Sustainability Challenges of Tanning Industries in Ethiopia

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Abstract

Since developing countries like Ethiopia have huge livestock resource potential and they must utilize available raw materials in order to eradicate poverty by generating the required revenue and create employment opportunity for their citizens. Life as usual way of industrialization that is “take-make-use-dispose” scenario is not recommended for sustainability of the leather sector. In order to mitigate environmental challenges, the leather industries need to implement RECP, waste recycling and reuse technologies in order to comply with the existing environmental discharge norms of the country as well as to ensure the social cohesion among the community, it is critical to establish the common effluent treatment facility having the state of art technologies that enable the tanneries to comply with the global environmental and social compliance requirements such as ZDHS, ZLD and LWG. To establish eco industrial park, regional government, land administration bureau’s and relevant government and non-government organizations must work closely in order to manage the waste generated. In addition to that the availability of raw hide and skin resource is not by itself guaranty to develop the leather sector, there should be development of related industries such as chemical industries, agro processing industries, mining sector, energy sector, agricultural sector and furniture industries are important for sustainable development of the leather and leather product industries.

Keywords: sustainability; resource efficiency; environmental challenges

1. Introduction

1.1 overview of the leather industry

The leather industry is considered as one of the top priority areas to drive our country’s economy due to its huge resources base. The industry benefits and attracts the FDI and expected to be one of major source for foreign currency for the country. Ethiopia has abundant livestock resources about 70 million cattle, 43 million sheep and 53 million goats (CSA 2020/2021 Survey report). Based on the off-take rate of 14 % for cattle, 40% for sheep, and 27% for goat (CSA, 2021), the potential production is estimated at 10 million hides, 17 million sheep skins 14 million goat skins.

The leather industry is a very old manufacturing sector producing a broad range of goods such as leather footwear, leather bags, leather garments, and so on. The raw material used in the leather industry is derived from the waste product of the food industry, specifically from meat processing. This waste product

is converted into desirable and useful leather products which are one of the most traded products globally[1].

Animal husbandry is the first step in the worldwide leather value chain, while leather goods production is the last. The most common hides are sheep, goats, and bovine hides. Before becoming leather products such as shoes, clothes, and accessories like belts and travel bags, hides/skins are utilized and processed in tanneries which is by itself a complex and resource-intensive process posing major environmental pollution[2].

One of the most trafficked goods in the world is leather. With an estimated annual global trade value of about US$100 billion, the leather and leather products sector is significant to the global economy. The population of the world increased significantly in the 20th century, and it is still expanding now. The demand for meat has increased as a result of the expanding population and overall rise in affluence, which has also kept the availability of raw materials for leather is relatively stable. According to current forecasts, the population will continue to grow along with the supply of raw materials for making leather, but costs will rise and there will be less land available for raising cattle and growing grains to feed the cattle. The availability of leather raw materials has increased in emerging nations, whereas the quantity of hides and skins has decreased in wealthy nations due to a decline in the per capita consumption of red meat. These days, emerging nations provide more than half of the world's supply of raw leather, and those nations with significant resources are increasingly looking to turn those raw materials into high-value-added footwear and leather products[3].

One of the important things of the sector is the use of renewable raw materials such as raw hides and skins as a major input for the production of different types of finished leather and leather products because the raw hides and skins are available because of the sustainable consumption of meat and meat products by a human being.

As per the data from International Trade Center (ITC) the global trade transaction in leather and leather products is estimated at over $ 250 billion a year and the market is still unsaturated. In this part of the report the overall global export trend of leather and leather products, world major exporters, world major leather and leather products importers will be presented, which shall be vital to understand the overall international performance of leather sector.

Based on International Trade Center (ITC) data, the global market trend of leather, footwear and leather products is analyzed for the last five years (2017-2021) and presented in the following sections.

As per the ITC data over the past five years (2017-2021), on average around $ 20.5 billion has been earned annually by the exporters of leather. As shown in the above figure about 43 % of the global supply of leather is supplied/ exported by the world’s top five major exporters (Italy, the United States, Germany, Brazil, and Hong Kong). Italy, the leading exporter of leather supplied about 42.8 % of world exports. The United States and Brazil being the second and third largest exporters of leather and they exported around 22 % and 15 % respectively to the world market.

Today, leather is still one of the most luxury materials that are used to produce a wide range of high-end products such as leather footwear, leather bags, leather garments, and so on. The rise in customer spending power, evolving lifestyles, and rising penetration of smartphones are also contributing to the growth of the market. Increasing awareness through online channels is encouraging consumers to purchase the latest and unique designs of leather goods. Furthermore, the growing number of working women across the world is also resulting in an increased interest in personal goods, such as handbags and footwear, which is contributing to market growth.

According to global leather industry factsheet 2020 report, Asia Pacific is the currently the largest market for leather and leather goods, the region has generated the highest revenue in the world for leather goods over the recent years. The developing countries such as India, China and Dubai are expected to pose the highest market demand in the near future, mainly due to the rising disposable income and rising inclination towards designer leather bags and accessories. North America also holds one of the biggest markets for this industry in terms of leather imports and leather products consumptions. China is the largest leather producing country in the world with over 6.2 billion square feet leather produced every year, representing more than 25% of the annual global leather production.

Leather processing has emerged as an important economic activity in several developing countries that are dependent on agricultural economy. It has been estimated that about 1.67 × 109 m2 of leather is being made annually in the world (FAO, 2001). The bulk of the leather production is carried out in developing economies, partially because of the high labor intensity of the processes involved in the conversion of hides and skins into leather. Leather has assumed importance as an opportunity sector for social development, employment generation, and export realization for most of developing countries [4].

Finally, the concept of sustainability of leather sector is addressed and best available practices to be implemented for the sustainability of the leather sector such as resource efficiency and cleaner production(RECP), conventional leather processing techniques and its environmental impacts, waste water treatment techniques, innovative technologies for waste utilization and reuse techniques as well as the real practices for Ethiopian leather sector potential and the level of treatment plants performance towards meeting the national waste generation standards is addressed. In addition to this, improvement area for resource efficiency and cleaner production have identified, conclusion and recommendations are made with respect to the sustainability and global competitiveness of the leather sector. Finally, for the leather industry sustainability, implementation of circular economy principles integrated with industry 4.0 is critically important to tackle the current challenges of the leather sector.

1.2. Sustainability in the leather Sector

Sustainability is defined by the World Commission on Environmental and Development as “development that meets the needs of the present generation without compromising the ability of future generations to meet their needs” (Keeble, 1988, p. 20). There is a relation between an industry and the environment that is a crucial part of the industrial business performance. According to various criteria, the importance of economic, social and environmental dimensions varies from time to time (Andrews, 2015). It is obvious that the success of an industry largely depends on its manufacturing performance. Accordingly, sustainable manufacturing practices have recently gained popularity due to increased consideration for environmental, social, and economic issues. For the given manufacturing industry to be sustainable it fulfills the three components of sustainability such as environmental sustainability, social sustainability and environmental sustainability at the same time otherwise the growth of the industry cannot be realized

1. **Material and Methods**

Materials and methods for this study have been described. To evaluate the three components of sustainability, different reports, total production cost, export data and laboratory test results have been analyzed for various tanneries in Ethiopia. To see the economic sustainability of the tanning industry in Ethiopia actual capacity utilization of each tannery compared with the attainable capacity have been measured by collecting, organizing and analyzing actual soaking performance as a limiting factor.

In order to evaluate the environmental performance of the tanning industry waste water samples were collected from different tanneries and key parameters such as chemical oxygen demand(COD), biological oxygen demand(BOD), suspended solids(SS), chlorides, sulphides and total chrome contents have been

analyzed at leather and leather products industry research and development center waste water analysis laboratory by using the official test methods. In order to see the actual environmental performance of each tannery, two kinds of sample collection were made: and the results were compared: the first one was waste water sample collected and submitted by private tanneries (Secondary source) and the second approach was that the waste water samples were collected by the laboratory analyst him/herself (primary source). Totally 100 different waste water samples were collected and analyzed from the different private tannery treatment outlet by using leather and leather products industry research and development laboratories and 218 samples were collected by private tanneries themselves and submitted for analysis.

3. Results and Discussion

3.1 Resource efficiency and cleaner production /RECP/ techniques and their advantages in leather industry

One manufacturing sector that uses a lot of chemicals and water is the leather tanning business. The industry is forced to reevaluate because of resource, environmental, and economic problems due to the protracted process unit operations accompanied by and do-undo actions. Many attempts have been made to limit pollution in light of the effects that leather-making activities have on the environment, but they haven't been able to guarantee long-term protection for a variety of reasons. The management's refusal to invest in environmental protection, the effectiveness and commercial viability of pollution control technology, the need for space, the lack of educated labor, and the need for space have all been early obstructions to note. Instead of continuing to rely on ever-expensive "end-of-pipe" solutions, it is more cost-effective to invest in cleaner production processes that prevent pollution and minimize resource usage. The advantages of CP for the environment can be converted into business potential for "greener" goods. Businesses that incorporate environmental concerns into product design will be well-positioned to gain from the marketing benefits of any future eco-labeling programs.

The principles of RECP can be summarized as:

Prevention is better than reuse

Reuse is better than recycling

Recycling is better than disposal

The critical principles involve the fundamental understanding of diverse industrial processes, adherence to the earliest techniques of a hierarchy for reducing wastes, and utilization of an underlying thought process to achieve pollution prevention successes that are both technically feasible and cost-effective. In the application of cleaner production, a thorough inspection of each processes to take measures in advance in the process or product design stage enabling elimination of waste before inception. Similarly, prevention or reuse of wastes produced through processes, products, services and eventually integration of wastes to convert to less- or non-hazardous materials are basic principles to consider. The following are key factors for manufacturing industries in general and tanning industry in particular triggering RECP or alternative processing schemes to be practiced:

International and national decrees and regulations covering environmental protection becomes highly demanding;

Requirement of correct allocation of costs needed to clean up a given production unit to comply with regulation, i.e. purification wastes and disposal of the waste from each unit operations;

Difficulties in the disposal of waste materials due to the shortage of dumping space and secondary costs of waste disposal plants;

Increasing costs raw materials and energy;

Increased public awareness of the importance of environmental protection; and

Requirements of leather making plants to meet high standards of workplace protection and operational safety.

In spite of the above demanding requirements, industrial growth is crucial for the development of the country, which eventually needs to achieve sustainable development. The leather industry is under pressure from environmental regulations to comply with the pollution and discharge legislation urging it shift towards the design and utilization of cleaner and softer technology like enzymatically enhanced processes. In the course of leather making, the challenge of environmental pollution is still prominent in Ethiopian tanning sector. Therefore, RECP generally enable reduces risks associated with workers, community, and product consumer and eventually with future generation. There are many opportunities within the leather industry for the promoting of RECP technology. When CP and pollution control options are carefully evaluated and compared, the RECP options are often more cost effective overall.

The redesign of the conventional effluent treatment processes with alternative or extra treatment approaches, which "supports resource recovery without added chemicals," is projected to provide a sustainable solution for the management of toxic wastewater in terms of RECP choices. By recycling, recovering, and reusing the treated wastewater with the use of cutting-edge cleanup technology, the Zero Liquid Discharge (ZLD) system ensures there are no water emissions from treatment facilities. The global scenario depicts ZLD being implemented as a result of pressure from regulatory organizations. The ZLD system includes a pre-treatment system that uses traditional physicochemical treatment, tertiary treatment, softening of the treated effluent, reverse osmosis (RO) treatment for desalination, and thermal evaporation of the saline reject from RO to separate the salts. Water usage is decreased when this technology is used. In locations where the tannery sector is a significant economic player, ZLD also becomes effective in disaster mitigation. [6]

In order to deliver finished leather to customers, the leather industry's supply chain must be sustainable from skin processing onward. Process design, the production of diverse products and byproducts from leather material, and other factors all have an impact on sustainability[5].

In addition, achieving social sustainability may entail meeting customer needs and expectations; achieving economic sustainability refers to maximizing profit by better utilizing raw materials; and achieving environmental sustainability by relying on non-renewable resources while making the best use of the resources already at hand. The industry of processing leather adheres strictly to tradition and resists changes in variables such as processing time, temperature, volume, and chemicals. The complicated process parameters and diverse chemicals used in leather production make it tough to produce leather as well. Tanners are therefore instructed to use sustainable leather technology to minimize the pollution issues.[7]

The tannery is a long-established industry that has undergone extensive industrialization across all nations over time. It also has a significant economic impact on the world. The law requires the tannery industry in industrialized nations to produce sustainable and clean production. The distribution of the processing locations was constantly changing as a result of the rigorous legal regulations. This change in the distribution is mostly due to two factors: 1) cheaper labor costs in certain nations than in others; and 2) less environmental constraints in some countries than in others [8].

Despite having serious environmental disadvantages, the modern tanning method is nevertheless largely based on the old one, using chromium salts to produce leather of exceptionally high quality. Since becoming industrialized, the tannery has demonstrated significant environmental effects brought on by the activities and procedures carried out along the supply and production chains, from the raw hides and skins to the finished leather. This industry, in particular, uses a lot of water and produces wastewater with significant levels of contaminants, primarily chromium(III), sodium sulfide, ammonium chloride, biocides, aldehydes, and colors. Additionally, it is important to take into account solid waste production and air emissions. Finally, the health effects on employees may cause issues over the short and long term[8].

Based on the fourth global workshop on improvements to cleaner production, which was held in 2013 in Sao Paulo, Brazil. The 53 articles demonstrate how soon unsustainable social structures and production methods need to change. They offer a range of cutting-edge tactics to help enterprises, governments, and society as a whole speed the transition to sustainable behaviors. Special attention was paid to sustainable methods for raw material substitution, renewable energy, technological breakthroughs, the development of new products, and regulatory reforms during the workshop. The critical duties of improved corporate management for sustainable societal transitions are considered, with a focus on stakeholder empowerment in promoting adoption of new cleaner technologies within firms, industrial sectors, supply networks, and nations. The evaluation techniques for biospheric environmental accounting have been enhanced by certain writers. Multiple examples of successful integration of CP in national and local policy structures, exemplified how focused work in key industrial sectors is delivering multiplier benefits within and among companies and in the community, at large. Numerous benefits were realized due to holistic integration of local, regional, national and global efforts to accelerate the transition to sustainable development and societal well-being[9].

Resource Efficiency and Cleaner Production (RECP) is a widely accepted strategy to increase productivity and lessen an organization's environmental impact. The use of RECP benefits businesses, especially SME's, by increasing their productivity and competitiveness; the environment by reducing the effect of their operations; and people by lessening the risks to employees and communities (UNIDO, 2015). By concentrating on already-existing industries and assisting a sizeable number of businesses, especially SME's, to boost resource efficiency and productivity while reducing their environmental effect, the greening up of economies, a major worldwide trend today, might become a reality. Applying "standard practices" to remedy current inefficiencies is necessary for the implementation of RECP. Solutions are proposed to intensify application of RECP methods, practices and techniques and innovative approaches are used to facilitate the expansion of RECP application and transfer of existing experiences and best practices to a larger number of enterprises[10].

Conventionally leather industry uses alkaline dehairing agent such as sodium sulphide and sodium hydrosulphide which causes huge environmental load and bad smell for the public. Innovative product development was undertaken to produce dehairing agent from hair waste using solid state fermentation techniques usually released during conventional liming process. The enzyme developed were applied on cow hides during liming process and the leather industry uses a chemical dehairing process that produces alkaline wastewater and hair as solid waste. Efficiency of the dehairing process were similar to those obtained with the chemical process, thus avoiding the need of chemical reagents and strong chemical conditions. The entire process permits the substitution of the chemical process of dehairing by an environmentally friendly enzymatic process, closing the organic matter cycle[11]. It was found that the performances of the integrated cleaner beamhouse process were similar or better than conventional process. Leather made by the cleaner process exhibited comparable physical and morphological properties to conventional one. Ammonia nitrogen and total nitrogen in the wastewater from the cleaner process were reduced by 97% and 48%, respectively. Meanwhile, reductions of chemical oxygen demand, total solids and sulfide were also achieved[12]

A salt-free and high exhaustion chromium tanning method was designed and optimized in both laboratory and pilot scale in order to simultaneously control the sever contamination of large amount of chromium and chloride discharge which is highly challenging in conventional process. Based on the new innovative process it was observed that the chromium exhaustion was increased to 98% from 73% in the novel process. Then the Cr dosage was minimized from 1.16% to 0.61% and the residual Cr concentration in the spent liquor dropped below to 50 mg/L from above 1100 mg/L. The pilot-scale experiments verified that the novel method was acceptable in the aspects of organoleptic and mechanical properties of resultant leather, product style and cost. It is anticipated that the spent liquor containing a very small amount of chrome and chloride can be more easily disposed and the generation of chromium-containing sludge will be stoichiometric much less. The established novel chrome tanning process satisfactorily solves the longstanding problems commercially and matches the integral requirements of the modern sustainable leather industry[13]

Combination tanning, which entails combining two tanning agents that separately can't give the leather the desired qualities, is projected to be a substitute method for chrome tanning. Combination tanning creates leather with characteristics akin to those of chrome tanning while also being an environmentally friendly process. A potential chrome-free tanning technique is offered in this regard by mixing vegetable tannins with aluminum sulphate. Further research is therefore strongly advised to optimize combination tanning technologies for commercial usage. The leather industry needs eco-friendly tanning solutions to reduce the negative effects that using traditional chrome tanning technology has on the environment, human health, and other organisms[14]

The UN's 2020 Sustainable Development Goals Report states that current efforts worldwide are insufficient to achieve the SDGs by 2030. It is also more challenging to accomplish these Goals given the present global health catastrophe brought on by COVID-19, which has sparked an unparalleled health, economic, and social crises. On the business front, the report urges the creation of recovery strategies to speed up the transition to a low-carbon, climate-resilient economy. As a change agent, European business, including the footwear and component industry, must commit to helping the sector achieve the SDGs by incorporating them into their daily operations[15].

To comply with sustainable development goals, global leather consumers and branded shoe and leather product manufactures has launched Leather working group protocol(LWG) for tanneries supplying finished leather to product manufacturers. The protocol has is especially designed to ensure the environmental, social and economic sustainability of the leather processing industries which is the base for production of footwear and various leather products.

3.2. Current capacity utilization of the tanning industry in Ethiopia

Even though there is a significant growth on investment of foot wear and leather product manufacturing, the leather processing industries what we call Tanneries are under a big challenge and some of the tanneries are closed and out of business and the capacity utilization as well as export earnings obtained from the industries are declining tremendously from time to time as indicated on the graph below.

Source: leather industry development institute report (2013-2023G.C)

Major reasons for the declining trend of capacity utilization are:

1. Shortage of foreign currency to import chemicals
2. Shortage of working capital
3. Environmental pollution and related compliance requirement

4. Increase on production of due to the increment on chemical prices and decrease on the unit price of finished leather due to the evolution of non-leather materials.

5. Decrease on global market demand due to substitution of leather products by synthetic and textile materials

Export Performance (value, volume, unit price)

The major products of leather industry exported from Ethiopia to different international market include semi and finished leathers, footwear, gloves and different leather goods. The export performance trend of the semi processed and finished leather is as follows:

Source:- LLPIRDC report of 2023

Source:LLPIRDC export report by product type

The export performance of tanning companies shows a sharp decline from 97.5 million USD in the 2012 E.C to 16.03 million USD in 2023 E.C indicating the sector export performance is declined by 84% over the last ten years. During this year both the volume and unit price was declined. The volume of finished product exported decline (62%) in the same period from 52 million square feet to 20 million square feet. The volume of export was almost constant (around 55 million square feet) during the year 2012 to 2018. But it sharply declined to 20 million square feet in 2023. The reason for this is due to the volume of goat suede leather has decreased significantly due to loss of demand in the international market. The average unit price also declined from 1.9 to 0.8 USD per square feet (58%). The reason for the decline in export performance is: -

- Deterioration of raw hides and skins quality forced manufacturers to shift their product from high price products such as dress glove, golf glove, premium sheep upper to low price products such lining and corrected grain products
- Increased export of semi-processed products (pickle and wet blue), raw hides and cattle head hides.
- Decline in global market demand for goat suede leather (shift to synthetic material)
- Shortage of chemical supply cause by FOREX availability
- COVID -19 impact
- Finished leather technological capability limitation
- Poor business and financial management of companies which leads closure
- Poor environmental performance of companies which leads to closure
- Inadequate international market promotion and support

3.4 Leather waste management practices in Ethiopia

3.4.1 liquid waste management practices

Ethiopian tanneries for the last long years producing their products just utilizing the raw hides and skins as input and produce the required products by using conventional chemicals and machinery and end up with the output and generate wastes and discharge the liquid wastes to the surrounding river without any treatment and damp solid wastes together with all the municipal wastes at open damping sites.

The approach was just life as usual way of practice or a linear way of production. But due to the establishment of legal standards for discharge of industrial wastes, tanneries started to build the primary treatment facilities and then recently built the secondary treatment facilities.

Even though, the huge investments made to build the primary and secondary waste water treatment plants by individual tannery's, the environmental performance against the established discharge standard is very low and hence do not meet the discharge limits for major parameters. The waste water test result analyzed by Ethiopian leather industry development institute by taking the waste water sample from the tanneries at 2023 showed that most parameters do not fulfill the national discharge limits as described below.

s/no	Type of test	Total tests conducted		Results accepted		Results not accepted	
	Parameters	WWS collected by analyst	WWS collected by tannery personnel	WWS collected by analyst	WWS collected by tannery personnel	WWS collected by analyst	WWS collected by tannery personnel
1	Chemical Oxygen Demand (COD)	20	53	0	36	20	17
2	Chloride	20	53	6	25	14	28
3	Sulphide	20	43	10	7	10	36
4	Total Suspended Solid (TSS)	20	53	0	14	20	39
5	Total Chromium	20	16	13	14	7	2
	Total test conducted	100	218	29	96	71(71%)	122(57%)

Source: Leather industry development institute report of 2023G.C

3.4.2 Solid Waste Management Practices

All ethiopian tanneries can process 20million goatand sheep skin and 2million cattle hides and it can generate approximatly 2.5milion cubic meter of waste water and significant amount of solid wastes.

Tannery solid waste represents one of the burdensome environmental problems owing to the large quantities of discarded material. Tanneries in Ethiopia as a general, are characterized by their unpleasant smell and polluting behaviors which is due to uncontrolled and desegregated disposal of tannery solid waste. Lack of waste-to-wealth approaches and secured landfill makes the segregation and disposal of tannery solid waste much more difficult. Segregation must be performed by separating various solid wastes based on their property.

Tannery wastes have historically been discharged into rivers, landfill waste sites and the air with little if any purification. Even though it is evident that improper management of the waste from the tanning industry is full of risk to human and environmental health, presently almost all of the leftovers from leather product industries in Ethiopia and elsewhere are sent to the land as waste. Most of the factories do not possess well-established treatment plants for their wastes and simply dump their waste into the rivers nearby. This dumping to the river causes a serious pollution problem to the habitats near the tanneries. Due to the huge

discharge of chemical containing wastes from tannery and improper management practice of such toxic wastes by the private tanneries, there is full of risk to the human that is living the vicinity of the industry and creates environmental health(Teklay et al., 2017).

The quantity and the type of solid wastes generated from tanneries and the level of utilization are described in the table below

s/no	Type of solid waste	Quantity generated(ton/year)	Level of waste utilization	Remarks
1	Untanned trimmings	6000	Partially utilized	Some SME and one medium scale comanies are involved in glueand gelatin making
2	Untanned fleshings	3500-11500	Not utilized at all	Dumped on open land
3	Tanned splits	5750	Not utilized at all	Dumped on open land
4	Shaving and trimmings	5000	Not utilized at all	Dumped on open land
5	Dyed/finished trimmings	1600	Not utilized at all	Dumped on open land
6	Buffing dust	100	Not utilized at all	Dumped on open land

Source : leather industry developement institute(2023)

As it is clearly indicated in the above table huge amount of solid wastes are generated and damped together with other manicipal wastes in open land causing severe challenges in polluting the environmnet especially the ground water pollution is becoming the critical problem.

Regarding some advancemnts on the management of solid wastes generated from all leather industries including the finished leather scraps, no treatment techniques are implemented so far except some pilot demonstrations on utilization of lime trimming and splitting wastes for production of organic glue, recycling of dedusted salt and chrome containing solid wastes to utilize for leather processing at pilot scale level.

Consequently, the tanneries are also sources of controversy and anger among city residents and the surrounding kebeles as they are major sources of pollution that significantly affects the environment of the town and surrounding local villages. Some of the huge quantities of solid wastes produced from various operations of tanneries are put to practical use, but the majority of the wastes is dumped without any effective usage and becomes a source of pollution. Lack of waste-to-wealth approaches and secured landfill is making the segregation and disposal of tannery solid waste much more difficult.




Tannery solid wastes dumped on open land at Modjo,Ethiopia

3.5. Application of circular economy concept in leather processing industries

Managing the negative consequences of unsustainable and environmentally harmful consumption and production habits is becoming impossible in today's cutthroat business environment. As the linear economy (take-make-use-dispose) developed, industries produced the goods, sold them to the final consumer, who eventually disposed of them when they were no longer needed. The Circular Economy (CE), a new paradigm shift, is brought on by this phenomena, which makes sustainability, the environment, and economic challenges for society more acute. With a focus on restorative and regenerative aspects, CE is a closed-loop supply chain. Through the explicit implementation of design models, product systems, and design, it allows the industrial system to adopt the concept of "end-of-life" with restoration, eliminates the use of dangerous materials, strives to reuse, and eliminates waste.

The number of varied criteria has been identified to transform the linear supply chain to circular supply chain to address 3R’s (recycle, reduce, reuse), but, these efforts are hindered by gaps and data discrepancies [17].

The goal of the circular economy is to keep materials, goods, and services in circulation for as long as feasible. The implementation of a systems-centered approach allows the resources used in business and industrial processes to maintain their best value for as long as possible. Through improved material, product, and system design, waste is to be eliminated. For countries in the European Union (EU), the circular economy (CE) is a key area of concern. Economic, social, and environmental considerations are all part of CE objectives. The creation of sustainable economic and environmental policies with an emphasis on product, component, and material recycling, reuse, renewal, and remanufacturing are of particular importance. Additionally, topics relating to sustainability and the circular economy are explored, including life cycle assessment, use/utilization and sustainability of products, components and materials for the promotion of their reuse as raw materials or products[18].

“Industry 4.0 and CE has motivated the business organizations to move towards the supply chain and offers a new outlook of production and consumption (Jabbour, Jabbour, Filho, & Roubaud, 2018)”. Therefore, sustainability can be achieved by integration of CE and Industry 4.0.

The basic idea of closed loop supply chain is quite close to the idea of CE. In closed loop supply chain, basically the recycling and the reuse of the products are considered for closing the loop. It focuses on the importance of coordination mechanism and governance to improve the circular system. It consists of forward and backward supply chain to maximize the profit of an organization. Lastly, the concept of blue economy is a philosophy where local environment and ecological features are focused for sustainable development of a nation economy[19].

4.Conclusion

- Since developing countries have huge livestock resource potential and they must utilize available raw materials in order to eradicate poverty by generating the required revenue and create employment opportunity for their citizens.
- But life as usual way of industrialization that is “take-make-use-dispose” scenario is not recommended for sustainability of the leather sector.

- In order to mitigate environmental challenges, the leather industries need to implement different waste preventive and corrective measures such as resource efficency and cleaner production/RECP/concepts, waste recycling and reuse technologies in order to comply with the existing environmental discharge norms of the country as well as to ensure the social cohesion among the community.
- It is critical to establish the common effluent treatment facility having the state of art technologies that enable the tanneries to comply with the global environmental and social compliance requirements such as ZDHS, ZLD and LWG.
- To establish eco industrial park, regional government, land administration bureau's and relevant government and non-government organizations must work closely in order to manage the waste generated.
- In addition to that the availability of raw hide and skin resource is not by itself guaranty to develop the leather sector, there should be development of related industries such as chemical industries, agro processing industries, mining sector, energy sector, agricultural sector and furniture industries and so on is important for sustainable development of the leather and leather product industries.
- Establishing different clusters such as tannery/leather processing clusters, lady's shoes, leather bags, leather garments, military and safety shoe clusters, school shoe clusters, etc.
- Devising incentive mechanisms for chemical, components, and accessory manufacturing companies similar to that of leather and leather product manufacturers.
- The government must initiate and provide financial assistance to establish by-product processing plants from tannery solid and liquid wastes within the industrial park or surrounding locality.

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