

Policy framework for formulating environmental management strategy for sustainable development of tanneries in India

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Abstract

Objectives The leather industry is one of the main examples of industries which play an important role in the Indian economy in terms of exports and employment opportunities, while being blamed for environmental pollution. The objective of this study was to find the advances or improvements in the Japanese leather industry which are not found in typical leather industries in developing countries. We examined the Japanese leather industry in this context because Japan is a developed country in which tanning processes have been a traditional business from ancient times, and also the leather industry has played an important role in the process of economic development of Japan.

Methods The study was based both on information collected from various areas related to the leather industry or leather industry stakeholders, and also on a review of published information. Information was collected through site visits, interviews, questionnaires, and detailed discussions with these stakeholders, as well as from their websites.

Results The framework of a typical leather industry is discussed in three sections: pollution prevention, pollution control, and pollution mitigation related to sources, processes, and impact possibilities, respectively. Eleven basic

differences were noted between the Japanese and Indian leather industries. The availability of melting centers is the main important feature of the Japanese leather sector.

Conclusion Guidelines are suggested which focus on some changes that are expected to lead to both environmental and economic benefits, with better pollution management, which should lead to continuous improvement of the environmental performance of the industry, and, finally, sustainable development.

Keywords Japanese leather industry · Pollution prevention · Pollution control · Pollution mitigation · Environmental pollution

Introduction

Industrialization is becoming an important way for the economic development of any developing country to come out with a new identity as a developed nation. Japan is one of the most important examples in this regard, with the world's second largest economy, and it has become an ideal example for many countries to follow to make changes in their economic policies. India is categorized as a newly industrialized country, and nowadays gives priority to industrialization that encourages the establishment of a large number of small-scale industries which play an important role in the national economy by contributing to gross domestic product (GDP), employment generation, production, and exports [1]. The Indian economy is growing fast not only with associated improvement in quality of life but also with several environmental and cultural problems [2]. Many people throughout the country are changing their livelihoods from agriculture and other traditional businesses to industries, e.g., small-scale

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leather tanneries have gained superiority over the traditional tanning businesses. The Indian leather industry is a good example of a successful industry [3] in terms of exports and employment opportunities. But, considering the environmental impacts of various tanning operations, it is categorized into the list of red-category industries. The main impact of tannery pollution is chromium pollution due to presence of its compounds in the effluent discharges from this industry. Chromium and other chemicals are recovered in India, but technically and economically it is not possible to recover all the chromium or other heavy metals present in the effluent. In such cases some amount of chromium remains and becomes responsible for possible adverse impacts on the environment. Besides this, tanneries are criticized for their consumption of water. Generally about 30–40 m³ of wastewater is generated per tonne of raw material processed. In India, there are many tanning units, of which 75% are in the small-scale sector, and they consume large quantities of water; that is why the leather industry in India is located near river banks: the Ganga river system in Uttar Pradesh, Bihar, and West Bengal and the Palar and Kaveri river systems in Tamil Nadu [4]. Central and State Governments have declared various schemes and suggested many solutions to overcome pollution problems [5] prevailing in the tanneries. Still there is need of some environmental and socially related directional changes in Indian tanneries to improve their environmental performance. An improved environmental performance is dependent on the successful use of new and sufficient technologies for production. Such technologies are based on the demand for various types of products or the market values of products and processes in tanneries that make such market-oriented products. The Indian tanneries can take advantage of the increasing environmental awareness in developed countries by undertaking cleaner production and the export of environmentally friendly market-oriented products [6]. In India, the local market as well as sales to developed countries is also important for leather goods. For improving this business it will be necessary to get general ideas about pollution management in the tanneries of developed countries such as Japan, because Japan is developed country where tanning processes have been a traditional business from ancient times and the leather industry has played an important role in the process of the economic development of Japan. Besides this aspect, in the past few years, Japan has become one of the largest importers of leather garments in the world. In Japan the leather industry is concentrated in two main clusters of tanneries. The first important cluster of tanneries, located in Hyogo prefecture, in the central part of Japan, uses major amounts of the total available quantity of cow hides and most of the total quantity of horse hides to make

leather. Most of these tanneries use the practice of chrome tanning; besides this, Hyogo prefecture is also famous for traditional Japanese oil-tanned leather. Another tannery cluster in Japan is located near Tokyo and these tanneries make leather from pig and sheep skin, including mountain sheep skin. Other prefectures such as Kumamoto do not use chrome tanning practices or there are bans on the use of environmentally hazardous chemicals after the ‘Minamata tragedy’. But they provide the raw material for the main tannery clusters after some basic pre-tanning processes. South Japan including Kumamoto is famous for a special dish ‘basashi’, which contains raw horse meat. So the horse hide is the second local raw material for tanneries.

In India, issues such as environmental performance, the impact of People for the Ethical Treatment of Animals (PETA), cost escalation, and Chinese competition are hindering the export growth of the Indian leather industry. Alam [6] has suggested some guidelines for the improvement of the environmental performance of Indian leather industries. Sreeram and Ramasami [7] have discussed the overall sustainable processes required in leather industries to improve environmental performance. The environmental performance of the industry depends on various factors involved with technologies and production methods, such as the availability of resources and treatment facilities. Are these practices in use in leather industries in Japan? Which resources are needed to adopt such practices? What facilities are available to provide services to leather industries and small-scale industries with respect to emissions and discharges from the facility to the environment? Against this background, it becomes necessary to study the general framework of the leather industry. The objective of the present study was to identify advances or improvements in the Japanese leather industry that are not found in typical leather industries in developing countries. This study was limited to the main areas related to the leather industry. The targeted end-users of this study are environmental managers of tanneries, and authorities from local governments will be expected to consider this study when developing environmental policies at the local level.

Materials and methods

The study is based on information collected from various stakeholders of tanneries, and from a review of published information. The information collected was enough to enable us to design an adaptation policy framework for the leather industry in developing countries. The selection of stakeholders for the study was the first step in this study. The areas of selected stakeholders are shown in Fig. 1.

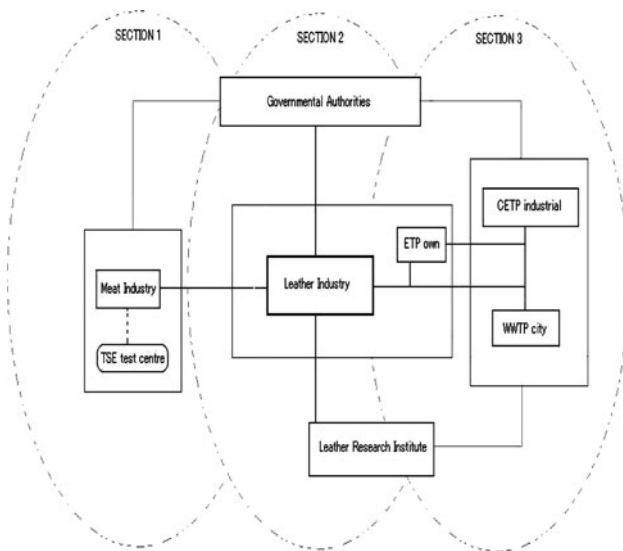


Fig. 1 Areas of selected stakeholders in the leather industry

Criteria for stakeholder selection

Stakeholders selected were people who have the potential to affect the leather industry; those who are the potential leaders in government, research communities, and civil society, who are responsible for facilitating and implementing policies and measures for environmental management; those who control the largest financial contributions for sectoral lending or direct foreign investment; those who are actively working in environmental management or on relevant issues; and the stakeholders who are responsible for the formal and informal dissemination of knowledge.

We undertook visits to find out about the actual workplace environment, the problems of tanners, and details of wastewater treatment facilities, etc. and we had discussions with the authorities and officials from the following selected areas:

1. Kumamoto Chikusan Ryutu Center or ‘Meat industry’ located in south Kumamoto Prefecture of Kyushu island of Japan.
2. ‘Kumamoto Prefectural Meat Inspection Office or the Total/Bovine Spongiform encephalopathy (TSE/BSE) test center located near the above ‘Meat industry’.
3. Kumamoto Prefectural Hall (Prefectural Government Office).
4. Kumamoto Tanpaku Meal Public Corporation/Skin process factory’, South Kumamoto, Kumamoto prefecture.
5. Skin processing factory [Kyushu Genpi Shokai], Nishihara, Kumamoto prefecture.
6. Leather Support Centre for Leather Industry, Hyogo Prefectural Institute of Technology, Himeji, Japan.

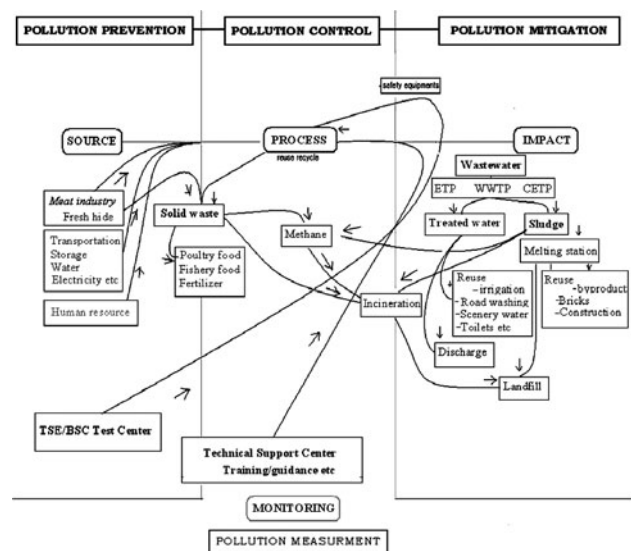


Fig. 2 Sections of typical leather industry in terms of pollution management

7. Wastewater Sludge Wide Area Treatment Plant or Melting Station [Hyogo Nishi Ryuiki Gesui Odei Koiki Shori Jyo], Hyogo Prefecture, Japan.
8. Kumamoto city wastewater treatment plant: named Chubu sewerage treatment center located at Kumamoto.

Information was collected through site visits, interviews, and detailed discussions with these stakeholders. Laws, policies, regulations, and standards regarding tanneries, enforcement of such laws and regulations, obstacle removal, etc. were the main topics of the discussions. We note that discussions with respect to the Indian leather industry are based on general assumptions and deductions. Information has also been collected from using questionnaires, and from searches on the internet websites of institutes and libraries.

Results

The framework of typical leather industry in terms of pollution management is divided into three sections: prevention, control, and mitigation, as shown in Fig. 2. The first important section is related to the source which provides raw material to the leather industry, and so it is linked indirectly with pollution prevention in the leather industry. The second section includes the leather factory itself, which is related to processes and unit operations in that industry to make products, and that is why this section is linked to pollution control. The third section is related to the wastewater treatment and discharges, so it is linked to pollution mitigation.

Major findings

1. Hides and skins are the basic raw material for the leather industry, which originates from slaughterhouses. And that is why the food habits of the people impact on the availability of raw materials to tanneries. In Japan, the main course of the main meal usually includes beef, pork, and other meat, so there are more local suppliers of raw material than in India. India has the largest number of bovine animals but a very small percentage of the population is nonvegetarian and the majority of these are fish eaters.
2. In Japan the raw hide for tanning is also imported from various countries such as the United States, the European Union, Australia, and countries in Southeast Asia. Local hides and skins are generally from cows, horses, pigs, and sheep. Half of the total quantity of cow hide is imported these days, while half is from local suppliers. The skins of other animals such as deer, kangaroo, and other mammals; crocodiles, lizards, and other reptiles; and birds like the ostrich are also imported from the countries where these animals are domesticated.
3. Particularly horse hide, which is rough and densely packed by meat ligaments, and 'Holstein' cow hide is used, and these hides are bigger than the hides of the common Indian cattle breeds. So cow hides from Japanese slaughterhouses are large, thick, and rich in fiber. The cattle feed on protein-rich food, particularly soybean, so they are strong and healthy, which results in a strong hide with a thick fleshy part, and less damage due to diseases etc.
4. The use of machinery and equipment in the meat industry to remove the skins of slaughtered animals results in less damage to the skins/hides, which is beneficial for further processes. However, in India, the meat industry is not totally commercialized. The major part of meat and milk production is from traditional businesses and individual suppliers. This may impact on the features of hides and skins.
5. Competition for jobs is not tough in Japan compared to India; ultimately this results in people really interested in this field working in and with leather industries. The workers in leather industries are economically not weak and they do not belong to a specific caste or category in modern days; this is one of the social differences between the Indian and Japanese leather industries.
6. For the safety of workers in skin processing factories and the meat industry it is necessary to know about the possibility of BSE infections in cattle and pigs. The Government of Japan does not allow the use of hides or skins from animals infected by such diseases, although hides and skins are not food products.
7. Besides chrome tanning, oil tanning is a traditional method of tanning in Japan which gives very soft and flexible leather. However, the vegetable tannin tanning which is the traditional method of tanning in India gives thick and robust leather.
8. The solid waste generated in the pretanning processes of tanneries and slaughterhouse wastes are used for many purposes to produce poultry food, fishery food, and also fertilizers, with the addition of some agricultural products. Besides this, methane generated from such solid waste, particularly from sludge or incineration and landfill, provides other options for skin processing factories and slaughterhouses for managing the solid waste generated in their processes.
9. In Japan, research centers and support centers play very important roles in helping the tanners. This help and cooperation is given in terms of technical support, use of equipment, training, raw material handling, safety procedures, quality assurance, control analysis, and environmental analysis, etc. However, in India, the Central Leather Research Institute (CLRI) does this work. But considering the wide geography of India, it is necessary to establish an institutional framework for the cooperation of local small and medium-sized enterprises, including tanneries, in terms of research and development to improve their environmental performance.
10. Treatment facilities for wastewater provide a wider range of options in Japan than in India. In India, the tanneries' own Effluent Treatment Plants (ETPs) and Common Effluent Treatment Plants (CETPs) provide a treatment facility for wastewater, including sludge. However, in Japan, as well as these two options, city Waste Water Treatment Plants (WWTPs) also treat the nontoxic industrial wastewater, if toxic metals and other compounds have already been removed by industry in their own ETP. Sludge is utilized for the generation of methane and finally the remaining sludge is incinerated and used as landfill. Toxic or metal-containing sludge is treated for melting to generate byproducts used in the production of bricks and construction materials. In India, however, the use of a chromium recovery plant (CRP) is necessary before ETP, which is economically beneficial for the tanners and also results in a lower amount of heavy metals being present in the generated sludge. So, with the treatment facilities in Japan there is a greater incentive to treat wastewater than to treat sludge.
11. In Japan there are stringent effluent standards which are different according to the public water area, the age of the facility, the volume of effluent, the type of

industry, and the ambient water bodies used for the discharge of treated water from tanneries or treatment facilities. This discharge to ambient water bodies is specific and is divided into classes or grades, e.g., river XXX class 1st or grade A, etc. These classes or grades are categorized by State or Local Governments on the basis of the site, area, ecology, and population dependent on that part of the river, etc. In areas where there are dense clusters of tanneries and/or other industries, the treated water is examined in terms of pollutant concentration as well as pollutant load. In India, ambient water bodies used for discharges are specific, but effluent standards are different according to the type of industry, and the treated water is examined in terms of pollutant concentration.

Discussion

There are no specific features of the Japanese hide processing industries, but better facilities such as storage and transportation, resources such as raw materials and water, awareness of health safety, and environmental safety play important roles in making these industries different to leather industries in developing countries. The facilities provided for wastewater and sludge management in Japan are efficient for mitigating the possible impacts of tannery pollution. Such practices as the reuse of treated water and chemicals, and the manufacturing of byproducts from waste have advanced Japanese industrial sectors towards becoming environmentally sustainable. The food habits of the people responsible for the availability of hides for tanning, and basic facilities such as sufficient electricity, water, transportation facilities, and storage facilities, result in the use of fresh hide, which makes further processes easier and consumes less chemicals and salts, resulting in lower concentrations of some environmental pollutants in wastewater.

The variety of skins and hides that is available gives rise to the proper use of skins for specific products. For example, to make leather clothes or shoes with properties that allow the material to ‘breathe’, it is necessary to use a type of skin that has the property of absorbing and releasing moisture easily. Pigskin has sebaceous glands, hair follicles, and pores on the skin which show this property; ultimately leather from pigskin is used for “breathing” materials such as clothes, gloves, and shoes, etc. This results in a limited requirement of chemicals and procedures and so ultimately has economic and environmental benefits. Safety tests such as TSE may play a role in the safety and hygiene of workers in this and related fields. The availability of safety equipment and the use of

machinery while working in the industry are beneficial for workers’ health and for carrying out further processes. Educated, well-trained, really interested human resources in this field also play an important role in the performance of the leather industry. The points shown in Fig. 3 and below should be taken into consideration while determining an adaptation policy for better environmental performance of the leather industry.

1. Use of hide that is as fresh as possible
2. Improvement in a few basic facilities such as electricity, water, transportation facilities, and storage
3. Educated human resources
4. Safety tests such as TSE
5. Separation of wastewater
6. Use of solid waste to produce byproducts
7. Methane production from waste
8. Technical support and training
9. Use of safety equipment
10. Practices which focus on reuse and recycling
11. Treatment of nonhazardous wastewater with municipal and domestic wastewater
12. Reuse of treated water
13. Specific ambient water bodies for discharges
14. Incineration of highly polluted sludge
15. Production of byproducts from sludge
16. Safety landfill

In the formulation of a strategy for better environmental performance, the potential adaptation options, the short- and long-terms costs and benefits, urgency, barriers to implementation, budget, sectoral plans and policies, and regulatory framework should be taken into consideration. Along with these factors, monitoring of the workplace environment and the environment related to the leather industry is a must for pollution measurement. Once this framework is established it should become part of the regular monitoring of government strategies and expenditures, including the traditional local governmental system and

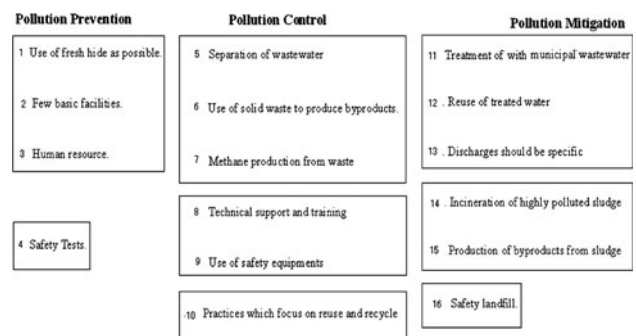


Fig. 3 Changes required for better environmental performance from tanneries

local consultations, financial investment, and political will. The application of these changes will lead to environmental benefits with better pollution management which, in turn, will lead to continuous improvement in environmental performance and, finally, sustainable development.

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