7. Case Study Of The Leather Industry In Tamil Nadu

7.1 Background

THE BED OF THE RIVER PALAR, flowing through the North Arcot district of Tamil Nadu, presents a picturesque sight. The traditional laundry men dry their customers' clothes, children play cricket and cows graze lazily—all on the riverbed. A few stray patches of water remain as the only indicators of the fact that a river once used to be in full flow here.


The River Palar

The river is dry with overexploitation, the groundwater is colored, saline and contaminated with the leather industry's effluents and the air is thick with the stench from the tanning process.

This is one of the strongholds of the leather industry in India. It was here, in the North Arcot district of Tamil Nadu*, that the study team decided to look for one more different context where Industrial Ecology concepts could be applied. Like the foundry cluster in Haora, the leather industry in this region was the center of a national debate due to the high levels of pollution it created. In this case as well, the Supreme Court had intervened to try and find a solution to the problem. A section of the local community was up in arms against the leather industry.

Like in Tirupur and Haora, the cluster of tanneries was a nearly homogeneous group of small industries that used similar processes. Just as in Tirupur and Haora, the study team documented a dossier on the region and the industry and attempted to understand the resource flows in the region.

*Since the period of the study, the names of the districts in Tamil Nadu have changed. The new name for the region covered by the erstwhile North Arcot District is Vellore District.

7.2 History of the Leather Industry in Tamil Nadu

Madras (now Chennai) was one of the important trading centers during the British days in India. Hides and skins were major items of trade. Much of the export consisted of raw hides and skins. Of the 25 tanneries reported in India in the early 20th century, 14 were said to be in Chennai.

In 1973, the Dr. Seetharamiah Committee, set up by the Government of India, recommended that export of raw hides and skins should be banned and the export of semi-processed leather should be restricted. The aim was to encourage exporters to process the hides and skins and export finished products. The government accepted the recommendations, as it was keen that there be substantial value addition to the exports. This would not only improve the foreign exchange inflow, a national priority, but also provide employment to thousands of people. Issues of environment were not an important part of the agenda in India before the early 1980s. The government, partly with the help of legislation and partly with a system of incentives, banned the export of raw hides and skins and discouraged the export of semi-processed leather. This accelerated the growth of tanneries.

India's trade balance

The balance of trade is most often not in favor of the country and the Government spares no effort to step up exports. Exports are high on the list of priorities for the Government. A variety of incentives are offered to industry to export goods and services.

As Chennai was the major trading center for hides and skins as well as the little processed products that were exported, it was not surprising that the new leather processing units were founded close to the city. Some of the tanneries, were located on the outskirts of Chennai city. With the aim of shifting the industries out of the cities, and providing equitable employment opportunities to the population in the hinterland, the state government provided a wide range of incentives to the industrialists to set up industries in pre-designated backward regions of the State. One such region was the belt in the North Arcot District of Tamil Nadu, half-way between the cities of Bangalore and Chennai, which was witness to the phenomenal growth of the leather industry.

The river Palar cuts through this region and the water flow in the river was considered adequate to meet the requirements of the industry.

7.3 The Growth of the Industry

The growth of the industry was spectacular. It was also aided by the fact that many of the developed countries did not wish to dirty their hands any more with the tanning process. The tightening of the environmental legislation in the West also made India a much more attractive production center than the developed countries. Much of the growth of the industry in India was in the small-scale sector (Table 7.1). The total investment in plant and equipment of most of the industries is less than that prescribed to qualify as small-scale units (US$ 70,000 at that time). The operations are mostly manual. The government tends to be considerably more tolerant with the small-scale units in matters concerning law enforcement. Laws concerning environment protection are no exception.

Table 7.1: Leather Industries in India: Small Scale and Large Scale

State	Small Scale	Large Scale	Total	Percentage Share
Tamil Nadu	536	41	577	53.3
West Bengal	227	6	233	21.5
Uttar Pradesh	140	7	147	13.6
Andhra Pradesh	18	5	23	2.1
Maharashtra	27	3	30	2.8
Karnataka	15	1	16	1.5
Punjab	8	3	11	1.0
Other States	37	9	46	4.2
Total	**1,008**	**75**	**1,083**	**100**

Source: Report on the Capacity Utilization and Scope for Modernization in Indian Tanning Industry. Central Leather Research Institute, Adyar, Chennai, 1990.

The annual output of the tanning industry grew to 1,800 million sq. ft (162 million sq. m) of finished leathers by 1995. A considerable portion of this was exported. Table 7.2 gives the export volume of the industry.

Of the 1,083 tanneries in India, more than half, i.e. 577 (Table 7.1) are in Tamil Nadu and of the 577, Chennai City and the North Arcot district account for as many as 397 tanneries. The production in Tamil Nadu is 44% of the total all-India production. Over 66% of the total production in Tamil Nadu is from the Chennai and North Arcot regions. The data regarding the number of tanneries relates to the year 1990. Since most of the tanneries are in the small-scale sector, they are often not registered with any statutory authority. Authentic figures later than those given here were not immediately available.

Table 7.2: Export Volume of the Leather Industry in India in 1995–96

Item	Quantity	Value US$ (Mill.)	Percentage Share
Finished Leather	283 mill. sq. ft	248.20	21
Leather Footwear	32 mill. pairs	220.60	19
Footwear Components	51 mill. pairs	162.80	14
Leather Goods	–	276.60	23
Leather Garments	9.4 mill. pieces	277.40	23
Total	–	**1185.60**	**100**

Source: Report of the Nationwide Survey of the Leather Product Units of India. Central Leather Research Institute, Adyar, Chennai, 1997.

7.4 The Problem

Over the years the groundwater in the areas where the tanneries are located, has become intolerably polluted. The industry is highly water-intensive. Each tonne of hide/skin tanned requires over 40,000 liters of water. Hence even a small tannery with a capacity to process 3 to 4 tonnes a day uses up well over 100,000 liters of water a day—the daily household requirement of at least 2,500 people. The pollution control authorities have been following their routine procedures in bringing the pollution from the tanneries under control.

Table 7.3 gives the characteristics of a typical raw effluent from a tannery. Table 7.4 gives the standards prescribed.

Table 7.3: Average Tannery Raw Wastewater Characteristics

Parameter	Quantity
Biological Oxygen Demand (BOD)	95
Total Kajeldahl (ammonia plus organic) Nitrogen (TKN)	17
Total Suspended Solids (TSS)	140
Total Chromium	4.3
Oils and Grease	19
Sulfides	8.5
pH	1.0-13

Source: Environmental Guidelines, The World Bank Environment Department, September 1988.
Units: kg/tonne of raw hide processed, except pH.

Table 7.4: Tolerance Limits for Effluents from the Tanning Industry in India

Characteristics	Into Inland Surface Waters	Into Public Sewers	On Land for Irrigation	Into Marine Coastal Areas
Color	Absent	—	Absent	Absent
Total Dissolved Solids (mg/l)	2,100	2,100	2,100	—
Suspended Solids (mg/l)	100	600	200	100
BOD (mg/l)	30	350	100	100
pH Value	6.0 to 9.0	6.0 to 9.0	6.0 to 9.0	6.0 to 9.0
Chlorides (mg/l)	1,000	1,000	600	–
Hexavalent Chromium (mg/l)	0.1	2.0	0.1	1.0
Total Chromium (mg/l)	2.0	2.0	2.0	2.0
Sulfides (mg/l)	2.0	5.0	—	5.0
Sodium (%)	—	60	60	—
Chemical Oxygen Demand (mg/l)	250	—	—	250

Source: Tolerance Limits for Industrial Effluents, Indian Standards Institution, December 1985.

The industry has been making the plea that available technology does not permit it to adhere to the legal requirement. Process economics do not allow them to treat their effluents adequately. This is particularly so as the units are very small. The investment in pollution abatement systems as a proportion of the investment in the plant is very high.

Some parts of the local community have taken the issue to court and the matter is the subject of an intense legal battle.

The industry has been using to advantage the fact that the legal processes in India are slow and it could take years before the Government can act. In the meantime, the problem persists.

7.4.1 The Issue of Water

The availability of water has become another worry for the industry. Earlier, the River Palar in North Arcot provided enough water for the process. Failing this, the plentiful availability of groundwater had been sufficient to meet their needs. Now, over the years, the surface water sources have dried up. The increasing population competes with the growing industry for this scarce resource. The groundwater table in most places has been going down with overexploitation. The available groundwater is polluted with effluents and highly saline.

The industry most often brings in water by truck from distant places, where the well water is still of acceptable quality. The industry can still afford the cost of transporting water, but ordinary citizens, who are often from the poor sections of society, face the brunt of the scarcity of water.

7.5 The Present Approach

The pollution control authorities, as well as a number of research institutions such as the Central Leather Research Institute in Chennai, have been working to develop systems and processes to help the industry to conform to the law. The United Nations Industrial Development Organisation (UNIDO) also has a special program for working on issues concerning the pollution from tanning.

As most of the tanneries are in the small-scale sector and cannot afford expensive treatment systems on their own, Central Effluent Treatment Plants (CETPs) are

being established under the aegis of the local industry association. Although this is helping to some extent, the water after treatment is still not fit for re-use by the industry or by the population. One major problem continues to be the high salinity of the water.

In addition, there is no answer as of now to the huge quantity of solid waste generated from water treatment (the quantity is estimated at 150 kilograms per tonne of hide tanned). Since the solid waste is carelessly disposed of, it finds its way into the groundwater during the seasonal rains. (For details of the leather tanning process, see Annex 7.1.)

7.5.1 A New Approach to the Problem

Since so many agencies had been working on solving the pollution problem, the study team found it difficult to define the kind of input that it could provide. The Central Leather Research Institute has a vast pool of expertise, which deals with every aspect of leather production and serves as a point of reference for the industry and the government. The institution has done commendable work in many aspects of pollution prevention and reduction in the leather industry. Some important contributions of the institution include a technology for recovery of chrome from the effluent and systems for minimizing the use of water in the process. Although, many laudable steps have been taken, such as the setting up of many Common Effluent Treatment Plants (CETP), a solution to the problem is still not in sight.

All the studies so far had focused on the issue of pollution from the tanneries and ways to treat it. The attempt was to use science to bring the effluent as close to the acceptable norms as possible. The quest was for the Best Available Technology. However, it was obvious that the Best Available Technology was still not good enough in any practical sense.

From the perspective of Industrial Ecology, it is not enough to just look at the end-of-pipe, but at the beginning also—to consider the resources going into the system. Without any serious study, it was obvious that the major critical resource was water. Of course, this had to be considered along with the various chemicals that go into the process.

The problem is not just the pollution from the tanneries, but whether the local community could afford to provide this valuable resource to the industry. The second aspect is whether the community could afford its freshwater resources poisoned by the effluents. Water is a serious issue affecting the lives of the population of the region and an academic exercise of how close can we get to the prescribed standards is certainly not just adequate.

If the industry were not using the water resources of the region, a major part of the problem would be solved. Hence it is logical that the industry find some other source of water and does not compete with the population for this scarce resource. Thus, any sustainable solution has to ensure that the industry does not use the water resources of the region. It also has to ensure that the industry does not pollute the water needed by the population.

7.6 A Direction to a Solution

Since dry tanning technology is far from being an immediately practical option to replace conventional tanning practices, one of the possible approaches that emerged was that the industry could draw seawater, as the state of Tamil Nadu has a long coastline. The current process parameters do not permit the use of seawater. This could be a possible direction to research for the industry.

If this is not feasible, then the industry would have to desalinate the sea water for its use and internalize the cost of desalination. Desalination of seawater is an expensive and energy intensive process. The cost of energy has to be minimized. One possibility is the use of the waste heat from a power plant. Many new thermal power plants are being planned in the state and it may be possible to use waste heat from one of the plants to desalinate water. The industry could internalize some part of the cost involved in using the waste heat for desalination, along the lines of the industrial symbiosis that has evolved in Kalundborg. The recovered salt could also be used by the leather industry or could be sold in the market.

A part of the treated effluent that is good for re-use could be recycled to the leather tanneries and the part that the industry finds unusable could be discharged into the sea (as is being done now by one of the CETPs in Chennai). If salinity is the only major issue, there should be no problem in discharging the effluent into the

sea. The power plant design could aim to include a facility for incineration of the solid waste (sludge) from water treatment.

However, for this purpose, it may be essential that the tanneries be relocated along the sea, so that costs of transporting the water could be minimized.

Hence, the following could be a possible solution.

- Re-locate all the tanneries along the coast
- Set up a power plant close to the tannery cluster
- Use the waste heat from the power plant to desalinate water
- Set up a central treatment system for the wastewater from the tanneries
- Re-use the wastewater in the power plant
- Incinerate the solid waste in the power plant

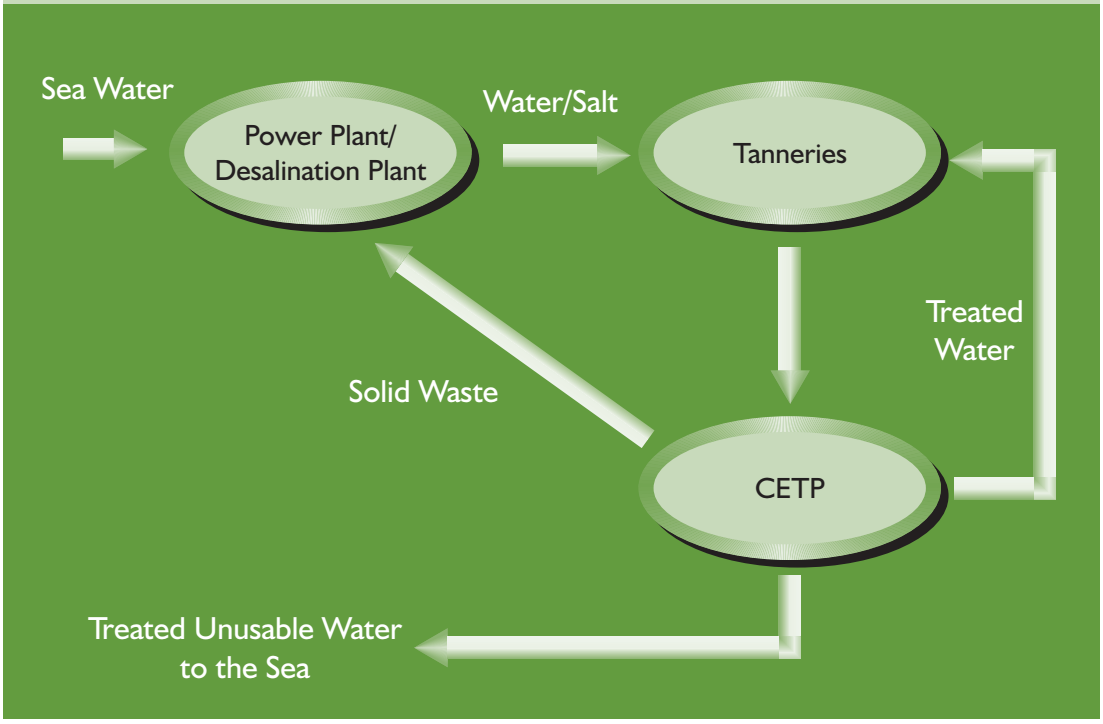
Figure 7.1 gives a schematic view of a possible sustainable system.

This is still a fairly idealistic perception. Considerable work needs to be done in ascertaining the technical and economic feasibility of the concept. However, the essence of this case study is that redefinition of a problem from the perspective of Industrial Ecology can result in a new systemic solution to a problem.

It must be mentioned that such relocation (though it may be a plausible and feasible option in India) cannot be achieved in a very short time. It involves the movement of thousands of families, their homes and their work. If such a scheme as suggested were feasible, it would provide a long-term goal to the industry planner. It is possible to develop a long-range plan (say over a decade) and create a suitable road map to achieve the goal.

FIGURE 7.1

Schematic View of a Possible Sustainable System



Annex 7.1

Leather Tanning & Finishing

Tanning is the process by which animal skins are converted into leather. The skin consists of three layers: flesh, derma or corium and epidermis. The epidermal and corium layers constitute the leather making portion, consisting mainly of the protein collagen. Basically, leather is formed by the reaction of collagen fibers with tannin, chromium, alum or other tanning agents.

This note deals with the processing of cattle hides and sheep skins.

Four general processes are used in this industry: beamhouse; tanning; retan, color and fatliquor; and finishing (Figure 7.2).

Cattle Hide Tannery

The beamhouse process provides for the receiving of the hides and for the initial cleaning and preparation for the other operations. Nearly all hides as received will have been trimmed and graded, and salted or brined at the meat packing plant prior to shipment to the tannery. They are normally received and stored at the tannery in packs 1.5 to 2 meters high. The moisture content in the hides, as received, is maintained during storage.

The first step in the process is to unfold and trim each hide, and cut it in half along the backbone, the step being frequently referred to as halving or siding. The trimmings are collected for shipment to glue or other by-product manufacturing plants.

The sides (or whole hide, in some instances) are transferred to vats, drums, or hide processors for washing and soaking to restore moisture. This serves to remove dirt, salt, blood, manure and non-fibrous proteins from the skins.

The skins are next transferred to a fleshing machine, in which they are carried through rolls and across rotating spiral blades to remove any flesh still clinging. Fleshings are normally recovered and sold for rendering or conversion to glue.

The final operation is the removal of hair. This is done by chemical loosening, followed by either machine pulling or chemically dissolving of hair. Machine removal is practiced where hair is to be recovered. Removal is accomplished in vats, drums or hide processors with lime slurry. Sharpeners, such as sodium sulfide and sodium sulfhydrate, are added in varying strengths depending upon whether or not the hair is to be saved. The unhairing process is one of the principal sources of wastes in tannery operations. The effluent is treated and the solid residue is dumped.

The basic tanning is accomplished in the tanhouse process. The first step is the bating, which prepares the stock for tanning. The hides are placed in a solution of ammonia salts and enzymes in order to de-lime the skins, reduce smell, peptize fibers and remove the protein degradation products. Bating is followed by pickling, frequently done in the same containers. A brine and

acid solution is used to bring the hides to an acid condition for subsequent tanning. This treatment also prevents precipitation of chromium salts in the chrome tanning procedure.

Nearly all hides are either chrome or vegetable tanned. In a few instances alum or other tanning materials are used. For heavy leathers such as sole, mechanical, and saddle leathers, vegetable tanning is used, in a solution containing vegetable tanners or other plant extracts.

Shoe upper leathers are usually tanned in a bath containing chrome sulfate. The tanned leather is then split to produce a grain side piece of essentially constant thickness and a flesh side layer.

The retan, color and fatliquor operations constitute the third major step. Retanning is done principally to impart different characteristics to the finished leather. Chrome, vegetable, or synthetic tanning agents may be used for this purpose. Bleaching with sodium bicarbonate and sulfuric acid commonly follows the tanning in producing sole leather. Coloring is done in the same drums as retanning, using natural dyes or synthetic products. The fatliquoring operation adds oils to the leather in order to replace the natural oils lost in the beamhouse and the tanning procedures.

After the wet processes, the hides are subject to the finishing steps such as drying, staking or tacking, and plating prior to marketing. Staking or tacking involves stretching the hide to make it more pliable and to prevent shrinkage. The plating operation "presses" the hide in order to give it a smooth surface.

Sheep Skin Tannery

Sheep skin tanneries generally omit the beamhouse operation but include a degreasing operation. Thus, the three major processes are the tanhouse; retan, color and fatliquor; and the finishing.

The tanhouse process includes receiving, storing, fleshing, degreasing, tanning and refleshing. After fleshing, the skins are placed in drums, washed and soaked. A solvent or detergent is then added to remove the grease, which is recovered as a by-product from those skins where the wool has been removed. Grease recovery is not normally practiced when the wool (shearlings) is still attached to the skin. The solvent is recovered and reused.

Sheep skins may be either chrome or vegetable tanned, with chrome being most frequently used. Where skins are received in a pickled condition there are no liming and bating operations. In some cases tanning is followed by refleshing.

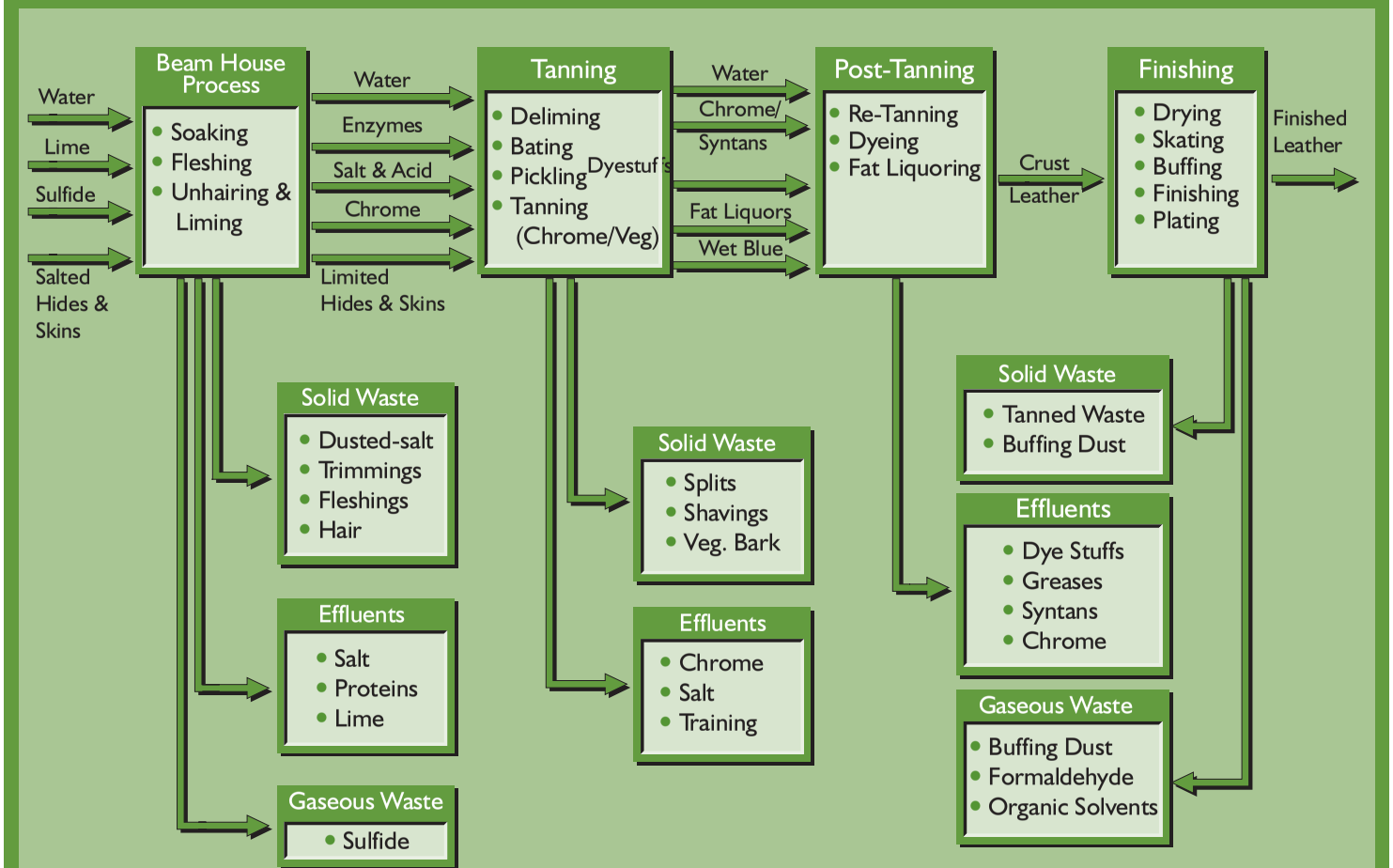
Skins to be dyed are immersed in drums containing a dye (usually synthetic) solution. Some bleaching may be done prior to coloring of shearlings. Fatliquoring follows the dyeing, and is usually carried out in the same containers.

The finishing process following the color and fatliquor operations includes drying, skiving (removal of the skins thin surface layer), staking, carding, clipping, sanding (use of abrasives or wheels to produce a specific texture) and buffing.

Source: *Environment Guidelines*, World Bank Environment Department, September 1988.

FIGURE 7.2

Process Sequences and Nature of Effluents in Tanneries



Source: Report on Capacity Utilization and Scope for Modernization in Indian Tanning Industry, Central Leather Research Institute, Adyar, Chennai, 1990.