

COMPARATIVE ASSESSMENT OF GREEN SUSTAINABILITY IN LEATHER SUPPLY CHAIN: CASE STUDY OF INDIA, CHINA, PAKISTAN, THAILAND AND INDONESIA

¹ Vishwanath Siddhanti

Research Scholar

Department of International Business, School of Management
Pondicherry University, Puducherry

² Dr. Yarlagadda Srinivasulu

Associate Professor

Department of International Business, School of Management
Pondicherry University, Puducherry

Abstract

Prelude: Leather industry is the oldest manufacturing industry in India dating back to 3000 BC (Vackayil, 2011). The tanning of leather then, was done primarily using indigenous techniques such as rubbing fat, smoking, drying, etc and were used for different utilities such as clothing, tents, footwear, seating's and the do. Skipping to the 19th century, the British introduced the modern methods of chrome tanning (1857) followed by setting up the first leather boot factory (1880) at Kanpur. By 1913, around 22 tanneries were set up in several parts of India in view of growing demand. The independent India witnessed the establishment of CLRI (Central Leather Research Institute) in 1948. In 1951, India banned the export of raw hides and skins, thus reserving the production of leather and leather goods only to the small scale sector. In 1972, as per the suggestions of the Dr. A. Seetharamiah Committee, exports were opened only for the finished leather and value added products. The 1990s witnessed extensive developments in the world trading front in terms of trade liberalization, commanding actions at national and global levels. It was anticipated that trade liberalization would result in gains for developing countries, which possess comparative advantage in production of natural resource and labor intensive products. But it didn't turn out to be true for this sector. In 1990, Germany was the first salvo in the environmentalist's battle against the toxic PCP (Pentachlorophenol) by enforcing ban in 1990, because PCP (Pentachlorophenol) can cause cancer and Germany has also identified other leather induced dangers caused by the use of formaldehyde and cancer causing azo-dyes and benzidine. This was immediately followed by other European countries who were major importers of Indian leather otherwise. Further, the export liberalization defined by WTO (World Trade Organization) from developing countries to developed countries and its adverse effects on the environment of the developing countries, which is true in case of Indian leather exports aggravated the scenario. Hence, the prospects for Indian leather products abroad is huge, since 1992 bans in consideration of the stringent environmental norms and requirements prescribed by the developed countries such as product specifications, regulations, standards, eco-labeling, process, production methods and packaging prescribed by the developed countries are preventing the access to their goods in markets of the developed countries or raise their costs and hence erode the anticipated gains from trade liberalization.

Statement of the Problem: It is apparent from the prelude that the green sustainability issues are not being properly addressed in this sector. This could bear a negative impact on the export prospects of this sector. Hence there remains ample scope to study the competitors to India in this sector and analyze the situations in these countries hitherto India.

Objective: To compare green sustainability and environmental compliance in China, Pakistan, Thailand and Indonesia with India.

Research Methodology: This paper uses *desk-study* approach to highlight the comparison between the countries. The comparison is done on the basis of some critical factors related to environment in general and leather sector in particular. To sum up the comparison of a single sector from various geographical regions is an intricate task. There is dearth of literature which can actually give the comparative picture of the state of leather sector in all the countries. The researcher has sought to give the assessment in the form of a compilation using content available freely on the varied sources of World Wide Web (internet). Therefore, the references have been quoted calculatedly.

Keywords: *Leather, Exports, Environment, Asian countries*

1. GREEN SUSTAINABILITY ASPECTS IN THE LEATHER SUPPLY CHAIN

On critical analysis of the available literature (Shetty, 1963; Usha, 1985; Qureshi, 1990; Sahasranaman, 1993; Chandramouli, 1999; Gupta, et.al, 2007; Yadav & Agarwal, 2007; Ozugnay, et.al, 2007; Reddi & Narsimha, 2012) on the topic in question it becomes quite apparent that the very basic nature of leather processing is pollution oriented and also green sustainability aspects have not been addressed in the India's leather sector up to the mark. But the ground realities in the industries need to be assessed. Hence a field study in a leather manufacturing industry was considered relevant. This section of the study reviews the entire supply chain of the leather production and foregrounds the green sustainability aspects in the different stages of leather processing such as tanning, post tanning and finishing, and attempts to understand the intricacies of the leather supply chain and its green conjunctions in manufacturing *cum* exporting organizations.

1.1 ABC Leathers - A case study

ABC leathers was established in the year 1986. It is engaged in manufacturing and exporting of quality and finished leather for shoes and garments. ABC is equipped with updated technology and product development techniques which cater to precision output. The production capacity of the industry is around 150000 square feet per month. Unlike any other leather manufacturer this industry also requires abundant amount of water (35000 to 40000 litres per day). 10 to 20 tonnes of assorted chemicals are required per year in tanning process which are supplied by Indian and European suppliers and has helped the ABC leathers to maintain good reputation as manufacturers of good quality leather. This industry is energy intensive and requires uninterrupted supply of electricity for its daily operations. The industry employs 40 workers. Majority of them are from weaker sections of the society for whom finding job is too difficult. Some workers are working for fixed salary and some of them on daily wages. Women workers are around 10% of the overall work force. Only a part of the work force is insured with Employee State Insurance (ESI). Secured clothing such as masks, hand gloves, jackets or aprons, and safety equipments are provided to only few of the workers. The raw skins are purchased from regular suppliers. The raw skin is usually stored in common salt which allows longer period of storage. The next process is the tanning process.

1.1.1. Tanning Process- The quantity of skin received is around 1000 pieces per day. These skins are received in gunny bags. The time consumed for tanning operation is usually 21 days, which includes the following stages of operations

1.1.1.i. Beam House Operations – Raw skin is first trimmed manually to remove unwanted parts and further it is weighed and sent for washing.

1.1.1.ii. Washing: Washing is done in a big tank, with paddles, filled with water. Paddles run for 1 to 2 hours with the help of machine. This process removes the impurities because of beating action, which helps the hair to open up. The water from this tank is then drained out with the help of a pipeline.

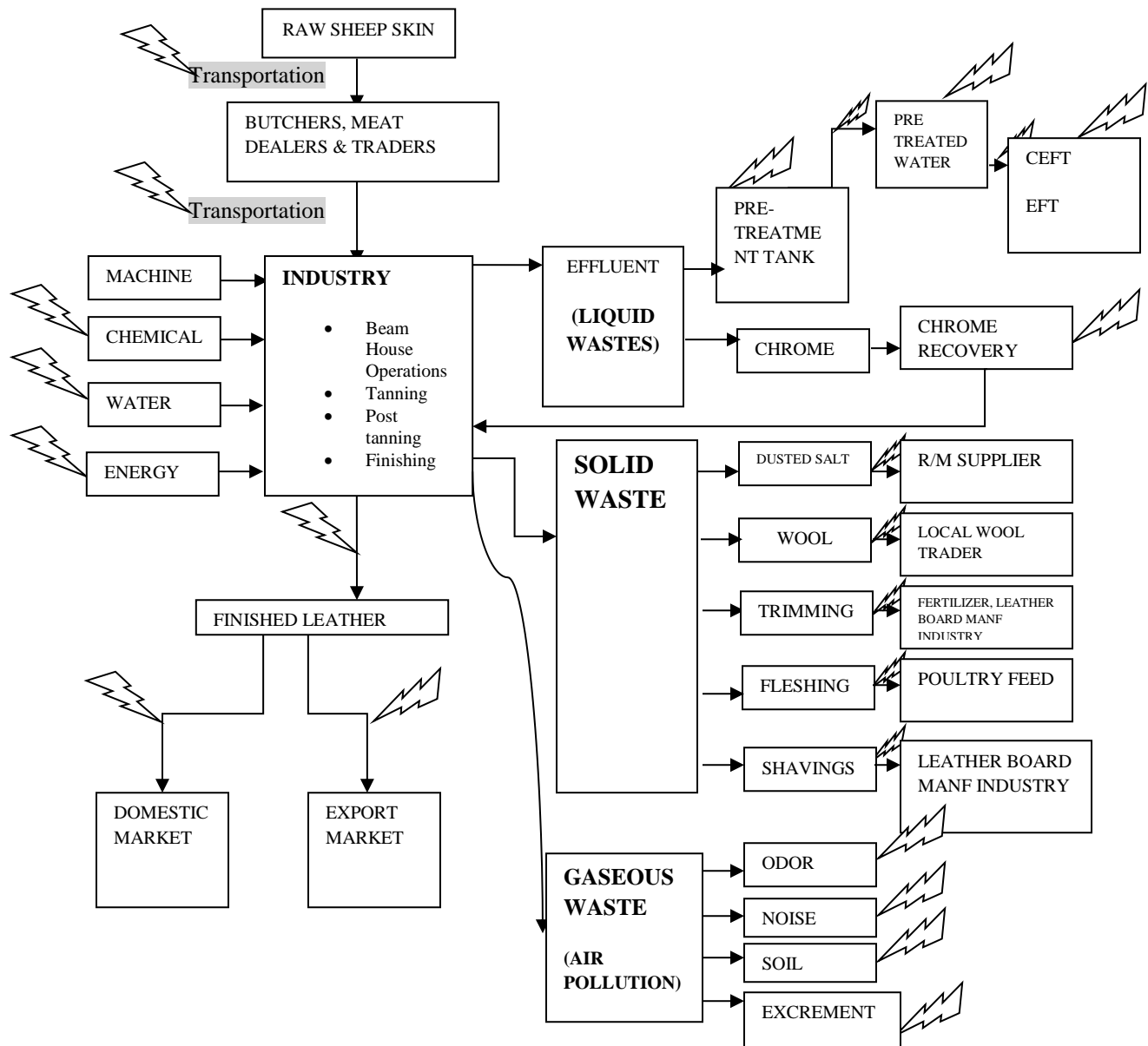
1.1.1.iii. Soaking: In the same tank, soaking is done by adding fresh water added with antibacterial preservative like sodium sulphide. The skin is then soaked overnight which removes dirt, manure, blood and preservatives from the skin.

1.1.1.iv. Liming: Next day, lime powder and sodium sulphide is added in the same tank. Lime helps the skin to swell and makes it soft and sodium sulphide helps to dissolve hair. The duration of liming is 48 hours.

1.1.1.v. Fleshing: Limed skin is then removed from the tank and fleshed by mechanically removing the extraneous tissue from the skin. It is then passed through the machine having two rollers and one blade to squeeze out the skin.

1.1.1.vi. Deliming: In this process the lime from the skin is removed as it is necessary to avoid interference with the subsequent tanning stage. Then, washing is done in wooden drums with manhole at one side of the drum, which is used to remove heat generated in this process. Ammonium sulphate and ammonium chloride are added in the drum to de-lime the skin.

Figure 1: Diagrammatic representation of Supply Chain Network of leather industry and green issues (marked by lightning bolt).



Source: Contrived by the researcher (2013)

1.1.1.vii. Bating: The unhaired, fleshed and alkaline skin is treated with enzymes, to remove hair remnants and to degrade proteins. During this process, hair roots and pigments are removed. The hides become softer by this enzyme treatment, which makes the skin fluffy. Air is blown in a piece of leather and squeezed, if the air passes out through the skin, it confirms that the leather has become soft and fluffy.

1.1.1.viii. Degreasing: The drum is again loaded with the skin for degreasing. Degreasing agents like sodium bisulphide and common salt are added to remove fats and oil from the skin. It also improves the final quality of leather.

1.1.1. ix. Pickling: Pickling increases the acidity of the skin to a pH of 2.8 by adding sulphuric acid. It improves the penetration of the subsequent tanning materials.

1.1.1. x. Chrome Tanning: After pickling, when the pH is low, chromium salts (Cr³⁺) are added. To fix the chromium, the pH is slowly increased through addition of a base like sodium bicarbonate, which increases the pH to about 3.2 to 3.5. This

process requires around 5 to 6 hours. The chrome tanned leather is called as semi finished leather or crust. The chrome is recovered in a separate tank.

1.1.2 Post tanning

Post tanning operation includes neutralization, retanning, dyeing and fat liquoring. Chrome tanned leather is loaded in a drum for dyeing having fat liquors, syntans and proteins to soften the leather. After dyeing and setting, the leather is hooked for natural drying.

1.1.3 Finishing

In this process the leather is given desired properties, includes processes like drying, skating, bluffing, finishing, plating, which is done with the help of advanced machineries. Finished leather is with different colors and patterns called as swat leather, natural leather, etc. This finished leather is packed in gunny bags with corrugated sheets and is then ready for transportation. For export, the packaging is done as per the requirement of buyer, which is mostly done in the corrugated box with all the specifications of leather mentioned on the box. The finished leather from this organization is then exported to Germany. Leather trimmings are used to make reconstituted leather which is used to make chappals and small leather products.

Table 1: Summary of green sustainable issues in India’s leather sector

Pollution of Air, Water, and Soil	<ul style="list-style-type: none"> Slaughter is legally allowed only in the states of Kerala and West Bengal. Rest of the states the slaughter happens illegally in the unorganized sector. The environmental aspects are neither mandatory nor monitored Water pollution is serious problem. Rotting waste and effluents is often dumped in the nearby rivers, water resources and in agriculture lands, leading to severe water and soil contamination As majority of the presence is in SME (Small and Medium Enterprises), pollution monitoring becomes highly impossible
Water Usage and Availability	<ul style="list-style-type: none"> Tanneries are highest consumption of fresh water about 30000 to 40000 liters per day leading to severe depletion of ground and surface water
Waste	<ul style="list-style-type: none"> No organized systems of disposal of waste exists Biggest problem is 50% of the hides and skins turn out to be solid waste (2400 tonnes/day)
Animal Welfare	<ul style="list-style-type: none"> Animals are ill treated during transportation Ill practices in slaughter is also witnessed Many indigenous breeds are close to extinction in India
Natural Resources	<ul style="list-style-type: none"> Land resources are affected by livestock grazing leading to depletion of marginal lands Water is key ingredient in all the stages of production
Nuisance	<ul style="list-style-type: none"> Effluents, noise and dust emanating from the industries is a serious issue with the local residents
Health Hazards and Safety of the Employees (HHSE)	<ul style="list-style-type: none"> Tannery workers are exposed to harmful chemicals during the process handling, loading and unloading HHSE aspects are poor in SME’s Child labor exists in industries Labors are paid less

1.2 Comparative Assessment Of Green Sustainability In The Supply Chain: Case Of China, Pakistan, Thailand And Indonesia

As far as the Asian competitors of India in leather exports is concerned China, Indonesia, Thailand and Pakistan are important leather exporters. To farther extent, export of leather and leather products in these countries do compete with India. Therefore, it would be instructive to compare green sustainability and environmental compliance in these countries with India. The comparison is done on the basis of some critical factors related to environment in general and leather sector in particular.

1.2.1 Profile of Leather Industry in China

China is the largest exporter of the leather in the world. China’s leather industry consists of 16,000 organizations, employing more than 2 million people and contributing over US\$ 12 billion per annum (as on 2002) in export revenue. Among these there are 2900 tanning organizations, which are mainly driven by domestic demands. The total production value of hide and leather industry was approximately US\$ 254 billion in 2011. The industry consists of four main parts- tanning, shoe making, leather goods and fur. The growth of Chinese leather industry has been magnificent. Majority of the producers and manufacturers are situated in Hebei and Zhejiang. The bifurcation of the hide/leather market value is 50.9 percent for small enterprises, 33.9% for medium enterprises and 15.2 % for large enterprises.

China has been facing serious challenges of the changing global trade requirements with regards to environmental protection. Chinese leather industry has taken a note of the developments and has taken serious measures to meet these challenges. Some of these are discussed below

- a. Environmental regulation associated to waste disposal and discharge have been framed and implemented. There are 90 nation wide rules and 1020 local ones on environmental protection. Small scale units which are not in a position to stick onto these regulations have been shut down. According to the government policies tanneries with capacities more than 100000 sheets per year should have their own ETP; those between 30000 and 100000 can join CEFT; and those with capacity less than 30000 should be closed down.
- b. So far as the waste discharge of the leather industry is concerned, it is estimated that 100 million tonnes of waste water a year, about 0.4 percent of the total discharge of industrial waste water in the country. The waste water norm has been specified vide GB 8978-1996.

Table 2: Summary of green sustainable issues in Chinese leather sector

Pollution of Air, Water, and Soil	<ul style="list-style-type: none"> • Stockbreeding is the 3rd most pollution intensive in China because of high amount excrement • China’s leather industry has grown manifold economically in the last 30 years at the cost of environment • The pollution from the leather manufacturing and tanning is posing a serious threat
Water Usage and Availability	<ul style="list-style-type: none"> • Leather processing requires high volume of water • China is suffering from scarcity of potable water. • Having to support 20% of the world population and 5% of the worlds renewable fresh water resources, water pollutions further add to the grievance • 78% of the China’s water is unfit for human consumption • 90% of ground water is polluted • 19% of the China’s river basins and 35 % of its lakes and reservoirs are too polluted to be used for agriculture purposes
Waste	<ul style="list-style-type: none"> • Amount of waste due to breeding is about 17.84 million tonne • Alkali is used to remove hair which results in liquid waste generation which contains sodium and suspended solid particles
Animal Welfare	<ul style="list-style-type: none"> • Inhumane treatment and illegal slaughtering is also an issue
Natural Resources	<ul style="list-style-type: none"> • In a recent survey done by Greenpeace, the scientists of Chinese Academy of Agriculture Sciences have warned that temperature rise and water shortage will lead to reduction in agriculture yield by 2050, which will further affect the cattle yield.
Nuisance	<ul style="list-style-type: none"> • Local residents who reside in the vicinity do complain about air, water and solid pollution
Health Hazards and Safety of the Employees	<ul style="list-style-type: none"> • Not enough protection equipments are provided to workers which results in fatal accidents and permanent disability of the workers • Chinese law doesn’t permit employing children below the age of 16 years, but in the remote areas the issue is still to pay attention. • Forced labor is also extremity
	<ul style="list-style-type: none"> • There are cases of missing contracts, high working timings

- c. China follows western countries in the implementation of environmental regulations. A compensation fee is charged according to the quantities and concentration of pollutants released by a violator instead of considering these as legal violations. But there is no denying of the fact that various deterrent factors such as corruption, subjective evaluation of level of violation, penalty fixation dilutes its effective implementation

- d. After the PCP ban by Germany in 1989, the Chinese government then ordered immediate ban on the production of PCP as fungicide. China, till today depends on imported fungicides with non-hazardous chemicals. China constantly revises environmental standards and regulations to be in line with international requirements
- e. China is very particular to ensure that the inflow of FDI does not lead to environmental degradation. A long term vision of sustainable development, ensuring economic, social and environmental benefits of trade, guides the Chinese policies. In spite of the tightening of regulations, the overall environmental performance of the Chinese leather industry is not satisfactory because many state owned and small scale units are not meeting the requirements and norms. The waste generated by these industries are often dumped untreated or is dumped with municipal waste. No standard land fills for this waste has been done. However, increasing awareness of the Chinese government about these issues and its continuing endeavor to improve the situation gives hope that these challenges will be over come sooner than later. Thus, the summary of green sustainable issues in China is given in Table 2

1.2.2 Profile of the Leather Industry in Pakistan

Pakistan's leather industry is one of the major foreign exchange earners for the country. There are over 800 tanneries in Pakistan of which around 300 use the same old methods of tanning. The formal sector uses the chrome tanning method which is prevalent in all most all the industries. The leather clusters are concentrated in few areas, among them the most prominent are like Kasur, Karachi, and Sialkot. The total leather exports for the year 2011-12 was around US\$ 226 millions. This sector contributes about 5% of the countries GDP and employs about 500000 people in the sector. The relationship between the Pakistan leather trade and the environment is being strained by a growing demand for its product in the world and ignorance of environmental problems resulting from

Table 3: Summary of sustainable issues in Pakistan leather sector

Pollution of Air, Water, and Soil	<ul style="list-style-type: none"> • Large section of unorganized slaughter houses with conventional methods- blood carcasses and hair • Tanneries near Peshawar are polluting Kabul river, domestic consumption is under threat • Sulphides and chromium are 20-100 times higher than the permissible limits • 9000m³ of waste generated everyday left in the near by water bodies
Water Usage and Availability	<ul style="list-style-type: none"> • For every 30kg of food cattle needs 100-150 liters of fresh water everyday, 5-6 times a day • Tanneries consume water in the range of 350-1000 liters/ kg. No reuse of water through heat and condense method
Waste	<ul style="list-style-type: none"> • Solid waste at the rate of 1000 tonnes/day. No proper treatment
Animal Welfare	<ul style="list-style-type: none"> • No specific document could be traced regarding this
Natural Resources	<ul style="list-style-type: none"> • Land and Water are the 2 key ingredients of the entire conversion process which are scarce in Pakistan.
Nuisance	<ul style="list-style-type: none"> • Slaughter house disposal of waste is an issue • Local residents pose problem of air, water and solid pollution
Health Hazards and Safety of the Employees	<ul style="list-style-type: none"> • Slaughter houses do not maintain clean environment for workers • Residents near slaughter houses have complained of vomiting dysentery, respiratory problems , skin rashes and diarrhea • 0.05% chemicals are allowed per PPM. Actual is more than 2% • US Dept of labor confirmed child labor in Pakistan leather sector • Bonded labor exist in tanneries • Bare minimum protection is provided to the workers. • Daily wages is around 2 dollars per person per day

manufacturing process. As far as the process water norms are concerned for tanning it is around 50 to 60 liters/kg of hide, but the actual quantum of waste water is much higher. The waste water discharged is around 30000 to 36000 cubic meters per day. The current practice is to leave this water untreated into the local environment, which causes severe contamination of soil and ground water. On the disposal of solid waste from the process, except for dusted salt, there are secondary uses of it such as glue, manure, and poultry feed. However no strict testing of the quality of solid waste reported to exist. Air emissions are found to be well below the level specified by NEQS (National Environmental Quality Standards). Ammonia emissions during processing and washing of drums have adverse effect on worker's health. Therefore the overall situation with regards to environmental management by the tanning industry in Pakistan is not satisfactory. Thus, the summary of green sustainable issues in Pakistan is given in Table 3

1.2.3 Profile of the Leather Industry in Thailand

The leather sector of Thailand earned about \$US 0.519 million of revenue for the country in 2010. The sector employs around 370000 people. The leather industries are clustered in two locations namely- Samuts Parkan and Bang Pu district. The leather tannery industry in Thailand is very small. 20 large tanneries provide on and average 300 cow hides daily or more than 500000 square feet per month. 50% production exported and the rest half sold to local manufacturers. 30 medium tanneries produce less than 100 cow hides daily or less than 100000-150000 square feet per month. 80 small tanneries produce less than 100 cow hides or less than 100000 square feet per month. The processing of leather is done by the large, medium and small enterprises in the ratio of 60%, 35% and 5% respectively. Majority of tanneries are family owned. The most critical environmental problem faced by Thailand is water pollution. Therefore it has been given highest priority in the government's environmental programme. Chao Phraya is main river which flows through the Bangkok area is facing acute pollution problem of untreated water. Besides depleting oxygen in the river, the untreated water contaminates the river with heavy metals including mercury. The government has setup Wastewater Management Authority in 1995, to build efficient waste water treatment facilities and administer them, until now these initiatives have not brought about any significant changes in the situation.

In so far as the tannery waste is concerned some steps have been taken to install (Common Effluent Treatment plants (CEFT). But these plants are basic in design. Solid waste of tanneries are converted to useful bi-products and do not cause a serious problem at present. Concussing, it can be stated that the overall situation with regards to environmental management of leather industry is not satisfactory for one or the other reason. The government agencies have not exerted enough pressure on the industries to adopt the norms set forth. Nonetheless, the industry is becoming increasingly aware of the fact that unless it is able to deal with pollution issues effectively, its exports will be severely affected. Thus, the summary of green sustainable issues in Thailand is given in Table 4

Table 4: Summary of sustainable issues in Thailand leather sector

Pollution of Air, Water, and Soil	<ul style="list-style-type: none"> • Very minimal water treatment facilities resulting in pollution of areas in terms of water, odor, noise and soil pollution
Water Usage and Availability	<ul style="list-style-type: none"> • Thailand consistently faces twin problems with water; severe flooding in rainy season and drought in summer season leading to water scarcity
Waste	<ul style="list-style-type: none"> • No waste problem reported on the sector
Animal Welfare	<ul style="list-style-type: none"> • No reports of animal cruelty
Natural Resources	<ul style="list-style-type: none"> • Increasing land usage for cultivation leads to cattle farmer going further far to graze the cattle.
Nuisance	<ul style="list-style-type: none"> • Pollution from farms reported
Health Hazards and Safety of the Employees	<ul style="list-style-type: none"> • There are no reported incidents of health hazards • Restricts child labor • Migrants are more vulnerable to bonded labors- Myanmar, Laos and Cambodia

1.2.5 Profile of the Leather Industry in Indonesia

The leather and tanning industry in Indonesia is quite strong, supported by a sizeable population of cattle and sheep. 60% of the raw materials required for manufacturing and processing the author are imported from the US and Australia by the industry. The annual export turnover is more than US\$ 2 billion. Leather sector occupies pride in Indonesia with a gross contribution of 75.7 trillion rupiah to the GDP in 2012. Small scale production has a capacity of 250000 square foot of leather, while large scale industry has production capacity of 200000 square feet annually (2010). Indonesia has 70 tanneries in the medium and large scale sector employing 7430 workers and 470 tanneries in cottage and small scale sectors employing 2650 workers. Of the 470 tanneries in the cottage and small scale sectors, 453 are located in the city of Java. There are only few tanneries which have installed waste water treatment plants some of which are not functioning properly. Most of wastewater generated is left to the rivers with little or no treatment at all. The Ministry for Pollution and Environment takes care of the environment issues and is enforced by the respective provincial authorities had launched the 'PROKASIH' in June 1989. PROKASIH was a clean river programme due to the high level of pollutants caused by the tanneries situated in these areas. There are also activities to control the generation and disposal of hazardous wastes, and a programme for water quality standards. There are several larger and medium sized enterprises which have installed ETP's of their own, but not all of them are well designed and functioning. Despite investments, the overall situation with regards to treatment and disposal of wastewater from the tanneries in Indonesia continue to pose serious problems. Solid waste is readily used in the manufacturing of by-products. People staying in the vicinity of the leather clusters are often complaining about the malodor. Thus, the summary of green sustainable issues in Indonesia is given in Table 5

Table 5: Summary of sustainable issues in Indonesia leather sector

Pollution of Air, Water, and Soil	<ul style="list-style-type: none"> • Finishing requires coloring. Reports with heavy chemical contamination are witnessed like sludge, organic solvents and heavy metals, from finishing and tanning process • River contamination have been reported
Water Usage and Availability	<ul style="list-style-type: none"> • Indonesia is facing severe water shortages with 1/3rd of the population having little access to clean water • Excess use of water in leather processing will further add to the problem
Waste	<ul style="list-style-type: none"> • Disposition of waste irresponsibly creating environmental problems
Animal Welfare	<ul style="list-style-type: none"> • Cruel treatment of live animals has been widely reported in Indonesia
Natural Resources	<ul style="list-style-type: none"> • Indonesia source only 40% of its leather locally rest all is imported
Nuisance	<ul style="list-style-type: none"> • River contamination
Health Hazards and Safety of the Employees	<ul style="list-style-type: none"> • Health awareness is very low in Indonesia • Child labor especially in family owned businesses is a norm in Indonesia, reasons being poverty and social culture • Human Trafficking prevalent • Questions remain on the effectiveness of Unions

2. Discussion and Conclusion

A comparative assessment of the leather industry in India with its competitors such as China, Pakistan, Thailand and Indonesia indicates that the situation is not very different among these countries. The legal framework is present in all the countries, but the efficiency of implementation varies from country to country. Within countries as big as China, it varies from province to province. But here is no denying fact that the environmental consciousness among sectors across all the five countries have improved tremendously, partly due to domestic regulations and wholly due to international pressures and regulations.

Further, it was noticed and recorded during the informal discussions with the proprietor of ABC Leathers that more and more organizations are applying for newer range of certification standards to satisfy their own organizational green sustainability needs and the needs of external stake holders. This study argues that mere certification of the standards may not serve the purpose and may increase the girth of parallel manuals and documentations which is nothing but duplication of work and waste of time. Therefore, the organizations should have a comprehensive management system covering all certifications generally being adapted in these organizations (*such as QMS, EMS, OHSAS and Ecolabel*). The authors strongly suggest the application of Green Supply Chain Management methodology for attaining green sustainability in the leather processing and manufacturing.

References

1. H. Ozugnay, S.Colak, M.M.Muttu, F.Akyuz (2004), 'Characterization of leather industry wastes', Polish Journal of Environmental Studies. Volume.16, No.6 (2007), 867-873
2. Kumar, R., Gessese, N., *Responding to Global Standards: A Framework for Assessing Social and Environmental Performance of Industries*. UNIDO, 1998.
3. Kumar, S. C. (1997). Indian Leather Industry: Growth Productivity and Export Performance. *APH Publishing Coporation*
4. M. Reddi Pradeep, G.Narsimha (2012), 'Effect of leather industry effluents on soil microbial and protease activity, 'Journal Environmental & Biology, 33, 39-42 (2012), ISSN: 0254-8704, retrieved from website www.jeb.co.in
5. Sarkis, J. (2003). A strategic decision framework for Green Supply Chain Management. *Journal of Cleaner Production*, 397-409
6. Shivam Gupta, Rocky Gupta, Ronak Tamra (2007), 'Challenges faced by leather industry in Kanpur', Term Paper
7. Sinha, S. A. (1991). Leather Exports: An Illusory Boom. *Economic and Political Weekly*, 26 (35), August 31, M111-116