment ventures and generate sustainable employment opportunities in rural as well as urban areas	• Credit-linked subsidy programme for setting up new micro-enterprise in non-farm sector. • Margin money subsidy in the range of 15–35 per cent of project cost for projects up to Rs 50 lakh in the manufacturing sector and Rs 20 lakh in the service sector.
2.	Credit Guarantee Scheme for Micro & Small Enterprises (CGTMSE)	• To encourage first-generation entrepreneurs to venture into self-employment opportunities by facilitating credit guarantee support for collateral-free or third-party guarantee-free loans to micro and small enterprises (MSEs), especially in the absence of collateral.	• Credit guarantee for loans up to Rs 2 crore, without collateral and third-party guarantee. • Guarantee coverage ranges from 85 per cent (micro enterprise up to Rs 5 lakh) to 75 per cent (other). • 50 per cent coverage is for retail activity.
3.	Micro & Small Enterprises Cluster Development Programme (MSE-CDP) Scheme	• To support the sustainability and growth of MSEs by addressing common issues such as improvement of technology, skills and quality, market access, etc.	• Creation of common facility centres, including plug and play facilities. • Support for infrastructure development projects, including flatted factory complexes.
4.	National SC-ST Hub Scheme	• To provide professional support to Scheduled Caste and Scheduled Tribe Entrepreneurs to fulfill the obligations under the Central Government Public Procurement Policy for Micro and Small Enterprises Order 2012, adopt applicable business practices and leverage the Stand-Up India initiatives.	• 25 per cent subsidy on purchase of plant and machinery/equipments or Rs 25 lakh whichever is less. • Marketing and mentoring support through participation in exhibitions and vendor development programmes. • Reimbursement of fees charged for bank loan processing, testing services, membership of Export Promotion Council, membership in government-promoted eCommerce portals, and single-point registration scheme of NSI. • Collection, collation and dissemination of information regarding SC/ST enterprises and entrepreneurs to CPSEs. • Free skill trainings and distribution of trade specific tool kits to trained candidates under the skill development programmes.
5.	Leather Footwear Activity under Handmade Paper Leather and Plastic Industry (HMPLPI) under Khadi Gramodyog Vikas Yojana (umbrella scheme)	• To revive the traditional and inherent skills of rural artisans • To renovate and modernize sales outlets • To promote marketing and exports	• Training on designing and manufacturing of footwear. • Distribution of machinery and tool kits to trained artisans.

S. no.	MSME scheme name	Objective	Key benefits
6	Pradhan Mantri MUDRA Yojana (PMMY)	• MUDRA provides loans to micro and small enterprises through various financial institutions, thereby facilitating their access to credit.	• Under the aegis of Pradhan Mantri MUDRA Yojana (PMMY), MUDRA has already created its initial products/ schemes. The interventions have been named Shishu, Kishor and Tarun to signify the stage of growth or development and funding needs of the beneficiary micro unit or entrepreneur and also to provide a reference point for the next phase of graduation/growth to look forward to. The financial limits for these schemes are: a. Shishu: Covering loans upto Rs 50,000 b. Kishor: Covering loans above Rs 50,000 and upto Rs 5 lakh c. Tarun: Covering loans above Rs 5–10 lakh[6]
7.	Stand-Up India Scheme for financing SC/ST and/ or Women Entrepreneurs.	• To facilitate bank loans of Rs 10 lakh–1 crore to at least one Scheduled Caste (SC) or Scheduled Tribe (ST) borrower and at least one woman borrower per bank branch for setting up a greenfield enterprise. This enterprise may be in manufacturing, services, agri-allied activities or the trading sector In case of non-individual enterprises at least 51 per cent of the shareholding and controlling stake should be held by either an SC/ST or woman entrepreneur.[7]	

2. Government's social schemes: The government has launched many such social schemes and in Agra, District Industries Centre (DIC) is closely working with Juta Dastkar Federation (JDF) to provide social schemes to informal workers. The following are a few of these schemes:

- **Prime Minister Jeevan Jyoti Bima Yojana** (PMJJBY): This scheme offers life insurance coverage to individuals at an affordable premium, providing financial security to their families in case of the policyholder's demise.
- **Pradhan Mantri Suraksha Bima Yojana** (PMSBY): It is an accident insurance scheme that provides coverage for accidental death and disability at nominal premium rates.
- **Ayushman Bharat**: This ambitious healthcare scheme aims to provide health insurance coverage to economically vulnerable sections of society, especially those in the informal sector.
- **e-SHRAM portal**: This online portal facilitates the registration of workers from the unorganized sector, enabling them to avail social security benefits and access various welfare schemes.

f) Occupational hazards associated with working with hazardous materials

Working with hazardous materials in a home-based business can pose significant risks and potential hazards. The study revealed that substances such as solutions made of PVC, thermoplastic rubber (TPR), rubber and softener (used to soften the thokan, [shoe toe]) are used in the footwear industry, especially in home businesses in confined areas.

As per the available research conducted in this domain, informal workers who engage in the process of soling—which involves fixing the upper portions of shoes to leather or rubber soles using glue—are potentially exposed to harmful vapours from industrial adhesives and glues. The workers are exposed to chemicals such as leather dust, benzene (utilized as a solvent in glues), and *p*-tert butyl phenols (found in neoprene adhesives). As a result, the majority of these informal workers experience respiratory issues, lung disease and skin infections due to prolonged exposure to glue and fumes.[8] In addition, workers face challenges such as inadequate lighting, excessive noise and insufficient ventilation.

Due to improper waste handling practices and working with hazardous chemicals, there is an increased likelihood of fire accidents occurring if not dealt with appropriately. Such incidents can have severe consequences, and require immediate attention from government bodies and authorities.

To mitigate these risks effectively, it is crucial to explore alternatives to the current solutions, adhesives, solvents and softeners used. Identifying and adopting safer alternatives can significantly reduce the potential for accidents and minimize the harmful impact on both the business and the environment. Government bodies should encourage businesses to seek out and implement these alternatives, promoting responsible handling and disposal practices.

Additionally, it is essential to prioritize appropriate handling procedures when working with hazardous materials, including use of PPEs such as safety mask, ensuring proper ventilation in workspaces, implementing secure storage practices, and employing appropriate waste management methods. These measures are crucial in preventing accidents and minimizing associated risks.

A worker working in limited space with minimum ventilation

Discarded polymeric sponge that was used to apply adhesive during the manufacturing process

Source: CSE, 2024

8. The way forward

Agra Nagar Nigam (ANN) has to adopt a multi-step approach in order to bring down mismanagement of footwear waste, appropriately plan and improve collection services, reduce and penalize unauthorized dumping, improve recovery and recycling and, in order to maximize the recycling, improve lifestyle and give social justice to informal as well as formal workers.

The local authority may take following steps to manage footwear waste more appropriately:

Creating an inventory of footwear manufacturing units in Agra city

For efficient management of footwear waste, it is essential to understand the locations of footwear manufacturing units, both formal or informal, in the city. This will help develop an inventory of footwear manufacturing units. Currently, there is no such database available with the city government. As a result, the local authority was unable to plan properly for collection, transportation, treatment and disposal of footwear waste.

The local authority (ANN) may deploy its resources at the zone and ward levels to create a database and geotag them for ease of tracability. It needs to initiate a ward-level survey of footwear-manufacturing units. Ward supervisors may be deployed to locate the footwear industry units following the leads provided in this report and capture other details at the ward level. Zonal Sanitary Officers (ZSOs) may compile the data at the zonal level before it is submitted to the office of ANN to create a city-level database. Reporting technology based on a mobile app may be used for faster data collection and real-time compilation with support from CSE research team.

The following template/form may be used to create the database:

ANN needs to ensure that all footwear industry units are registered and accounted for, and pay applicable taxes. ANN should also ensure that every footwear industry receives a trade license or gets their license renewed as they are directly or indirectly engaging in business by selling footwear products. By geotagging the locations and providing trade licenses to footwear manufacturing units, ANN may keep a tab on the every increasing or decreasing number of footwear-manufacturing units.

Form 1: Footwear units and industry details

S. no.	Name of footwear manufacturing units	Name and mobile of owner or manager	Location with latitude and longitude	Whether the business is registered with ANN	Average daily consumption of raw material (in kg)	Average daily footwear manufacturing (in numbers)	Average daily generation of footwear waste (in kg)	How are they managing footwear waste? (describe)

Delisting of units

ANN should also have mechanism for manufacturing units that close or shut down for any reasons so that a proper assessment can be done half yearly or on an annual basis. This will also complement the revenue records and can help in effective planning for footwear waste management.

Modify bylaws to address footwear waste issue in the city

ANN should amend the existing bylaws to comprehensively address footwear waste in the city. It should cover empallenment, de-listing, collection and transportation, processing and treatment and scientific disposal for non-recyclable footwear waste.

Collection and transportation system

Based on the final number of footwear manufacturing units and their locations, ANN should deploy a dedicated number of vehicles and staff for regular and on-time collection of footwear waste from such units to prevent throwing of waste in open plots or drains and other unauthorized areas. Strict monitoring should be done to keep a watch on polluters and heavy fines imposed on violators. Collected waste should be transferred to the processing or treatment facility in order to prepare waste for reuse or recycling.

IEC activities

Agra Nagar Nigam (ANN) should collaborate with government agencies such as Central Footwear Training Institute (CFTI), Ministry of Micro, Small & Medium Enterprises (MSME) and District Industries Centre (DIC) for awareness activities with regard to mismanagement of footwear waste and what should be done in order to bring this down in Agra city. The following trainings should be undertaken:

Clean-up drives

Clean-up drives should be conducted in areas where footwear waste is a problem. It should be done with help of local residents, area manufacturers, and schools

and college students to bring a change in people's perspectives and drive them for change.

On-site and online trainings

ANN should collaborate with training institutions to train existing manufacturers and also open a window for fresh manufacturers. It should provide trainings on the process of footwear manufacturing and include how each step of manufacturing is responsible for waste generation and how this can be bring down to minimize waste generation in the city.

Reduction of waste

Home-based businesses in Agra predominantly rely on manual methods for manufacting, with basic hand tools used despite the availability of advanced technologies. CSE's observations indicate that smaller units, particularly those affiliated with ASMA, show a marginal improvement in mechanization compared to HBBs. Conversely, medium-scale units under AFMEC demonstrate more advanced mechanization.

The limited adoption of modern technology in these businesses stems from factors such as insufficient awareness about contemporary manufacturing techniques, high cost of machinery, spatial constraints hindering expansion, and a lack of technical expertise to operate sophisticated equipment. Consequently, production capacity and ability to handle large-scale orders is hindered. Additionally, manual processes lead to inconsistencies in product quality, substantial material wastage, and increased rejection rates, thus affecting overall efficiency and competitiveness.

Shifting towards mechanized operations presents a significant opportunity to reduce waste generation and enhance productivity in these businesses. However, achieving this transition requires collaborative efforts from financial institutions to provide affordable financing options for acquiring machinery and from government regulatory bodies to offer supportive policies and incentives.

The following are some financing institutions:

i. Small Industries Development Bank of India (SIDBI)
ii. Uttar Pradesh Finance Corporation (UPFC)
iii. Nationalized banks
iv. Pradeshiya Industrial and Investment Corporation of UP limited (PICUP)
v. National Small Industries Corporation (NSIC)

The following government bodies are key players

i. Ministry of Micro, Small & Medium Enterprises (MSME)
ii. District Industries Centre (DIC)
iii. Directorate of Industries
iv. Council of Leather Exports (CLE)
v. Uttar Pradesh State Industrial Development Authority (UPSIDC)
vi. Uttar Pradesh Skill Development Mission (UPSDM)

Credit and social schemes offered for individuals and business entity are also mentioned in this report (see section on integration of informal sector, chapter 7e).

Reuse

During discussions with ASMA and AFMEC representatives, it was noted that rejected materials and waste from footwear manufacturing are repurposed to create small products such as keychains and doormats, either through small manufacturing units or by establishing dedicated units for waste reuse. These practices, by diverting waste towards productive reuse, could be beneficial for home-based businesses in Agra.

Upcycling or downcyling of footwear waste materials with help of self-help groups (SHGs) or industries

It was also observed that there were interventions around making use of discarded footwear waste materials such as bags, rags, key chains or wallets which can be scaled with the help of local authority, who has advised interventions through exhibitions and competition programmes to identify individuals or SHGs that can undertake such interventions. They should provide them proper guidance to enhance their initiative to a larger scale.

ANN should also explore with mattress, automobile, apparel or other relevant industries to explore possible interventions to address footwear waste management. According to officials of the local authority, they are exploring solutions for waste management and have sent samples in furniture-manufacturing industries to identify the solutions to address the issue of footwear-manufacturing waste.

Recycle

Field visits revealed that some waste from home-based businesses (HBBs) and small industries in Agra is utilized in informal recycling plants to produce lower-quality outer soles. Collaborative efforts can be made with these recyclers to enhance their operations for managing larger quantities of waste effectively.

Further, there are industries in Agra transforming leather waste into tiles and boards. Engaging with these enterprises to replicate their models across other industries is recommended. This approach could be implemented either through a cluster-based approach or by establishing a centralized facility, potentially through a public–private partnership (PPP) model.

Recent discussions also suggest exploring opportunities with soft-toy manufacturers to determine if waste material can be incorporated into soft toy production. This avenue presents potential for innovative waste utilization strategies.

Diverting waste with help of local scrap traders for recyclable materials

As there is already a strong informal recycling sector presence in Agra, and it would be a good option to divert recyclable materials generating from manufacturing units to these informal waste recyclers. ANN may take the necessary steps to ensure participation of informal waste recyclers towards this and authorize appropriate informal waste recyclers to send recyaclable materials for recycling. They may create a team of officials to ensure proper channelization, monitoring and data collection for efficiently planning of footwear-waste management.

Integrated facility for proper footwear waste management

An integrated facility could be an effective intervention to address issues with respect to management of footwear waste. This facility can work as a storage facility until the local authority comes forward with different interventions. The local authority may also deploy workers to sort out recyclable materials with the help of local waste traders and channelize the recovered material to further recycling or energy recovery.

Rejuvenation of a leather park dedicated to the footwear industry

A leather park of area approximately 283 acre has been long awaited. It was meant to develop in such a way that raw material suppliers, manufactuers, traders, buyers could come under this large park. This would have helped the local authority to plan more efficiently for proper footwear-waste management. The local authority may work with the District Industrial Centre (DIC), Ministry of Small and Micro Enterprises (MSME), Central Footwear Technical Institute (CFTI), district admistration and other government organizations to rejuvenate this park to address issues related to footwear manufacturing.

Energy recovery

Alternate fuel (composite footwear waste): Co-processing in cement kilns

The majority of waste generated from footwear manufacturing units are non-recyclable and non-hazardous in nature such as polyurethane (PU), ethylene vinyl acetate (EVA), leather, textile, etc. The identified waste is mix of high- and low-density wastes, which if managed in the proper size (35– 70 mm) could be packaged in the desirable load density and sent to nearest co-processing facility. The calorific value of the footwear waste in Agra is in the range of 3,281–5,712 Kcal/kg, which is signicantly higher than the limit prescribed (1,500 Kcal/kg) in the *Solid Waste Management Rules 2016*, thus making the respective waste very suitable for co-processing.

The CSE team intereacted with experts in the cement industry domain about whether footwear waste can be used as fuel in their plant. As per the discussion, it was found that as this footwear waste has a high calorific value, it is a good add-on that can be used as an alternative to coal.

The supply chain of co-processing will involve packaging, loading, transportation, unloading, storage and pre-processing. Taking into account the overall scope of activities, the cost for co-processing to ANN would be approximately around Rs 5 per kg assuming the nearest co-processing plant available to ANN for the service is 250 km away. The major share in the cost for co-processing of footwear waste would include transportation and making the pre-processing mix. The logistics cost, which will involve unloading and transportation, could be around Rs 3 per kg.

Waste to energy

Considering the nature of footwear waste and properties well aligned for waste-to-energy (WtE) plants, a situable option for ANN is to establish a WtE plant in Agra for which the city had been in court since 2016. A proposed WtE plant at Kuberpur dumpsite in Agra received the go-ahead from the Supreme Court in February 2021, nearly five years after it first reached the court's doors. The WtE plant is under construction and is likely to start operating from December 2024. ANN should therefore consider creating a value chain in consultation with informal and formal footwear manufacturing units to plan for efficient collection and transportation of footwear waste to the upcoming waste-to-energy plant. The capacity of this plants is approx. 800 TPD and it will generate electiricty 15 MW per hour.

The estimated waste generated from home-based businesses is 13.71 tonne per day (TPD), international exports is 25 TPD and the domestic market is 6.25 TPD. Thus footwear-waste-generating units in Agra could provide feedstock for the WtE plant. Developing the supply chain for the WtE plant would be critical as the generating units are different and coming on mutually decided scope of responsibilities and rates could be difficult. ANN in collaboration with the waste-generating units could devise a model wherein the collection and taking footwear waste to a common point could be within scope of the three major generating associations and final transportation of overall collected waste from that point to WtE plant could be within the scope of ANN. Thus a tripartite agreement between ANN, waste generators and the WtE-plant owner could be a fruitful model to handle the menace of footwear waste.

Fee and penalty provisions

ANN should come up with a proper and payable tariff rate that covers collection, transportation and disposal through scientific processing of footwear waste. The system of tariff should be based on the scale of business and types of waste generated.

ANN must enforce timely collection of user fee/tariff from all footwear manufacturing units and owners of units not cooperating with the rules of ANN and not paying fees must face strict action.

Units practising open burning of waste, throwing waste in drains or tossing waste in empty plots must be identified by a sanitary inspector with written, geotagged locations with photograph proof so that applicable penalties can be imposed in such instances. After imposing penalty, ANN must try to recover or ensure deposition of penalty from defaulters. If not followed up on, neighbouring units will not be deterred from open throwing of waste as they will feel that ANN's notice, penalty or challan are only in name. ANN must ensure that penalty amounts are recovered from defaulters to discourage such behaviour.

Annexures

Annexure 1: Location of footwear manufacturers in Chhatta Zone

S. no.	Ward name	Ward number	Location	Number of units
1.	Kazipara	1	Kazipara	200
2.	Kazipara	1	Chakkipaat	120
3.	Kazipara	1	Aliya road	130
4.	Kazipara	1	Rawlins	60
5.	Kachhpura	14	Gadi Chandni	40
6.	Kachhpura	14	Sushil Nagar	20
7.	Kachhpura	14	Devjit Ka Nagla	30
8.	Dhalikhar	16	Dholikhaar	70
9.	Dhalikhar	16	Munda Pada	80
10.	Dhalikhar	16	Taliya Kazipada	60
11.	Dhalikhar	16	Ashok Gali	50
12.	Dhalikhar	16	Tila Shaikh Mannu	70
13.	Ratanpura	17	Ratanpura	80
14.	Ratanpura	17	Masta Ki Baghichi	50
15.	Ratanpura	17	Patel Nagar	70
16.	Ratanpura	17	Garib Nagar	90
17.	Ratanpura	17	Naya Gher	40
18.	Free Ganj	20	Gadhapada	30
19.	Free Ganj	20	Nagla Mahadev	20
20.	Bagh Mujfar Kha	25	Bagh Mujfar Kha	20
21.	Bagh Mujfar Kha	25	Sheetla Gali	15
22.	Nai Ki Sarai	28	Nai Ki Sarai	50
23.	Dera Saras	32	Moti Katra	60
24.	Mantola	53	Mantola	240
25.	Mantola	53	Sadar Bhatti	80
26.	Mantola	53	Meera Husaini	55
27.	Mantola	53	Kangaal Pada	43
28.	Mantola	53	Hing Ki Mandi	35
29.	Naraich West	58	Nagla Jamni	20
30.	Naraich West	58	Naagla Kishanganj	20
31.	Belanganj	64	Jeoni Mandi	30
32.	Belanganj	64	Surajbhan Fatak	20
33.	Belanganj	64	Koala wali gali	35
34.	Tedi Baghiya	83	Gadi Jeeven Ram	60
35.	Nai Ki Mandi	100	Nai ki Mandi	40
				2,133

Annexure 2: Location of footwear manufacturers in Hariparvat Zone

S. no.	Ward name	Ward number	Location	Number of units
1.	Charsu Darwaja	11	Nala Budhan Saiyyad	10
2.	Charsu Darwaja	11	Khatikpada	15
3.	Charsu Darwaja	11	Harigan Basti	25
4.	Nagla Harmukh	13	Nagla Harmukh	25
5.	Nagla Harmukh	13	Nagla Chhidda	20
6.	Nagla Harmukh	13	Langde Ki Chauki	15
7.	Khandari	29	Khandari	120
8.	Nagla Padi	71	Nagla Padi	40
9.	Sikandra	73	Sikandra	120
10.	Bhim Nagar	82	Anand Nagar	20
11.	Bhim Nagar	82	Bhim Nagar	25
12.	Balkeshwar	90	Lal Masjid	50
13.	Vajirpura	92	Nehru Nagar	30
				515

Annexure 3: Location of footwear manufacturers in Lohamandi Zone

S. no.	Ward name	Ward number	Location	Number of units
1.	Jagdishpura (West)	3	Jagdishpura	100
2.	Jagdishpura (West)	3	Bhim Nagar	40
3.	Khataina	7	Khatiana	70
4.	Khataina	7	Naubasta	50
5.	Khataina	7	Telipada	40
6.	Ghas ki Mandi	9	Ghas Ki Mandi	25
7.	Ghas ki Mandi	9	Indra colony	20
8.	Ghas ki Mandi	9	Jogipada	32
9.	Ghas ki Mandi	9	Dayal Nagar	28
10.	Ghas ki Mandi	9	Shibd Nagar	10
11.	Prakash Nagar	10	Ram Nagar Nai Abadi	30
12.	Prakash Nagar	10	Manas Nagar	40
13.	Nagla Mohal	12	Nagla Mohan	20
14.	Nagla Mohal	12	Shanti Nagar	20
15.	Raj Nagar	18	Raj Nagar	50
16.	Raj Nagar	18	Nagla Gangaram	60
17.	Bara Khamba	21	Seva Ka Nagla	20
18.	Bara Khamba	21	Nai Basti	30
19.	Bara Khamba	21	Kanhaiya Kunj	40
20.	Bara Khamba	21	Ayodhya Kunj	40
21.	Bara Khamba	21	Prahlad Nagar	30
22.	Bara Khamba	21	Bara Khamba	10

S. no.	Ward name	Ward number	Location	Number of units
23.	Bara Khamba	21	Sarai Khwaja	20
24.	Gadi Bhadoriya	24	Gadi Bhadoriya	30
25.	Gadi Bhadoriya	24	Krishna Nagar	40
26.	Gadi Bhadoriya	24	Anand Nagar	35
27.	Gadi Bhadoriya	24	Chanakyapuri	25
28.	Ajit Nagar	27	Ajit Nagar	120
29.	Ram Nagar	30	Ram Nagar	20
30.	Ram Nagar	30	Ram Nagar puliya ke pass	15
31.	Ram Nagar	30	Prem Nagar	25
32.	Ram Nagar	30	Maruti Estate	20
33.	Bhogipura	34	Bhogipura	35
34.	Bhogipura	34	Prakash Nagar	40
35.	Bhogipura	34	Shivaji Nagar	25
36.	Bhogipura	34	Soron Katra	45
37.	Bhogipura	34	Kolhai	15
38.	Bhogipura	34	Namak Ki Mandi	25
39.	Nagla Ajita	37	Nagla Ajita	50
40.	Ashok Nagar	45	Panchkuiya	20
41.	Alwatiya	67	Alwatiya	50
42.	Dhakran	76	Dhakran	80
43.	Kaidar Nagar	77	Kaidar Nagar	48
				1,588

Source: CSE, 2022

Annexure 4: Location of footwear manufacturers in Tajganj Zone

S. no.	Ward name	Ward number	Location	Number of units
1.	Gummat Takt Pehlwan	2	Gopalpura	150
2.	Gummat Takt Pehlwan	2	Nandpura	80
3.	Gummat Takt Pehlwan	2	Mayapuri	60
4.	Gummat Takt Pehlwan	2	Kashi Nagar	50
5.	Himachal Colony	5	Kotli Bagichi	75
6.	Himachal Colony	5	Devri road	35
7.	Eidgah	8	Eidgah	50
8.	Eidgah	8	Nagla Chhaua	30
9.	Eidgah	8	Nagla Fakir Chand	30
10.	Eidgah	8	Bara Khamba	50
11.	Sarai Malook Chand	15	Sevla Sarai	30
12.	Sarai Malook Chand	15	Nagla Parsoti	40
13.	Bundu Katra	19	Nagla Laturi Singh	30
14.	Bundu Katra	19	Nagla Bhawani Singh	40
15.	Bundu Katra	19	Nagla Tekchand	20

S. no.	Ward name	Ward number	Location	Number of units
16.	Bundu Katra	19	Shanti Nagar	10
17.	Sohalla	22	Sohalla	85
18.	Sohalla	22	Mushtafa Quarter	35
19.	Mohan Nagar	23	Mohanpura	30
20.	Mohan Nagar	23	Sundarpada	40
21.	Mohan Nagar	23	Gihara Basti	35
22.	Mohan Nagar	23	Dholpur House	15
23.	Dhandoopura	33	Dhandoopura	20
24.	Dhandoopura	33	Nagla Deem	25
25.	Dhandoopura	33	Nagla Pyarelal	20
26.	Dhandoopura	33	Nai Abadi Dhandoopura	30
27.	Dhandoopura	33	Nagla Paima	14
28.	Dhandoopura	33	Gadi Bangas	16
29.	Dhandoopura	33	Kolhai	20
30.	Mustafa Quarter	35	Mustafa Quarter	50
31.	Mahadev Nagar	36	Jangjeet Nagar	20
32.	Mahadev Nagar	36	Raj Nagar	25
33.	Mahadev Nagar	36	Karhai Mod	30
34.	Naamner	39	Kutlupur	30
35.	Naamner	39	Prataappura	20
36.	Naamner	39	Katghar	40
37.	Baluganj	40	Auliya	40
38.	Baluganj	40	Old ITO compound	10
39.	Katra Fulel	44	Nunhai	35
40.	Katra Fulel	44	Asad Gali	10
41.	Naripura	48	Naripura	80
42.	Naripura	48	Shiv Nagar	10
43.	Naripura	48	Budhha ka Nagla	25
44.	Ukharra	57	Bich Ka Ukharra	30
45.	Chawli	63	Chawli	70
46.	Chawli	63	Bhim Nagar	20
47.	Nagla Mewati	72	Nagla Mewati	40
48.	Shahid Nagar	78	Shahid Nagar	30
49.	Gobarchowki	97	Gobar Chowki	30
50.	Gobarchowki	97	Pakki Sarai	40
51.	Vibhav Nagar	98	Malko Gali	35
				1,885

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Agra, renowned for its historical heritage and vibrant footwear industry—with footwear production dating back to the Mughal Era—faces an environmental crisis due to improper disposal practices. Further, the volume of waste generated by footwear manufacturing units is substantial, necessitating immediate and effective management strategies.

This study presents a ground-level assessment of current waste generation, its composition and calorific value. It evaluates the effectiveness of the local authority Agra Nagar Nigam's existing waste management mechanisms, identifies the gaps that need addressing and offers insights into potential mitigation strategies, including improved waste segregation, recycling initiatives and adoption of scientific waste treatment methods. It emphasizes the need for urgent intervention in the waste management practices of Agra's footwear industry.

This report aims to inform authorities, institutions, policymakers and stakeholders about the critical need for sustainable footwear waste management practices in Agra for a cleaner and healthier environment for future generations.

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