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COLLEGE OF DEVELOPMENT STUDIES
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TANNERY WASTEWATER MANAGEMENT PROBLEMS IN ETHIOPIA
THE CASE OF BATU TANNERY

*THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES IN PARTIAL
FULFILLMENT OF REQUIRMENTS FOR DEGREE OF MASTERS OF ART IN
ENVIRONMENT AND DEVELOPMENT*



BY:- ZELEKE ABEBE

ADVISOR: - ABDULHAMID BEDRI (PhD)

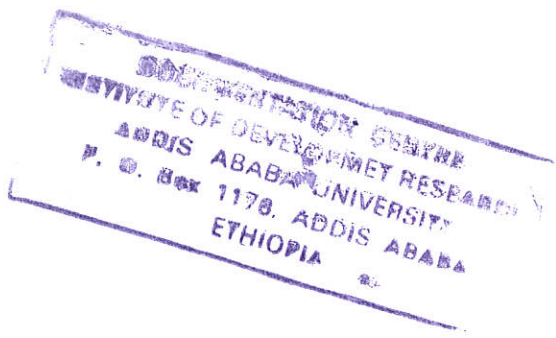
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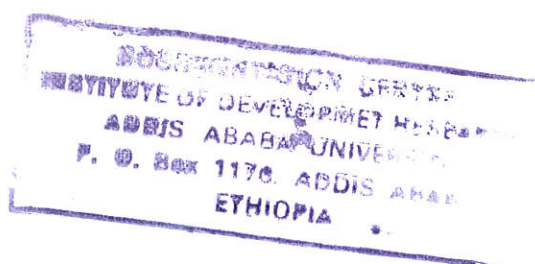
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(IDS)**

Title

*Tannery Waste Water Management
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By
Zelege Abebe

DEVELOPMENT STUDIES

APPROVED BY THE BOARD OF EXAMINERS:

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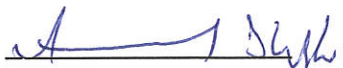
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I praise GOD and thank my courageous wife Hirut who shouldered all my stresses, covered all the self sponsor expenses and assisted me through my entire career along our children Tsiyon and Binyam for the heroic achievement despite the job lose sacrifice.

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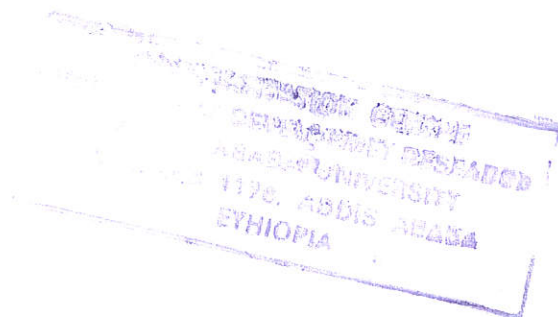


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Preliminary assessment report/ Benchmarking EMS Report-Document/

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LIST OF ABBREVIATIONS AND ACRYNOMS

AA	Addis Ababa
AAEPA	Addis Ababa Environmental Protection Authority
AKEO	Akaki- Kality Environmental office
BAT	Best Available Technology
BTPLC	Batu Tannery Private Limited Company
BOD	Biological Oxygen Demand
BPR	Business Process Reengineering
CLRI	Central Leather Research Institute
COD	Chemical Oxygen Demand
CSE	Chemical Society of Ethiopia
CP	Cleaner Production
ECPC	Ethiopia Cleaner Production center
ESTC	Ethiopia Science and Technology Center
EIA	Environment Impact Assessment
ELIA	Ethiopia Leather Industrial Association
EMS	Environment Management System
EPA	Environment Protection Authority
EPB	Environment Protection Bureau
EPO	Environment protection Office
ETP	Effluent Treatment Plant
FAO	Food and Agricultural Organization
FEPA	Federal Environment Protection Agency
FGD	Focus Group Discussion
FGOE	Federal Government of Ethiopia
JEP	Journal of Environment programme
LIDI	Leather Industry Development Institute
LLPTI	Leather and Leather Products Technology Institute
MOI	Ministry of Industry
NOWTR	Natural Oriented municipal Wastewater Treatment and Reuse
OEB	Oromiya Environment Bureau
PASDEP	Plan for Accelerated and Sustained Development to end poverty
QMS	Quality Management System
SANA	Situation Analysis and Need Assessment
TDS	Total Dissolved Solid
TQM	Total Quality Management
UNEP	United Nation Environment Program
UNESCO	United Nation Education, Science and Cultural Organization
UNICEF	U Nation Institute for Children and Education Fun
UNIDO	United Nation Industrial Development Organization

CHAPTER ONE

1. Background of the study

Tanning industry in Ethiopia is currently believed to be one of the sectors supporting economic development of the country significantly by generating foreign currency and it is also pollutant intensive sector that threatens the environment at large. Ethiopian tanneries are now on a new path of adding values to the products that therefore requires a series of additional individual process steps and varieties of chemical input that possibly intensifies the pollution load of the waste water effluent. The environment and development integration in a leather industry has to be strengthened to achieve the intended sustainable economic benefit for the whole human well being (Heidemann, 1993).

Hides and skins processing in to leather involve series of individual process stages in a tannery. This industrial process activity requires large amount of water and different chemicals that generate waste water effluents composed mainly of potential pollutants. Efficient management of individual tannery processes and the waste water contribute largely in reducing the negative environmental impacts. The waste water effluent management can be seen in relation to the low-waste /clean technology/ applications, water consumption, processing chemicals input optimization, good housekeeping and waste treatment or discharge efficiency (Sharphouse, 1983)

There are a number of challenges in managing tannery wastes in general and the waste water in particular in that there is a gap in integrating the individual process with the waste water management activities that would eventually reduce productivity, lowers cost-efficiency, and threatens the environment adversely. . Manufacturing of leather and leather goods produces high amounts of wastewater containing different pollutants. The waste water constituting parts, organic and other ingredients are responsible for high BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) values and represent an intense pollution effect, high costs in effluent treatment and immense problem concerning the entire tannery production processes. (Sharphouse, 1983)

Tannery wastewater management inefficiency can be seen in its adverse effects on development in that the pollution threatens the environment and eventually suppresses and

undermines sustainable development. Unregulated discharge of wastewater from farms, communities, villages, homes, urban area or industry that possibly contain harmful dissolved or suspended matter undermines biological diversity, natural resilience and the capacity of the planet to provide fundamental ecosystem services, impacting both rural and urban populations and affecting sectors from health to industry, agriculture, fisheries and tourism. In all cases, it is the poorest that are the most severely affected (UNEP, 2010)

These impacts continue to grow. Global populations are increasing rapidly and will reach between nine and eleven billion in 2050, and as population increases so does the production of wastewater and the number of people vulnerable to the impacts of severe wastewater pollution. Almost 900 million people currently lack access to safe drinking water, and an estimated 2.6 billion people lack access to basic sanitation (UNICEF, 2010). Lack of capacity to manage wastewater not only compromises the natural capacity of marine and aquatic ecosystems to assimilate pollutants, but also causes the loss of a whole array of benefits provided by our waterways and coasts that we too often take for granted; safe water for drinking, washing and hygiene, water for irrigating our crops and producing our food for sustaining ecosystems and the services they provide. The financial, environmental and societal costs in terms critical indicators of general human wellbeing are projected to increase dramatically unless wastewater management is given very high priority and dealt with urgently. (Corcoran et.al, 2010)

1.2. Statement of the problem

Tannery processes embrace a series of chemical reactions and mechanical processes conducted in water media generating wastewater that is usually discharged in to rivers or different water bodies or by drainage through to the land. Purifying the effluent waste before discharge to reduce the environmental adverse impacts usually received no adequate attention and action. Tannery processes including the clean technological applications, pollution-free chemical substitution, recycling and waste treatment options are inefficiently managed. The environmental policy compliance and implementation problems related to tannery wastewater management manifesting itself in leather sector created a significant policy gap that needs to be enforced to ensure sustainable improvement of the sector.

One of the most damaging ways in which tanning industries affect the internal individual process integrated aspects and the external ecological system involves the different waste water disposal and treatment schemes. Preference of inadequate and costly end-pipe waste treatment

technique to the technology aided preventive approach at the source in each process step of most Ethiopia tanneries is a puzzling issue to be dealt with. The best option selection by the right stakeholders needs critical and genuine evaluation of tannery process strategy at hand that should maintain equilibrium between leather sector utilities and community wellbeing. Tanneries discharge their waste water effluents inadequately treated or totally untreated, directly in to rivers, other water bodies, and land without considering the level of damage it may bring to the local community at large. That it seems, is one of the reasons that the government is striving at least to set and approve environment related series of proclamations though there exist a fallacy as to prioritizing the most burning issues of concern. Solid waste management proclamation got priority and the equally important wastewater management proclamation settings lagged behind while the community is urgently under threat. There is an attempt to transfer technology concerning waste management in tanneries, from countries having improved tannery practices though there is reluctance to apply sounding pressure on polluting leather industries. There are also weaknesses related to enhancing and implementing legal and legislative environmental policy enforcement mechanisms and empowering regulatory environmental agencies.

1.3. General objectives of the study

The main objective of the research is assessing tannery pollution reduction and adverse impacts associated with the waste water management problems of Batu tannery targeted to downstream community wellbeing.

The specific objectives are

Assess the Batu tannery waste water management efficiency

Identify pollutant load reduction techniques applied in Batu tannery.

Show the environmental policy implementation gap related to wastewater management in Batu tannery.

The paper will answer the following research questions

How is the tannery waste water management efficiency assessed?

Does the pollutant load reduction techniques applied in Batu tannery clearly defined?
Is there environmental policy implementation gaps related to tannery wastewater management?

1.4. Significance of the study

The study is intended to develop low-cost process modification, improve productivity, reduce pollution loads and effects, enhance clean technology and integrate tannery process-waste water management activities. Ethiopia tanneries are now reluctant in implementing advanced process management style that significantly hinders the positive contribution of the leather sector in generating foreign currency. The conventional approach of tannery processing takes the country nowhere because the sector is known for its pollution intensiveness and the world is at the same time aware, alert and highly sensitive to environmental adverse impacts. This research paper therefore would contribute in triggering environmental awareness at all levels of governmental establishments; assure compliance of Ethiopia environmental laws and legislations with the basic operating requirements and strengthen the clean technology approach implementation. This will have a paramount significance in providing concrete evidence for development policy makers in assuring sustainability by mitigating the environmental threat caused by inefficient tannery wastewater management.

1.5. Scope and limitations of the study

The fact that environmental issues in Ethiopia related to development are apparently sensitive and delicate among respondents for that it can easily be negatively interpreted, limited the study. This research is limited in depth and scope due to time and resource constraints. This research paper tries to focus only on the relatively larger reservoir of pollutants in the tanneries- the waste water. The solid and gaseous waste receives less attention here.

1.6 Organization of the paper

The paper is organized in such a way that the first chapter embraces the introduction part, statement of the problem, general and specific objectives, and research questions, significance of the study, its scope, organization,. The second chapter consists of the research design and methodology part. Literature Review is displayed in chapter three. The fourth chapters assess the findings and discuss the outcomes. The last part consist conclusion and recommendations.

2. METHODOLOGICAL APPROACH

2.1 Research Design

The general objective of the study is identifying the problems associated with the tannery waste water management issues and the opportunities available to enhance integrated approaches on tannery pollution load reduction techniques of Batu tannery to improve downstream community wellbeing. To achieve this objective both quantitative and qualitative methods are employed in dealing with existing wastewater management problems of Batu tannery. In an attempt to solve the problems under study, information is secured from the sample selected purposefully from the target population. The focus group discussion, interview and key informant interviews were employed to generate in-depth information from individuals who are believed to be knowledgeable about the area and the problem. The primary purpose is to triangulate, strengthen and substantiate the findings of the extensive qualitative approach by focusing on respondents' feelings, perceptions and experiences about the problem which are not fully addressed by the other data collection instruments.

2.2 Research strategy

The survey study here consists of both quantitative and qualitative mixed approaches. In order to collect quantitative information at the factory level, questionnaires with a mixture of closed and open-ended questions were used. These quantitative responses are used to answer questions that are mainly descriptive in nature that would enable generalization. Qualitative research methods on the other hand, were employed to identify the appropriate dimensions of various concepts. In-depth interviews and group discussions are administered based on the survey to contextualize, interpret and help understand the participants' perspectives in more detail. Besides, observation and document analysis methods were employed as alternative techniques of obtaining information on the subject matter.

A mixed-method approach combining both quantitative and qualitative methods is selected mainly due to sensitive nature of some data that it is difficult to use one single research method. Triangulation which this study employs most is defined as the use of different methods of

collecting data with the aim of comparing diverse aspects of the same phenomenon. It is often thought to help in validating or verifying the accuracy of information.

2.3 Site selection and study area Settings

Batu tannery is a private limited company established in 2001 G.C. located east of Ethiopia-Akaki Kality Kifle Ketema about 15 Km away on the way to Bishoftu just adjacent to the ring road and the Little Akaki river. Batu tannery is a private limited company situated in Ethiopia, Akaki Kality Kifle Ketema (Kadisco Paint factory area near the little Akaki river), on the main road quit away from the residential units.

BTPLC has a capacity of processing 8400 sheep skins or 9000 goat skin or 1000 cowhides or a combination of the above per day. The tannery is processing hides and skin in a chain of processing machineries in the same compound.

The company's achievement of targets set are: improving the quality of Batu's products, Improving productivity to meet international standards , searching new markets, having quality certificate both on management and environment.

BTPLC is a privately owned company engaged in the tanning of sheepskin, goatskin and cowhides with a capacity of processing 8400 sheep skins or 9000 goat skin or 1000 cowhides or a combination of the above per day. The tannery is processing hides and skin in a chain of processing machineries in the same compound. Among its short term objectives are minimizing wastage of material and increase product efficiency (productivity) and the Long Term objectives are putting in place an effective QMS and TQM ,Cleaner leather production as per the established Eco- norms/REACH protocol ,EMS as per the Government norms and exploring the options to recycle leather by-products.

2.4 Data Collection Procedures

After developing the drafts of the questionnaire and interview questions, for the convenience of this study questions which were written in English were used to gather information from factory production and quality heads, shift leaders, and Amharic language is used to collect information from the operators, casual workers and the farming community group. The researcher and one volunteer factory worker distributed the questionnaire. The researcher orally had well informed the factory worker about the purpose of the questionnaire and procedure to be followed to

administer. The researcher himself has distributed the questionnaires to all respondents and factory management groups.

The interview questions were set consisted of a series of questions that focused on encouraging them to explain the issue under study on the methods of making durable collaboration from which both parties may benefit.

2.5 Data Collection

Prior to conducting the actual data collection, a visit to the study site were made to establish some contacts with key informants and influential leaders on the ground to explore the study area and get some general insights into the nature of the problem. Secondary data were reviewed from available information. The information gathered through the questionnaire also poses the issues which should be addressed in greater depth and follow-up, and provides a basis for selecting individuals (key informants and focus group discussants) whose further participation is credited. FGD were conducted soon after the factory workers questionnaire administration is completed. The size of key informants and group discussants were determined depending on the detail of information needed and type of issues arising during the survey. Tape recorder was used in the in-depth interview and focus group discussions to capture important points.

2.6 Sampling Procedure and techniques

In order to determine the sample size for the questionnaire survey, factory workers at different levels were stratified based on the problem content knowledge and occupation. To do this, lists of all the factory workers were primarily obtained from the factory administration then stratified in to three groups. The first group consisting production and quality heads shift leaders and supervisors eleven in numbers. Six machine operators constitute the second class. The last causal worker group, seventy three all let to respond. The FGD involved two groups (leading and non leading farmers) of Hechu kebele farming community clustered in to ten. Purposive sampling determined number of respondents from stakeholder institutions. With pre arranged time schedule that was made with the respondents and key informants of the interviews was conducted by the researcher with each of these informants in their office.

2.7 Data Collection Instruments and Sources of Data

The instruments used to collect the necessary information regarding wastewater management problems in Batu tannery were secondary data analysis, focus group discussion, interview and questionnaire. Documents analysis and observation instruments are also used to assess the wastewater management efficiency and evaluate its current status of the tannery.

A/Document analysis

Documents from different sources were used to extract reliable information. Benchmarking reports from Indian experts made on Ethiopian tanneries in general and on Batu tannery in particular, AA EPA research outcomes on tannery wastewater related issues are assessed documents among others. This includes benchmarking documents, Policy guidelines, proclamations, reports and articles.

B/Observation

Researcher observation in this study is meant to triangulate and confirm the obtained information. This maintains credibility and reliability of the secondary data collected. Realities that persisted in relevant tanneries sharing similar scope of assistance from stakeholders were evaluated to have general understanding about some descriptive problems and issues. LIDI model tannery as the name tells is there to serve all Ethiopian tanneries including Batu tannery as the best model in improving tanning processes and management. Researcher’s observation extended to LIDI model tannery, Walia tannery and China-Africa Overseas Company to have general understanding of the scope of tannery wastewater problem under consideration.

C/Interview

Interview questions were set in such away that the respondents from stakeholder representatives can easily sense the mutual benefits the respondent and the researcher can get in working together to improve people welfare. Interviews conducted and recorded helped in supplementing other instruments of data collected in this study.

Table: 1 Stake holder and position of respondents

S.no	Stakeholder institutions	Position of respondent
1	MOI	Environmental unit representative
2	EIA	Foreign investment-leather and textile desk
3	FEPA	EU,M&E and Awareness directorate directors

4	AA EPA	EIA representative, research experts
5	OEB	Environment representative
6	AKEO	Pollution desk representative

D/Questionnaires

To assess tannery wastewater management efficiency of Batu tannery on the factory floor level, to identify the current pollution load reduction methods employed and to show the integrative linkage between process and wastewater management practices questionnaires were distributed among all the factory community in Batu tannery stratified into management group (Production and quality head, shift leaders, supervisors), the operator group and the causal workers.

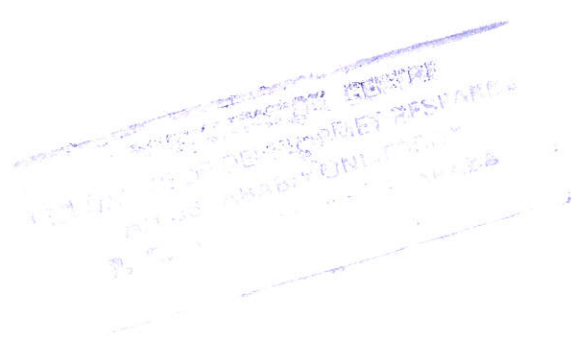
E/ Focused Group Discussions

FGD were conducted with the Hechu kebele farming community utilizing Little Akaki river composed of Batu tannery wastewater among other wastes to cross check the real environmental policy compliance related to tannery wastewater management problems in this country. This community is among the immediate recipients of the damaged little Akaki river.

2.8 Methods of Data Analysis

The data that were generated were analyzed by using various techniques of matrices, theme categorization, interpretation, description and triangulation.

Responses of the data gathered using the close and open ended questions were tabulated and presented in frequency counts. Then percentage values were calculated and used to analyze the responses. The descriptive data obtained from the structured interview and open ended questions were analyzed by identifying the themes which have informed the categories as they emerged from the data. Facts extracted from different documents were analyzed thematically and served to confirm study outcomes accordingly.



CHAPTER TWO

2. Literature Review

2.1 Conceptual framework of the study

Leather tanning is a production process in which animal hides and skins are transformed by using of water, chemicals and mechanical process. Therefore, wastewater from the process will contain a high concentration of pollutants. The characteristics of wastewater and the pollution load depend on the type of production process including the source of the tanning. Effluent/wastewater/ management in tanneries require comprehensive approach so that chemicals used in leather processing is optimized, pollution minimized, and water consumption reduced. In most of Ethiopia tanneries effluent management systems are not clearly defined and efficiently installed. Inadequate wastewater management system in tanneries triggers inefficiency in environmental management. (UNIDO, 2003)

Leather industries or tanneries use huge amount of water to process raw skin and hide in to leather. In addition different chemicals are used and applied in a water medium which has unique properties of dissolving and carrying in suspension of varieties of chemicals. This waste in liquid form requires advanced and low cost treatment in a distinctively and separately constructed treatment system. Tannery management has a legal and ethical obligations of effectively treating liquid wastes before it is discharged to rivers, soil etc or in general to the environment whose eventual effect is devastating and victimize the community as a whole. Tannery processes are invariably conducted in water media and removal of the surplus materials are conveniently affected by washing with water forming liquid waste. In every case the discharged liquid waste have adverse effect on all forms of life. Discharge in to the urban sewerage system may also cause blockages, corrosion of pipes and valves etc and disturb the efficient sewerage treatment plants. The adverse effects of the materials in tanneries that cause pollution and found in the effluent are chlorides, sulphides, sulphates, chrome oxide, bactericide, total suspended solids (TDS) and other pollution indicating parameters like biochemical oxygen demand (BOD), chemical oxygen demand (COD). (UNIDO, 2003)

The very essence of tannery wastewater management can be viewed basically in reinforcing sustainable development. The world in general and Ethiopia in particular, is facing water quality crisis. Continuing population growth, urbanization and rapid industrialization meant for development are putting pressure on water resources and increasing the unregulated or illegal

discharge of contaminated water within and beyond regional borders. This presents a global threat to human health and wellbeing, with both immediate and long term consequences for efforts to reduce poverty whilst sustaining the integrity of some of our most productive ecosystems. There are many causes driving this crisis, but it is clear that freshwater and related ecosystems across the globe, Ethiopia being part of it, upon which humanity has depended for millennia, are increasingly threatened. It is equally clear that future demands for water cannot be met unless wastewater management is revolutionized. (Corcoran et.al, 2001)

2.2 Related Literature Review

2.2.1 Description of Tannery production process and wastewater generation

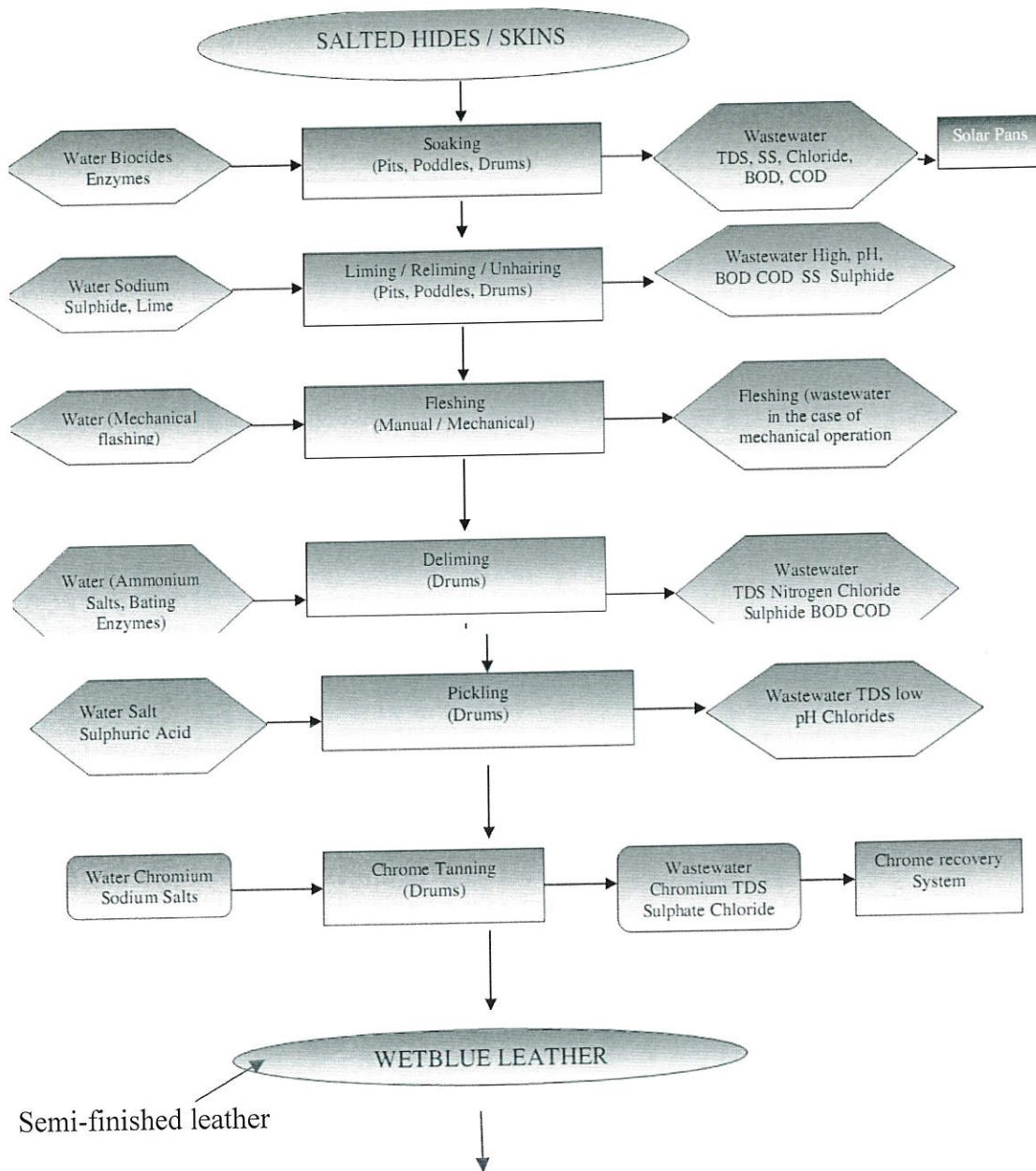
Leather production process in tanneries is categorized depending on the type of product, chemicals used, water usage, and machineries employed and other technical specificity. Soaking and washing to remove salt, restore the moisture contents of the hides, and remove any foreign material such as dirt and manure; liming to open up the collagen structure by removing interstitial material; fleshing to remove excess tissue from the interior of the hide; dehairing/dewooling to remove hair/wool either by mechanical or chemical means; bating and pickling to delime the skins, and condition the hides to receive the tanning agents; and tanning to stabilize the hide material and impart basic properties to the hides; (UNEP,1991)

As a result of these processes, effluents (wastewater) or untreated liquid wastes are generated that constitute a major environmental and health hazard. Surveys reveal serious health disorders and environmental problems in the areas where tanneries are located, including contamination of soil, underground water and food (Khan, et.al.2002)

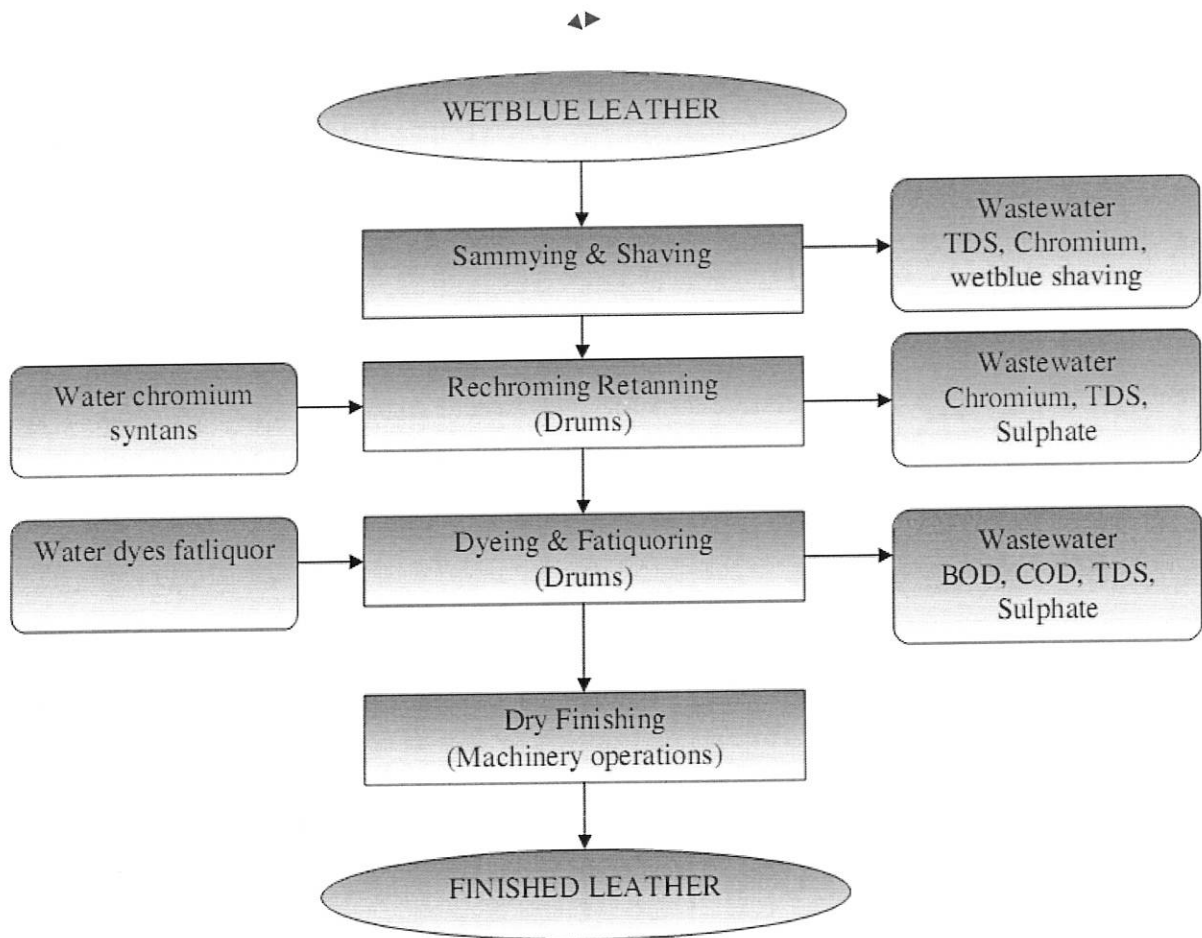
Individual tannery production process linkage with the respective wastewater generation is shown in the following flow chart that ultimately helps in assessing their integration status.

Fig: 1

The tanning operations of raw hides / skins into semi-finished and finished leather are given below:



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Source: Andhra Pradesh pollution control board, 2005

2.3.2 Wastewater from tanneries

In the leather industries the specific water demand per unit finished product is very high in tanneries. Appropriate animal hides and skins are made in to leather is treated in two phases, the preliminary treatment that include washing, soaking, liming and deliming. The second phase is tanning done by various process like chrome, and vegetable tanning. The amount of wastewater in tanneries is 0.7 to 5.0 m³ for every larger hide depending on the size and equipment of the plant and the type of tanning. On an average, 1.0 to 1.5 m³ water are used. Where effluent is discharged direct into streams and rivers, it needs to be of higher quality as the environment is sensitive and highly susceptible to damage. The greater the volume of the effluent compared to the volume of surface water, the higher the quality of the effluent demanded by the environment (UNIDO, 2000).

Leather is material that has a reasonable resistance, good chemical stability and acceptable thermal behavior. Those industries with a great water and chemical consumption are required to exhaustive waste water treatment and water reuse. Tanning industries use large quantities of

water approximately 15 to 20 m³ per ton of raw skin. During tanning process large amounts of waste water sludge and solid containing chromium, sodium chloride and sulfate are produced. The tannery effluents are characterized by high COD and BOD and conductivity values. The composition of the effluent varies according to the tanning process used and the type of leather to be obtained (Krishanamoorthi et.al. 2009)

Waste water is the effluent of the tannery that has a fast interaction with environment. The amount of waste water varies between 30 and 50 L per kilogram of the processed skin (Alexander K.T.W et al., (1992).

The economy uses the environment as a waste sink. Wastes may originate from either production processes or from consumption activities. Wastes may be of a number of basic types: solid, gaseous or water borne; whilst the environment has a limited assimilative capacity to absorb and transform some wastes in to harmless substances (Hanley et.al. 2001).

According to the 1996 report by Ministry of Health on the study of liquid waste management, out of 118 industrial establishments assessed in the city of Ethiopia, 40 have solid waste discharges, 61 generate air pollutant discharges while 62 generate liquid wastes that are discharged to the surrounding. Only 6 out of the investigated factories are found to have some form of wastewater treatment plants and the rest discharge their wastes without any form of treatment (UNESCO, 2004)

Most of developing countries including Ethiopia often suffer from the absence of efficient institutions; lack of technological knowledge and empirical Know-How of wastewater treatment processes and their implementation; also inappropriate management practices. The anaerobic treatment benefits as winning of biogas as an alternative source of energy as well as less quantity of sludge with a very good stabilization status, and cost effective benefits as low capital, operation and maintenance cost. (Halim et.al.2008)

2.3.3 Tannery wastewater characteristics and management schemes

Wastewater is characterized in terms of its physical, chemical and biological composition with the parameters all interrelated. (Metacalf and Eddy, 2003). Characteristics of wastewater generated from the tanning process in each production stage can respectively be seen for beam house process as. BOD, COD, salt, pesticides, flesh, hair, suspended solids, sulfate, ammonia, base, chloride for Tanning process (chrome tanning) as. BOD, COD, salt, acid, chromium,

suspended solids and for finishing process as BOD, COD, salt, chromium, oils. (Metacalf and Eddy, 2003).

A significant number of operations within a tannery are wet operations consuming large amounts of water, chemicals and energy and leading to large amounts of polluted water. Through “process integrated” measures a significant reduction of water consumption and pollution load can be achieved, however tanneries keep producing wastewater requiring special treatment. In cases where the potential for “process integrated” measures has worn out, further pollution reduction has to be found in the improvement of end-of-pipe measures (Layman, 2002)

Most of developing countries including Ethiopia, according to Walid Abdel-Halim, Dirk Weichgrebe, K.-H. Rosenwinkel and Johan Verink(2008) often suffer from the absence of efficient institutions; lack of technological knowledge and empirical Know-How of wastewater treatment processes and their implementation; also inappropriate management practices. Trying to get some solutions of the wastewater problems in those countries, Natural Oriented municipal Wastewater Treatment and Reuse concept (NOWTR) will be implemented as a naturally oriented low cost technology for wastewater treatment and re-use, where the wastewater will be anaerobically treated with a benefits of winning of biogas as an alternative source of energy as well as less quantity of sludge with a very good stabilization status, and cost effective benefits as low capital, operation and maintenance cost. The findings also reveals that the treated wastewater will be naturally disinfected in polishing/disinfection pond at low cost manner by means of sunlight, then the produced disinfected treated wastewater will be re-used for the agriculture purpose as a potential to recovery of the high valuable nutrients in wastewater(Walid Abdel-Halim et.al,2008

2.3.4 Tannery wastewater treatment as part of the process management

Tannery wastewater treatment falls under the purpose that the major aim is to remove as much of the suspended solids as possible before the remaining water, called effluent, is discharged back to the environment. As solid material decays, it uses up oxygen, which is needed by the plants and animals living in the water. "Primary treatment" removes about 60 percent of suspended solids from wastewater. This treatment also involves aerating (stirring up) the wastewater, to put oxygen back in. Secondary treatment removes more than 90 percent of suspended solids. Although there are a number of high- tech alternatives to treat tannery wastewater none are, as

yet, appropriate for Ethiopia condition mainly due to their prohibitive capital costs, high maintenance and operation costs and the need for skilled man power(Tadesse,2003).

2.3.5 Chromium from Tannery Effluent and its alternative treatment options

Waste contains pollutants which are discarded materials, process materials or chemicals. Pollution could be caused by all sectors of a society generate waste: industry, agriculture, mining, energy, and these pollutants when they are released beyond the assimilation capacity of the environment. Industrial wastes are generated from different processes and the amount and toxicity of waste released varies with its own specific industrial processes. Tannery effluents are ranked as the highest pollutants among all industrial wastes. They are especially large contributors of chromium pollution (JEP, 2010)

Chromium is highly toxic and carcinogenic to human beings, animals, plants and the general environment (soil and water sediment).Chrome is the primary threat when ever tanning industry comes in to practice. Though many treatment options were evaluated to prevent its consequence on the environment, neither of them could achieve to treat or recover chrome 100 %(Alebel, 2010). Treatment options are either; inefficient, complicated, energy demanding, costly or applicable to a certain parts of the world due to technology or skilled man power demand (Alebel, 2010)

2.3.6 Pollution Loads of Industrial Wastewater

Most of the high water consuming industries in the Awash basin in particular in the city of Ethiopia and in the Akaki area draw water for production purposes from water supply sources and discharge their by-product wastes in to streams and rivers without any kind of treatment. Besides this, there is no restriction on industrial plants discharging their wastewater into the rivers and watercourses. EPA and Ethiopia cleaner production centre (ECPC) realized that the tanneries built along the Awash river basin especially on the Akaki and little Akaki rivers carrying all the devastating pollutant wastes on their way to the neighboring peripheral Oromiya region needs due attention (ECPC, 2004). Investigation made on the presence and concentration of heavy metals including toxic hexavalent Chromium from tanneries, in vegetable leafs irrigated by the Akaki River was found to be more than the maximum limit that may induce gastrointestinal ulceration and cancer(Prabu et.al,2009)

Findings from the Sheba tannery in Ethiopia also shows that the levels of hexavalent chromium in the downstream river and spring water samples exceed the World Health Organization (WHO) permissible limit of total chromium in drinking waters (0.05 mg/L) as opposed to the levels in the upstream waters. The increased concentrations of Cr (VI) in the water samples indicate the possible environmental pollution of the downstream water bodies by the tannery effluents, Sheba Tannery an instance in this case. In view of the toxicity and related environmental hazards, the levels of hexavalent chromium from the tannery effluents must be reduced to a permissible limit before discharging into the downstream waters being used for domestic purposes by the nearby communities. (Abraha G,et.al.,2009) However, even tanneries in the city of Ethiopia and elsewhere in Ethiopia, which have treatment facilities, divert their raw wastewaters into the storm water drainage system or directly to the watercourses. The reason could be either for technical reasons related to the wastewater treatment plant operation or for practical reasons since there are no regulations and effective control regarding industrial effluent discharges by concerned parties. Some studies indicate that the industries equipped with some form of effluent treatment facilities have installations undersized and frequently inoperable. It seems that the main function of these facilities appeared to have been obtaining the permit required to build the factories. There are very few industries in the city of Ethiopia that use septic tanks for the disposal of industrial waste effluent. (UNESCO, 2004)

2.3.6.1 Tannery wastewater mismanagement and Water pollution

The river near by the tanneries can be said highly polluted rivers since they are serving as recipient of effluent from the factories. The effect of this scenario is expressed by different indicators. The Akaki -Kaliti and the tributaries of Awash River are best examples of polluted water body. The residents around the river and /or the tannery reported the death of their cattle, dried up of green plants, water born diseases and bad smell resulted due to the death of micro organisms that in turn caused by depletion of dissolved oxygen. Even though the incidences are merely the result of discharges from tanneries but it is impossible to deny the fact that the discharge from tanneries has its own contribution.(Dagneu and Daniel,2011)

2.3.7 Environmental legislative and regulatory status

The sustainable development among others builds on the requirement that any new legislative proposal must include an assessment of their potential economic, environmental and social costs

and benefits. Efficient wastewater management as a strategy for pollution control and environmental protection is an integral part of development. The pollution problems in large measure caused by industrial sector, with its decaying and old installations and wasteful use of resources and to reduce it an investment in the best available technology is essential which will increase eco-efficiency in the sector (Baker, 2006).

Whilst the desire to promote economic development remains the dominant policy goal for governments at all levels, there appears to be widespread public concern about unanticipated consequences of continued industrial development. It can be argued that these concerns are directly related to the perceived inability of governments and industry to anticipate and avoid new threats to the quality of life and viability of ecological systems. (Gouldson and Roberts, 2000).

2.3.7.1 Environmental regulations, legislation and institutions

Despite significant achievements (formulation and approval of the Environmental Policy of Ethiopia (EPE), establishment of the Environmental Protection Authority (EPA)) and the overall influence that it has had in pushing forward critical issues related to environmental protection embracing wastewater management as its integral component, and sustainable development. The implementation of environment related policies that need to be undertaken in improving community wellbeing have been characterized by significant gaps between policy and implementation and limited stakeholder participation. As far as the institutional development is concerned a research in Sri Lanka revealed that it is very difficult to build a control system for industrial pollution without strengthening the institutional capacity for monitoring pollution and enforcing the regulations. Building up local capacity to develop cost-effective pollution reduction systems, to adapt and retain imported technology, and to provide access to foreign technical information for industry is under practice (Azeez.M, 1996)

According to Mulu.S(2008) due attention has to be given to revisiting the laws and regulations as to the management of wastes in addition to improving the institutional structural arrangements that helps in improving the coordination and integration among concerned institutions and stakeholders. The government also is required to put the enforcement laws and regulations in place.

2.3.7.2 Environmental policy compliance issues

The country's Supreme law gives a right for development, article 42, 43 and 92, especially, "to participation in national development and, in particular, to be consulted with respect to policies and projects affecting the community and levels of the adverse impacts generated." Based on this the country formulated three proclamations, proclamation 295/2002 'Environmental protection organs establishment proclamation', proclamation no 300/2002 'Environmental pollution control proclamation', proclamation no 299/2002 'The environmental impact assessment proclamation' and Environmental policy in 1997). The new economic policy adopted by the government is envisaged to encourage the acceleration of local as well as foreign investment in the industrial and agricultural economic sectors of the country. The expected rapid development will have both positive and negative impacts (EPA, 1995)

Environmental sustainability is recognized in the constitution and in the national economic policy and strategy as a key prerequisite for lasting success. However, there is as yet no overall comprehensive formulation of crosssectoral and sectoral issues into a policy framework on natural resources and the environment to harmonize these broad directions and guide the sustainable development, use and management of the natural resources and the environment. Therefore, given the current stage of the country's political and policy development, the time is opportune for developing a comprehensive environmental policy on natural resources and the environment addressing tannery wastewater management problems. (EPA,1997)

There are serious weaknesses in the use of the strategy of environmental policy integration in industrial sector especially the tanning area as a tool for the promotion of sustainable development (Baker, 2006).

In his findings Gashaw.T (2007) tried to pinpoint that especially tanneries should select key strategy to maintain achievement and enhance its performance that extends beyond compliance in promoting EMS in general in tanning process, transfer technological and eco-friendly management practice. According to him the tanneries development path way should comply with five pillars of sustainable development; - ecologically protective, socially acceptable, economically productive, and environmentally just and efficient.

In this highly competitive and environmentally conscious world, the business as usual will not be the right approach to expand the business and maintain competitiveness in the market. The

compliance towards environmental laws and regulation is not a choice rather it is a mandatory as it is time the enforcement of environmental legislations will come to realization. In this context, some tanneries trying to consider the environmental issue as part of the manufacturing process. Of the 23 tanneries, two of them have effluent treatment plant of up to secondary level, seven of them have primary treatment plant and in addition to that some of them have chrome recovery set up. ISO 14001:2004 based environmental management system is implemented in two of tanneries. They received a certification for that. The extent the tanneries respond to the environmental impact is not in an appropriate magnitude when it is viewed from the point of complying with the customer requirement, environmental regulation and safeguarding the safety of the environment and the society. The factors prohibiting the effort of tanneries are high installation cost, high operation and maintenance costs. The other point the factories facing is the decline of profit which freezes investment to expand the business and on environmental protection. (Dagneu and Daniel,2011)

2.3.7.3 Environmental impact assessment (EIA) issues

In order to ensure sustainable development, it is essential to integrate environmental concerns into development activities, programs, policies, etc. Environmental Impact Assessment as one of environmental management tools facilitates the inclusion of principles of sustainable development aspiration well in advance. (EPA, 2003) The PASDEP is focusing mostly on EPA's mandate, which has resulted in a highly regulation driven policy plans, with relatively limited partnerships and cooperation aspects (including sectoral ministries, private sector, and civil society) that are at the forefront of implementation(EPA,2003).

Ethiopia has environmental impact assessment laws and procedures, which are used to predict and manage the environmental effects which can be brought due to a proposed development activity as a result of its design, sitting, construction, operation, modification or termination (EPA, 2002). New development project, major expansion or alteration, any existing undertaking, or any resumption of work that have been discontinued is subjected to environmental impact assessment. The potential project areas related to Environmental Impact Assessment in Ethiopia are Agriculture, Industry, Transport, Mining, Dams and Reservoirs, Tannery, Textiles, Hydropower generations, Irrigation projects and Resettlement projects (EPA, 2000).

The EIA proclamation, in its article thirteen, requires undertaking the environmental impact assessment of public instruments. The types of public instruments for which the EIA process will

apply were supposed to be indicated in a separate directive, but none of it is yet prepared. (FGOE-SANA, 2010)

2.3.8 Mitigation options and cleaner production methods

Wastewater management in tanneries conventionally focuses on its treatment at the end rather than the preventive option. Cleaner production as a preventive strategy designed to conserve resources, mitigate risks to humans and the environment, and promote greater overall efficiency through improved production techniques and technologies require attention in a new dimension of advanced tannery production practices.. Cleaner production methods may include: substituting different materials, modifying processes, upgrading equipment and redesigning products. In addition to environmental, health and safety benefits, many cleaner production techniques provide opportunities to substantially reduce operating costs and improve product quality. Ethiopia tanneries can profit from cleaner production through more efficient use of inputs and machinery, higher quality goods that can command higher prices, and reduced waste disposal (EG, 2009).

Asfaw M.(2008)in his finding tried to show that, improving workers especially the machinery operators skill and awareness limitations on wastewater management, water and chemical consumption ,inefficiency in parameter control and smooth staff interactive systems, employing continuous production steps along with production process modification to reduce the intensity of wastewater generation and creates better mitigation option to deal with.

CHAPTER THREE

3. RESULT AND DISCUSSION

Under this section, results displayed and discussions made consist an assessment of tannery wastewater management efficiency with respect to wastewater treatment efficiency, consumption, recycling and reuse of water and chemicals, raw material handling, and machinery status. The four main methods of tannery wastewater management efficiency indicators basically known as 4R: Replace, Reduce, Reuse and Recycle study results also discussed in the context of BTPLC.

3.1 Assessing tannery wastewater management efficiency

Manufacturing of leather produces numerous by-products, and high amounts of wastewater containing different loads of pollutants. The uncontrolled release of tannery effluents to natural water bodies increases health risks for human beings and environmental pollution. Effluents from raw hide processing tanneries, which produce wet blue, crust leather or finished leather, contain compounds of trivalent chromium and sulphides in most cases. Organic and other ingredients are responsible for high BOD and COD values and represent an immense pollution load, causing technical problems, sophisticated technologies and high costs in concern with effluent treatment whose management system has to be assessed and evaluated.

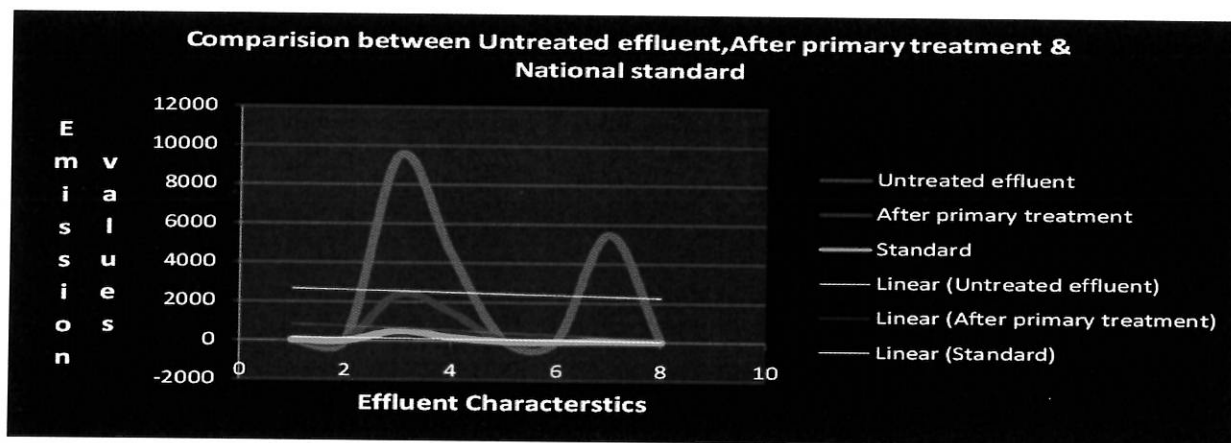
3.1.1 Tannery Wastewater treatment

The major aim of wastewater treatment is to remove as much of the suspended solids as possible before the remaining water, called effluent, is discharged back to the environment. As solid material decays, it uses up oxygen, which is needed by the plants and animals living in the water. "Primary treatment" removes about 60 percent of suspended solids from wastewater.

This treatment also involves aerating (stirring up) the wastewater, to put oxygen back in. Secondary treatment removes more than 90 percent of suspended solids. Batu tannery, as argued by a production manager, is reluctant to treat wastewater at secondary level because it is costly. Tanning industry is one of the oldest industries of the world and the problem of treatment and disposal of these wastes is probably as old as the industry itself. Tanneries wastewater effluent is treated in many different ways. There are situations in which an individual tannery applies all the available wastewater treatment steps on site. In other situations an individual tannery may apply (on site) only pre-treatment or a part pre-treatment or no treatment at all, sending the effluent to a rivers. Nevertheless, a treatment is necessary due to the wide range of toxic effects on the environment caused by untreated tannery effluents and sludge. As it is shown below, the environmental pollution is highly sensitive issue since the manufacturing process come up with huge amount of wastewater discharge. Establishing primary treatment plant will reduce the environmental impact as shown in the chart. As can be inferred from the following chart, it is possible to highly reduce the environmental load by installing primary treatment plant. All effluent characteristics show significant improvement but to meet the standard fully the secondary treatment plant is essential.

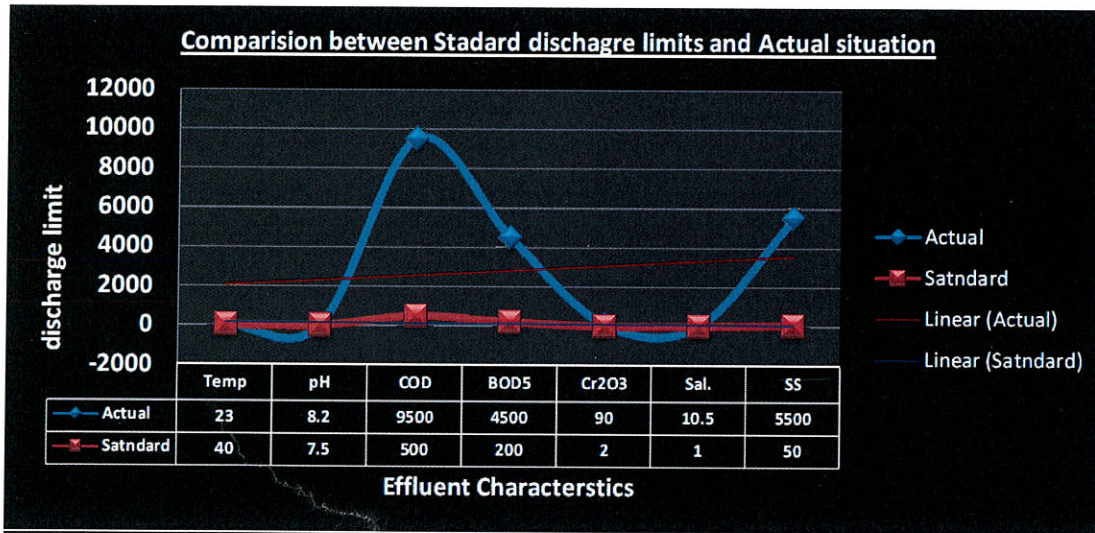
However the gap between the efficiently treated and the untreated effluent can easily be seen from fig.3.1 below and moreover a comparison between standard discharge limits and the actual situation is also displayed. (Fig.3.2)

Fig: 1



Source: (adapted from research paper on Leather and Environment, LIDI)

Fig: 2



Source: (adapted from research paper on Leather and Environment, LIDI)

The effluent treatment plant in Batu tannery is physically in a good status and like any other ETP in Ethiopia industries. The real purpose it serves however is questionable. The first question that comes to ones mind, when thinking of why is even the government is usually planning to allocate industrial village areas near river? And why is the first choice of the proponent industry construction site is near rivers? These questions clearly triggers an implication that whether an ETP is there in the industry in general or in tanneries in particular or not, as far as there is no strong monitoring and evaluation system implementation and there is no body taking strict measures against the tannery pollution caused as per the offenses listed on the environmental pollution protection proclamation No 299/2002 it brings no difference.

Responses of the distributed questionnaire among respondents of BTPLC concerning the question “what do you think is the main purpose of installing wastewater treatment plant in tanneries?”, about 90% of the respondents argued that it is there to protect the environment and others said it is there only to pretend to serve protect environment and to cheat and not to be penalized. This shows that at least in principle, people are aware that ETP should be established in tanneries with a purpose of protecting environment but they are not sure that the wastewater is confidentially treated effectively. ETP issues are among the top secret ones in tanneries and

nobody is willing to disclose activities of the plant. The result of observations in different tanneries reveals that the firm owners and managing groups show reluctance in being transparent in letting a researcher to collect data and getting reliable information especially taking photographs of the ETP areas while other manufacturing areas in the tannery are permissible and free to collect data in any form.

The same thing was observed during triangulatory survey work for the same study in China-Africa overseas leather products share company (CAOLPSC) currently established in Sululta-Oromia Region that the Chinese representatives are absolutely reluctant in explaining and showing the company's ETP status and when asked why? just replied "it is secret, even after being convinced that the information is collected only for a research purpose. One of the farming community member looking for his cattle around the company responded: "This area were and is still now one of the rare and only option we have to graze our cattle-the source of our livelihood, but as can easily be seen, the area is now under threat. It seems a new trend that a company that is not transparent to us releasing liquid waste foaming and discharge irresponsibly to the former safe life-line stream used for drinking." The respondent added "what surprised the community is that we are penalized if found commenting about this company related to the current likely environmental threat caused. In expense of foreign investment incentives rendered, unethical leather trading and environment damaging practices are evident. It is considered as a barrier to investment and our participation is undermined and we are sorry to say that the community as a whole feels helpless."

This indicates that the wastewater treatment issues are in their "hide and seek" mode of display among the stakeholders eventually victimizing the community irreversibly. Consistent and continuous monitoring and evaluation of the wastewater treatment plants whether, the tanneries comply with the standards by the authorized body is undermined. Also the key informant from the federal EPA monitoring and evaluation directorate director responded, because of the previous capacity and structural incompetence that required new structural arrangement, a BPR lately installed seems clear the existing inefficiencies, a wait and see paradigm of course exists. Tanning industry generates wastewater with unique characteristics, different from other industries, that it needs standard consistent with tannery specificity and local condition for monitoring and evaluation.

As per the Ethiopian Environmental Protection Agency, the tanneries are obligated to set up effluent treatment system either individually or collectively to control environmental pollution. The treated effluent shall meet the standards as stipulated by the Ethiopian Environmental Protection Agency (EEPA). Standards tolerance limits for tannery effluent discharge into Inland Surface Waters are given below from the benchmarking document of tanneries in Ethiopia.

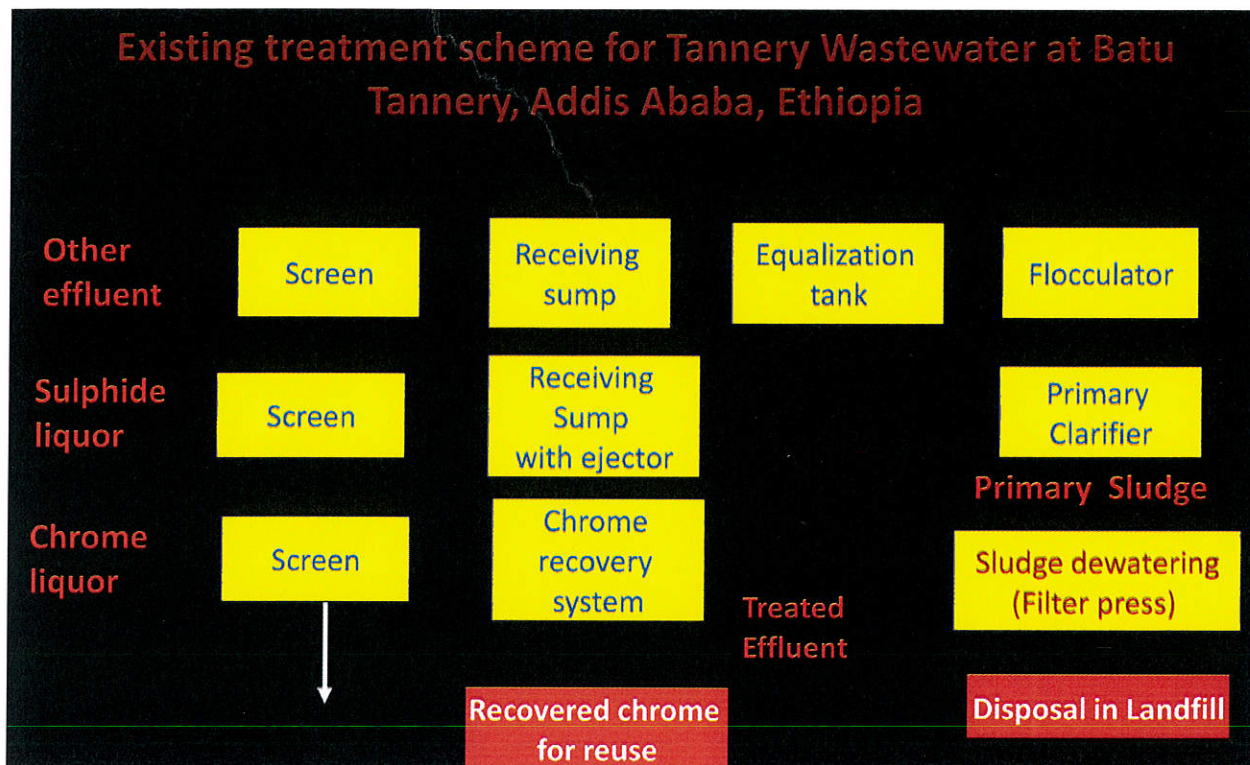
Table 2. Emission limits for discharges to water/ pollution control requirements/

<u>Parameter</u>	<u>Emission limit mg/l</u>
Temperature	40
pH	6-9
BOD ₅ at 20 ^o C	>90% removal or 200 mg/l
COD	500
Suspended solids	50
Total ammonia as N	30
Total nitrogen as N	>80% removal or 60mg/l
Total phosphorous as P	>80% removal or 10mg/l
Oils, fats and grease	15
Mineral oil (interceptor)	20
Chromium as total Cr	2
Chromium as Cr(vi)	0.1
Chloride (as Cl)	1000
Sulfide	1

Source: Benchmarking report- bench marking programme for tanneries in Ethiopia

The wastewater treatment scheme incompatibility with the current operating practices in Batu tannery is clearly shown below indicating that best and additional options other than wastewater treatment should be looked for.

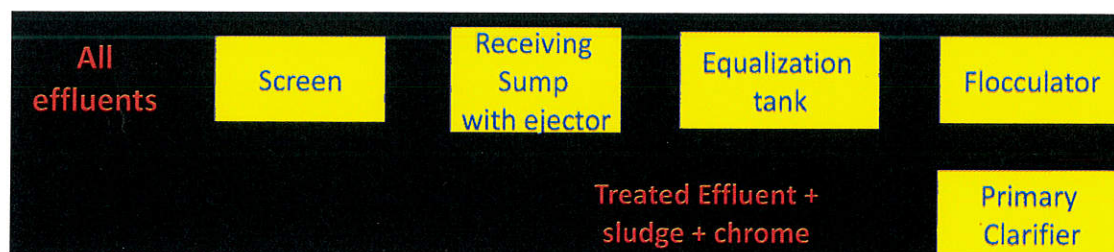
Fig: 3 ETP Process flow diagrams/Batu Tannery/



Process flow diagram as per original ETP design and implementation

Source: (Benchmarking -/Up gradation Technology/ for Ethiopian Leather Industry)

Fig: 4. Process flow diagram as per current operating practices /for comparison/



Source: (Benchmarking -/Up gradation Technology/ for Ethiopian Leather Industry)

The above figure is to show the fact that all the effluents (chrome, sulphide and other streams) are collected through a common drain. But as per design of ETP, chrome, sulphide and other

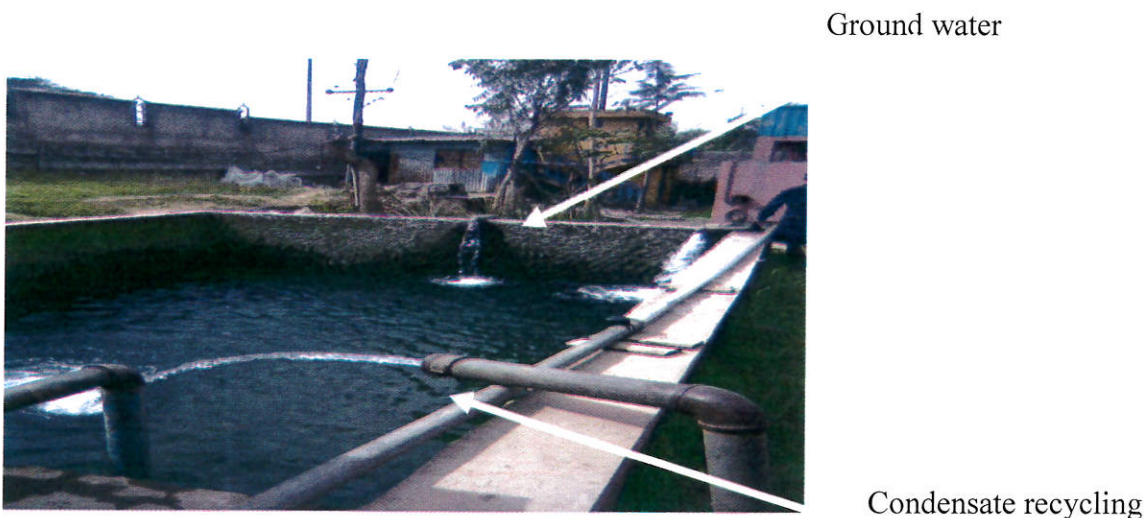
streams are to be collected separately and treated separately. Chrome, sulphide and other streams are however to be segregated, collected and conveyed separately to chrome recovery system and ETP respectively.

3.1.2 Water consumption and recycling

Water is an important requirement in tanning industrial processes, for heating, cooling, production, cleaning and rinsing generating a substantial proportion of total wastewater. Unregulated tannery wastewater has the potential to be a highly toxic source of pollution. The vast array of complex organic compounds and heavy metals used in modern tannery processes, if released into the environment can cause both human health and environmental disasters. Industry has a corporate responsibility to take action to ensure discharged water of an acceptable standard, and accept costs of any required clean up. The most cost-effective solutions usually focus on preventing contaminants from ever entering the wastewater stream or developing a closed system of water use. Tannery can also benefit from access to cleaner water resources with fewer impurities, as impurities can add costs to the production processes.

BTPLC is using underground bore water to process leather manufacturing. As there is no restriction on water use according to the response from the tannery workers and an observation that there is no flow meters that control water utility, unlimited volume of water turns into polluted waste water. The workers and tanners have no sense of water conservation because the result of the question concerning awareness is rated low, and there is also no incentive to conserve water. Systems of recycling and reusing waste water do not exist except a reuse of a condensate from finishing section, distilled on the way, safe and simple to reuse. The puzzle lies in that the tannery is mixing up the untreated ground water with this distilled condensate in a tank that shows the recycling here is unintentional. There is no defined ground water pre-treatment practices to protect machinery depreciation that would help minimize wastewater generation. It is also difficult to estimate the actual volumes of water used and waste water generated by a tannery. They can be estimated only on the basis of the weight of raw material processed and the discharge of a corresponding volume of waste water.

Picture 1. Mixing up water from the groundwater and the condensate in the water tank.



(Source: survey study result: Batu Tannery)

Leather processing requires water in almost every stage of production, but certain production methods or machinery status can lead to overuse. Ground water from a well and pumped, will favor excessive water use that can deplete water sources for future production or community use. Energy costs for pumping, as well as environmental impacts from energy consumption will also be higher than necessary. Excessive groundwater use may lower the water table and require frequent re-drilling of wells. Also, untreated wastewater (effluent) from processing operations may contain organic wastes which can both pollute local water sources and degrade water quality for downstream communities.

Water consumption and using water more efficiently guarantees production with low cost and ensures against water scarcity that could hinder production processes. Conventional production processes consume large amounts of water thus produce larger wastewater as compared to the technologically advanced processes as the following table shows.

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Table3. **Water consumption in individual processing operations** (C-conventional technology, A-advanced technology Operation Discharge (m3/t raw hide)

Individual processes	C	A
Soaking	7-9	2.0
Liming	9-15	4.5
Bating	7-11	2.0
Tanning	3-5	0.5
Post-tanning	7-13	3.0
Finishing	1-3	0
Total	34-56	12

(Source: adapted from benchmarking manual)

3.1.3 Chrome Recovery and Recycling

Conventional chrome tanning in leather production produces spent liquors containing significant amounts of chromium and other polluting substances, both organic and inorganic. From the total chromium used for tanning only 60% to 70% is utilized, while the rest 30 to 40% remains in the spent tanning liquor, which is normally sent to a wastewater treatment plant. This inefficient use of chromium and its release to the environment has to be compensated by designing a good recovery and recycling scheme. The recovery of chromium from spent tanning and re-tanning baths provides a significant economic advantage in terms of both its reuse and the simplification of the processing of wastewaters. In practice, there are two ways of chrome recycling methods which are widely practiced: these are direct and indirect recycling. The direct form entails spent float being recycled direct to the chrome tanning processing for re-use. While, the indirect form entails precipitating and separating the chrome from the float containing residual chrome, and then re-dissolving it in acid for re-use.

Observation of BTPLC chrome recovery and recycling status shows that the system and the plant is installed to employ recovery of the acidified chrome processed in a direct recycling though its application efficiency requires further study. The efficiency of both chrome reuse methods can be very high and depends on the effectiveness of the float collection process and the recycling or reusing technique. Of the two approaches, chrome recovery is more widely used than chrome

precipitation. However, it is mandatory to adopt and practice the new technologies which are more efficient in recovering this chemical, which is a big challenge to tanning industry nowadays.

3.2 Pollution load reduction techniques in tanneries

This issue particularly focuses on pollution load reduction methods and liquid waste/wastewater/minimization in a tannery that would automatically reduce waste treatment costs. These techniques consist of minimization of pollution at the source of generation (preventive or CP approach), substitution of chemicals, water and chemical consumption, reuse and recycling.

Picture 2 Batu tannery wastewater discharged to little Akaki River mismanaged at source.



Source: Researcher's Field work

3.2.1 Reducing environmental impact of tanneries

Tanneries, are releasing a large quantity of toxic waste at the time of processing of leather, causing a severe environmental pollution seriously affecting the livelihood of people in Ethiopia. It is a confirmed fact that most of the urban-based industries in Ethiopia Akaki –Kality sub city pollute environment. Of them, tanneries do the extreme damage. Residual chemicals from the leather manufacturing process, such as sulphide used for unhairing and chromium employed for the tanning process, contribute to the waste. Chemical analysis suggests that tannery wastes are characterized by strong colour, high biochemical oxygen demand, high pH and high dissolved salts. Disposal of these wastes into water course or onto land, with or without prior sedimentation, creates a great problem in the environment in the vicinity. So, it has become essential to treat the waste to certain degree prior to its disposal

The key targets which are identified for reducing environmental impact of leather processing are replacement of chromium, more efficient use of chemicals, sulphide-free unhairing, possibly with hair recovery, utilization of wastes, reuse of water and odor control whose actual implementation in a BTPLC case is at its very low level.

Pollution prevention and control involves additional investment to reduce the unintended environmentally harmful tannery /industrial/ products. Evaluating the pollution load reduction techniques in tanneries requires detail assessment of possible options related to the tannery production processes. Even the design of new plants should address the process modifications such as: Processing fresh hides or skins to reduce the quantity of salt in wastewater, where feasible. Reducing the quantities of salt used for preservation. When salted skins are used as raw material, pre- treat the skins with salt elimination methods and using salt or chilling methods to preserve hides instead of persistent insecticides and fungicides are common practices. . Response collected from BTPLC respondents for the question “whether hides are pre-cleaned before they are washed “resulted in 65% said not pre-cleaned and the rest said yes. This shows that little is done to reduce the quantity of salt in wastewater and reducing salt expenses.

Fleshing of green hides instead of limed hides and using sulfide and lime as a 20-50% solution to reduce sulfide levels in wastewater is also used to reduce wastewater pollution in tanneries.

Observing the raw material store of BTPLC tannery with the help of an expert, casual workers were busy trimming and fleshing the green hides. That shows tanneries are willing to reduce pollution in this respect and the problem they are facing as the informant argued, green hide supply is not dependable and consistent because supplying fresh skin and hide all times is not feasible for the simple reason that fresh skin and hide are sensitive to putrefaction- a rapid decay in a short period of time besides less availability of raw material in such form.

Conventional chrome tanning has poor chromium uptake, only about 55–60% (average). So, constant innovative process modifications for cleaner technology have been of the utmost importance in the leather-processing sector to safeguard our environment. The responses from the questionnaire distributed among respondents within Batu tannery concerning issues of the production process that are more prone to mistakes in generating large amount of wastewater and easier to modify, about 80% argued the beam house and tanning production processes require modification to deal with the pollution load reduction in a tannery. This involves splitting limed hides to reduce the amount of chrome needed for tanning, consider the use of carbon dioxide in deliming to reduce ammonia in wastewater. Using only trivalent chrome when required for tanning and recycling chrome, after precipitation and acidification, improving fixation of chrome by addition of dicarboxylic acid and recycling spent chrome liquor to the tanning process or to the pickling stage also helps. Survey study at BTPLC reveals that this process modifications status is at its lower level. There is no convincing evidence that shows the chrome liquor is effectively recycled. The informant explained how the chrome liquor recycling plant operates- open ended, while it is not still clear whether the spent chrome liquor is discharged (for chrome recovery plant in place) or recovered as there is no supporting recipe document confirming the evidence and moreover there is no objective evidence supporting spent chrome liquor either recycled or reused.

The method employed in the leather processing industry subjects the hides and skins to treatment with a wide variety of chemicals and passage through various unit operations.

All this involves an enormous amount of time and they contribute to an increase in chromium, COD, chlorides, sulfates and other mineral salts, which end up as effluent. But, perhaps more alarmingly, the process uses extra quantities of water in areas where there is rapid depletion of ground water. Regarding the water source used in BTPLC, most of the respondents (95%)

replied the source is ground water. The fact that people consider groundwater as a cheap water type let the tannery owners and workers to have a clear misunderstanding in that they are not ready to economize ground water. 60% of the respondents concerning whether they are aware of water scarcity in future replied yes and the rest are unaware. The tannery owners are also reluctant in controlling extravagant water use and installed no meter that read amount of water consumption of each tannery process stages.

This extravagance ground water usage increases the amount of tannery wastewater and also incurs additional cost though a little attention is given to the issue due to ground water abundance misconceptions simply because it is not taxed like municipality waster. Research findings show that ground water in cities is not free of pollutants. Most of the respondents (60%) know for sure that the ground water used for production processes is not pre-treated. According to the respondents un pre-treated water causes scale formation and deposition in machineries that down run machinery performance thus reduce production efficiency and increase wastewater generation.

3.2.2. Tannery wastewater pollution Preventive approach

3.2.2.1 Clean technology status in tanneries

The overall assessment of characteristics of clean technology indicators in BTPLC shows that its status related to wastewater management is rated surprisingly low, indicating that transferring cleaner technology were a challenge to be further studied. There is a lack of critical control on the production process and management which leads to unnecessarily excessive use of chemicals, resulting in a high pollution load, like an incomplete liming process leads to poor chrome fixation, resulting in: lower leather quality, unnecessarily high cost of chemicals, ,and high chrome content in effluent . Others also include conventional practices like no recycling of floats, continuous washing, creating large volumes of unwanted waste water and unimproved tannery machinery as well as drums.

These negative characteristics mainly result from a lack of: critical sense towards chemical use and technical know-how, well equipped testing facilities and experienced leather technologists, research and development service in tanneries, technical know-how about cleaner technology, process quality control and quality improvement of the end product, total quality management.

3.2.2.2 Problems and Possibilities for Cleaner Technologies

Various factors, among them the absence of adequate technical know-how and motivation, are the major obstacles preventing cleaner technology in Ethiopia tanneries. However, as the tanneries are still in many respects in a pre-mature stage, care is needed to ensure that the necessary modernization is consistently adopted. Cleaner production is a preventive business strategy designed to conserve resources, mitigate risks to humans and the environment, and promote greater overall efficiency through improved production techniques and technologies. Cleaner production methods may include: substituting different materials, modifying processes, upgrading equipment, redesigning products.

Experience has demonstrated that, with assistance, tanneries can frequently identify cleaner production opportunities that produce a positive financial return, sometimes with little or no investment. Many enterprises that change to CP methods may realize substantial financial and environmental benefits, indicating that CP should be the first option considered in addressing tannery environmental problems. The result of the research question concerning the CP preference as the first option is rated 50% showing that prevention option is usually undermined and conventional treatments tend to persist. Trying new option is feared for its unforeseen risks and challenges even if it pays. An awareness that the preventive approach in tannery wastewater management has to be the first option seems promising.

3.2.3 Environmental safety measures as a part of the preventive approach

Environmental, health and safety benefits, as part of cleaner production techniques provide opportunities to substantially reduce operating costs and improve product quality. Tanneries can profit from cleaner production through more efficient use of inputs and machinery, higher-quality goods that can command higher prices, and reduced waste disposal costs. Improved safety measures can also help tanneries avoid costly accidents and worker absences. The responses of the respondents from the BTPLC concerning worker health hazard status and whether there is any safety measure in place or not resulted in about 75% negative and the rest claim yes. The result of the data collected on the frequency of worker exposition to hazardous chemicals in the wastewater, that most of the respondents replied not frequent or sometimes (55%) clearly indicates that attention given to the worker safety issues is rated low and even the worker themselves are not aware enough that they are frequently exposed to harmful chemicals because there is weak awareness plan and implementation schemes practices according to the

respondents (95%). The workers have very little opportunity to know the kind and level of contamination of hazardous chemicals in the tannery wastewater thus difficult for workers to manage it properly.

Picture: 3. Tannery wastewater contributing to the uneco-friendly little Akaki river used for vegetable irrigation.



Source: (Researcher's Field work)

3.2.4 End-Pipe wastewater treatment option

Although there are other effective options and measures to minimize pollution, if pollutants still remain in wastewater, end-pipe treatment is mandatory. For the wastewater treatment system there should be separate treatment for different types of wastewater before all wastewater is combined. Tanneries including BTPLC are found tend to employ the end-pipe treatment option rather than the preventive one. Monitoring and evaluation department of the federal EPA is also confined to auditing and evaluating occasional point pollution status of Awash River basin down stream, Akaki River being its component. Wastewater end-pipe treatment status of BTPLC separately is not actually evaluated consistently and the system is totally missing, the document analysis reveals. This however encourages tannery owners to prefer the low cost incurring, inefficient, and irresponsible end- pipe treatment option to the BAT rich preventive wastewater management option that rewards best in sustaining overall development.

Despite all the scientific attempts to reduce pollution, tanning industry is still one of the major polluter of the environment. Therefore, to prevent the public health and environmental impact of tannery waste in its liquid form as wastewater has to be managed effectively.

End-of-pipe effluent treatment in tanneries at least requires two levels of treatment, primary and secondary. The primary treatment system includes mechanical screening, pH equalization and physiochemical processes. During this stage, coarse particulate flesh and hair is removed by means of perforated screens which also reduces the BOD load; the amplitude of pH fluctuation is reduced to a manageable and consistent range; and coagulation and flocculation are applied to remove suspended solids. During secondary treatment, biological processes are used to remove most of the organic matter from the wastewater by converting it into different gasses and into cell tissues. The most widely used processes for secondary treatment tend to be aerobic. However, anaerobic process is also utilized to some extent. Different documents show that efforts are made by the government, non government bodies and international organization like UNIDO in establishing and capacitating ETP (e.g. Walia tannery just adjacent to BTPLC, capacitated by UNIDO) while the clean technology, pollution preventive option, that should have strong system of implementation, received relatively little attention.

3.2.5 Tannery wastewater treatment, sludge formation and disposal

Tanneries discharging their waste water into inland rivers or streams, especially large tanneries, have treatment facilities that are not very effective in reducing pollutants, perhaps because: there is no mixing and intermediate neutralization of effluent which would improve precipitation; the tanks are seldom cleaned or maintained so they are mostly filled with the solid waste and sludge from the tannery and they are not functional; sludge removal from the tanks (ponds) is very difficult since it should be done manually. Waste waters from beam houses and tanyards are not separated, so they contain high concentrations of dissolved solid materials, chemicals and chromium salt. The effect of such polluted water can be easily seen in and around discharging water bodies and land. In a well-operating purification plant with proper sedimentation about 10 per cent of sludge is separated from the initial waste volume. This sludge contains up to 4 per cent of dry weight. The sludge volume should decrease to about 1 to 2 per cent of the initial volume of mixed waste water. The sludge is composed of the coarse material retained in the grid chamber and on the mechanical screens, chemically precipitated sludge from the equalization

and sedimentation tanks, and biological sludge from the activation and final settling tanks. Fresh sludge has a low viscosity and may be easily transported in pipes.

The most simple and cheap method of tannery effluent sludge disposal is by thickening and air-drying it on prepared beds. Model tannery of LIDI consist ETP intended to effectively display a model and exemplary wastewater treatment process possessing primary, secondary and tertiary treatment stages that finally is designed to remove sludge dried on prepared beds, made in to sludge cake. What observation revealed however is the prepared beds are deserted for relatively long period of time and seen grasses grown in it. BTPLC only about one Km away from LIDI, couldn't exploit an opportunity to improve and upgrade its ETP status because the model LIDI tannery and its ETP are no more model. During the research work, it was observed that the model tannery was fully operating and giving services for private tanneries beyond the aim it is established on unclear very little payment bases and the striking issue is that the ETP was operationally dismantled and all the wastewater generated is discharged in to the river totally untreated. It has to be noted that as the name clearly tell, LIDI model tannery is established to serve all tanneries in the country as a model in every aspect including wastewater management issues while the study result revealing the contrary for no part of the ETP all along its treatment line observed operationally malfunctioning.

Picture 4. Non functional sludge drying beds – LIDI Model tannery



(Source: Field work-LIDI)

The wastewater treatment capability of BTPLC is technically inadequate to chemically precipitate, activate, settle, dry on prepared beds and make in to cakes for transportation. According to the tannery respondents about 90% know the location of the disposal site of the sludge collected from wastewater mechanical screens in the tannery even though those who think the disposal site is free adequate to protect pollution and those who are not aware are rated 50-50. This shows that in wastewater management practices the sludge disposal site selection and efficiency requires close supervision by the concerned bodies.

Leather industry development institute/LIDI/ established by the government with the help of UNIDO and Italian government is there to assist the leather sector in training skilled man power, giving technical assistance for the needy sectors, help the leather sector to be competitive in the world market, promote best available technology /BAT/ transfer and retention through the benchmarking activities initiated by the primary stakeholder the ministry of industry/MOI/. Though a model tannery of the institute is aimed to display an exemplary role in any improved quality production processing and pollution control is now made to serve a purpose beyond its scope. The model tannery is being overloaded by orders of private tanneries to use the machinery and even chemicals meant for training purpose. There is no clear government budget allocation monitoring used for specific planed actions in the institute and that is why the private tannery owners got an opportunity to mix up the LIDI utilities with their own. According to the key informant, the representative of the model tannery of the institute, the model wastewater treatment plant now is more or less non- functional because the model tannery is overloaded and the treatment plant meant to display primary, secondary and tertiary treatment stages with the appropriate sludge disposal processes is incompatible. LIDI is also incapable to support the private tanneries in Ethiopia including BTPLC in this regard as it stands. Rehabilitation of the model ETP is underway implying that LIDI is striving to improve wastewater treatment persisted weaknesses though its implementation capacity requires capable and devoted top management.

3.3. Environmental policy and regulatory measures related to tannery wastewater management

Ethiopia has a huge livestock population consisting of cattle, sheep and goats. Hides and skins are one of Ethiopia's most important export products. Already in 1928, the country's first tannery and shoe factory was established. In 1994, six state-owned enterprises formed the Ethiopia Leather Industries Association (ELIA), which today is an industry association with

members, including basically all large tanneries and leather product manufacturers. ELIA organizes specialized trade fairs and exhibitions and helps to match export deals with foreign customers. In 1998 the Ethiopia Leather and Leather Products Technology Institute (LLPTI) was established, with support from the Italian government. LLPTI is now LIDI the main service provider for tanneries and the leather processing industry. It provides consultancy and training. It is order of our time that tanneries have to comply with the environmental regulation in place, retain and win export outlets by complying with international environmental standards and with the growing expectations and requirements of the global market to use environmentally eco-friendly technologies, according to the key informant from the ELIA representative. Members are aware of the current global market preconditions including environmental conditions. ELIA is on its new innovative path to mainstream environmental issues as a key component of leather sector development sustainability according to the informant. The challenge, as the former LLPTI and the now LIDI and ELIA representatives added, is lack of financial incentive schemes arranged to initiate the members to produce and serve in the leather sector as per the global requirements related to the environmental issues. ELIA key informant also argued that tannery clustering and adapting respective best practices can possibly remedy the ETP efficiency to comply with tolerable standards and environmental policy requirements.

Government environment regulation can trigger sustainable development, though success depends on other factors such as incentives, supporting measures, and relationships between industrial players. Key informant from the representative of National Regulatory Office in the ministry of trade argued that mandatory regulations concerning issues related to any tradable products including leather products produced for customer consumption should serve customer protection whether the product imported or exported is eco-friendly. The informant added that proclamation concerning this issue is already prepared but how to implement it is yet a challenge to be resolved. EIA implementation is also one of the mandatory regulatory requirement measures that have to be considered. Standards and regulations as an indicator and feedback input mechanisms concerning tannery wastewater lack consistency, continuity, dependability, transparency and reliability according to the informant.

3.3.1 Environmental policy gap analysis related to tannery wastewater management problems in tanneries

3.3.1.1 Environmental policy gaps matrix

Tannery wastewater management problems have their basic solution roots in the environmental policy enforcement, compliance and implementation capability. The central theme of the Ethiopia environmental policy to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment. As a whole environmental policy set is aimed at to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. This study is trying to show gap in defining and implementing the policies related to the environment in general and tannery wastewater management problems in particular that adversely affect the community and development sustainability. The following matrix shows the existing gap as per the current study case situation at hand.

Existing policy(relevant)	Gap observed by the researcher
<p>Ensure that essential ecological processes and life support systems are sustained, biological diversity is preserved and renewable natural resources are used in such a way that their regenerative and productive capabilities are maintained and where possible enhanced so that the satisfaction of the needs of future generations is not compromised; where this capability is already impaired to seek through appropriate interventions a restoration of that capability</p>	<ul style="list-style-type: none"> • The Batu tannery waste water one of the constituents of the polluted river nearby contributed to the damaged ecological and life support systems, biological diversity and regenerative capability that symmetrically oppose the need and satisfaction of the generation to come. The FGD with the Heechuu kebele community, the immediate recipients of the polluted little Akaki river, concerning this subject revealed that the trend of the river pollution and environmental deterioration is increasing with negligible intervention. One of the community members tried to show this frightening trend with examples like the disappearance of different species of birds, the

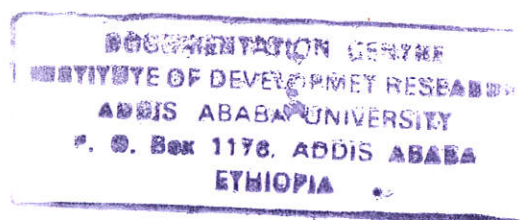
	<p>darkness colour intensity of river, deposition of non-degradable plastics, cattle dehairing, health status deterioration and total dissatisfaction among the young and the old dwellers followed by undermined public application, accusation, and complaints by the concerned government environment stakeholders. The response from the FGD generally indicated that the right of the community to live in a clean environment is under threat and showed little improvement as far as this policy is concerned</p>
<p>Ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities</p>	<p>According to the discussion outcomes of the Heechuu kebele community empowerment, participation and organizations are just mere policy ambition and not applicable yet</p>
<p>Raise public awareness and promote understanding of the essential linkages between environment and development</p>	<p>The public awareness on environment –development linkage practices basically depends on the capability of the stakeholders to disseminate valuable information, avoid misconceptions about the public and commitment to favor public participation. The fact that there is intense will on the government side to attract investors and high interest among the investors to appropriate cheap labor, environmental issue non compliant people and reluctant governance, created clear policy compliance gap. The key informant from the federal EPA awareness directorate director argued that the awareness creation plan is on its way to be installed as per the new BPR structural arrangement to strengthen the support schemes. The pre-BPR awareness creation processes were believed to be inadequate thus a new structural arrangement is ready to remedy the problems</p>

The Key Guiding Principles underlying broad environment policy objectives as evaluated in accordance with the purpose of this specific study revealed that there is a gap, analyzed accordingly based on the results of the research findings.

Existing policy	Gap observed
<p>Every person has the right to live in a healthy environment</p>	<p>FGD made with the immediate recipients of polluted little Akaki river the Heechuu Kebele farming community argued that they even don't have an awareness that they have this right showing that no concerned party on an environment played its ethical part to let the community know its legal right ,rather it is considered taboo.</p>
<p>Sustainable environmental conditions and economic production systems are impossible in the absence of peace and personal security. This shall be assured through the acquisition of power by communities to make their own decisions on matters that affect their life and environment</p>	<p>The FGD with the community clearly reveals that -there is a gap here in that let alone the community is given power to make their own decision the public or community participation in decision making with other parties is significantly undermined. The capacity of governmental line ministries and environmental institutions and stakeholders is of course inadequate and limited due to the structural ,capacity building and ,environmental management unit inefficiencies among the primary and secondary EMS stakeholders in general and tannery wastewater management in particular according to the response from</p>

	the key informants of MOI,EPAs/Ethiopia and Oromia/.
The development, use and management of renewable resources shall be based on sustainability	This study managed to find out that the development, use and management of the little Akaki river that receives liquid wastes from different sources including Batu tannery is inadequate. Different research findings, observations, group discussions and benchmarking document analysis all reveal that the development, use and management of water in BTPLC is not sustainable.
Use of non-renewable resources shall be minimized and where possible their availability extended (e.g. through recycling);	According to the response from the questionnaire distributed among the Batu tannery management group and workers the larger source of water for production is from the ground water that the firm assumes non-taxable and cheap thus its extravagant use in the tanneries is favored to the extent water inlet lines to equipments or machineries is devoid of water gauge showing the right amount of water used that helps to minimize wastewater and at the same time save production cost.
Conditions shall be created that will support community and individual resource users to sustainably manage their own environment and resources	There is a clear gap in that the awareness and favorable condition creation to support community in this respect is inadequate according to the responses from the key informant federal EPA-awareness creation directorate, MOI, Ethiopia EPA and Oromia EPO.
Social equity shall be assured	Urban dwellers and the rural farming

<p>particularly in resource use</p>	<p>community around tanneries are victims of the wastewater discharged and owners of the firm enjoy the profit at the expense of the victim community according to the discussions made undermining the social equity at large.</p>
<p>Regular and accurate assessment and monitoring of environmental conditions shall be undertaken and the information widely disseminated within the population</p>	<p>The interview with the federal EPA monitoring and evaluation directorate director revealed that the establishment in a new BPR structural arrangement frame work of this directorate is only one month ago and this directorate and others also are highly deficient of professionals and experts that need to be employed and then there is a plan to undertake new support strategies and arranging new feedback reporting schemes that would strengthen the former weak link concerning information gathering and dissemination within the population</p>



<p>Increased awareness and understanding of environmental and resource issues shall be promoted by policy makers, by government officials and by the population, and the adoption of a "conservation culture" in environmental matters among all levels of society shall be encouraged</p>	<p>The role of education and awareness in wastewater management is rewarding in that the problems associated with it need due attention among policy makers in Ethiopia where the industrial sector is expected to boom in the next times to come according to the growth and transformation plan set by the government. Observations and document analysis of this study shows that a little has been done in describing and verifying specific and clear policy issues concerning the number one pollutant sector and its larger pollutant reservoir, the wastewater in tanneries. Wastewater is everyone's concern in the home and at work and using education to help change behavior to both reduce wastewater discharge and also see the opportunities of managing wastewater is part of the solution. Increased understanding of the links between wastewater and health, ecosystem functioning and the potential benefits of wastewater reuse in contributing to development and improved wellbeing can increase uptake of initiatives. It is vital that education in wastewater management and engagement of stakeholders in all sectors should include access to solutions and be culturally specific. Education, awareness, advocacy and stewardship should be addressed at multiple levels, including the development of professional skills for improved inter-sectoral collaboration and multi-year financial planning.</p>
<p>Local, regional and international environmental interdependence shall be recognized.</p>	<p>The Oromia EPB representative strongly argued the misconception that the FEPA have in considering it as independent environment protecting body and giving it very little support.</p>

<p>The integrated implementation of cross-sectoral and sectoral federal, regional and local policies and strategies shall be seen as a prerequisite to achieving the objectives of this Policy on the Environment</p>	<p>Integrated implementation of environmental policies to assure community wellbeing in dealing with river pollution from tanneries is weak. Key informant from federal EPA when asked whether there is integration with regional and sectorial environmental protection agents responded saying that federal EPA is there just to give support and the relative freedom of the regional EPA to install their own structures to some extent hindered smooth interactions and sounding integrity. The key informants from Ethiopia EPA confirmed this issue by citing an example that their office currently through BPR arrangement formed two core processes one of the core processes consisting the EIA directorate totally missing in the federal EPA (BPR structural arrangement lately practiced). The Oromia EPO however is structurally merged up with the land use office according to the key informant from the Oromia EPO representative arguing that this structural incompatibility is a big troubleshooting that</p>
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3.3.1.3 Legislative issues and implementation gaps

Based on Article 55(1) of the constitution of FDRE Ethiopia government has approved proclamation No 9/1995 to provide for the establishment of the EPA with the objective of ensuring that all matters pertaining to the country's social and economic development activities are carried out in the manner that will protect the welfare of human beings as well as sustainably protect, develop and utilize the resource bases on which they depend for survival. According to the result of this study obtained from the FGD with the community utilizing the Akaki river, carrying tannery wastewater among others, for their survival the economic development activities supported by the tanning industry is now carried out in a manner that will damage the welfare of the surrounding community because of the inadequacy and incapability of the environmental policy enforcing mandated bodies. Among the duties of the authority rendered,

specially the follow up the implementation of environmental policies within the framework of the country's social and economic activities , a key issue, is not clearly stated that would possibly widens the implementation gap of realities.

Proclamation No.295/2002, the establishment of environmental protection organs, is also set with the same objective now stressing the implementation process of enhancing the well being of humans and safety of the environment basically to assign responsibilities to separate organization for environmental protection and management activities on one hand, and environmental protection , regulation and monitoring on the other, thereby avoiding possible conflicts of interests and duplication of efforts.

The proclamation also state very important issue concerning re-establishing an autonomous public institution that would install a system that fosters coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels. According to the responses from the key informant from the Ethiopia EPA the federal EPA and Oromiya EPO, the separation, coordination and differentiation of responsibility should have been backed by strong structural arrangement that would help the system working. It is now that BPR is installed and on trial basis to re-engineer the efficiency and of course takes time to make sure and assure solving the problem of the structural arrangement incompatibility seen. Especially the Oromiya EPO and Ethiopia EPA representative argued in similar way that there is a weak link and system gap between the federal EPA, Ethiopia EPA and Oromiya EPO because there existed a misunderstanding as to the mode of coordination and differentiation in dealing with integrated act on reducing the river pollution by industries at large and tannery wastewater in particular, discharged in to rivers covering wide range of regions. The monitoring and evaluation directorate of the federal EPA representative said that the directorate came to being lately since last month that it is difficult to suggest the improvement to come because the regions are already mandated to accomplish any environmental monitoring and evaluation activities and it is devolved among them. This directorate is there to support and assist the regional EPA in training, funding whenever required and consolidate reporting systems trying to strengthen public participation in collecting information and feedback dissemination. This all is just a plan and an intention not yet realized. The new BPR structural arrangement in a federal EPA consist no EIA directorate that would help and support the regional EPA in a defined way in implementing the current burning

issue of protecting the environment and human well being mainly in improving the EIA implementation status especially in a leather sector.

A proclamation No 299/2002 is cited as the proclamation on EIA used to predict and manage the environmental effects which a proposed project or a development activity as a result of its design sitting, construction, operation or an ongoing one as a result of its modification or termination, entails and thus helps to bring about intended sustainable development through administrative transparency and accountability. Among the general provisions of the proclamations is one that says “without authorization from the authority or from the relevant regional environmental agency, no person shall commence implementation of any project that requires EIA as determined in a directive issued pursuant to Article 5 of the proclamation”. Tanneries are known to produce large amount of wastewater and discharged it to rivers with out efficient treatment and eventually causes unintended and irreversible adverse impacts. Now there is a gap observed in the EIA implementation as per the proclamation intent clearly compromising the right of the people to live in a clean environment including the future generation. The key informants all argue that it is worse good to at least approve the proclamation indicating that the existing government is concerned about the welfare of its people but the problem is EIA issues are considered additional troubleshooting task that apparently oppose investment attracting strategy the government thinks appropriate and the project owners are not comfortable with EIA because there is a misconception among the proponents in that EIA that it may incur additional cost and considered as a goodwill damaging instrument that rather destroy the project sustainability. Had EIA implementation system be efficient in the country, the tannery wastewater management problems could have been solved effectively and contribute to government legitimacy buildup.

Now despite the fact that Ethiopian government made all these efforts in setting different environment related proclamations,, the result of this study made a crystal clear investigation that there is a very low concern about the pollutant number one sector, the leather sector at the same time the most favored especially the waste type that made it the most pollutant, the tannery wastewater. An indicator for this is that, Ethiopian government approved the solid waste management proclamation 513/2007 and of the most attention seeking one, the wastewater management issue is undermined.

3.3.1.4 Policy gaps related to community participation

- To develop effective methods of popular participation in the planning and implementation of environmental and resource use and management projects and programmes:-

There are limitations in developing effective methods of popular participation concerning Akaki river water use and management related to wastewater management in tanneries situated along the course of the river including BTPLC.

- To develop the necessary legislation, training and financial support to empower local communities so that they may acquire the ability to prevent the manipulated imposition of external decisions in the name of participation, and to ensure genuine grassroots decisions in resources and environmental management; ----- local community empowerment, training and awareness creation is almost left aside as the Heechuu kebele community confirmed in the FGD conducted during survey.

- To ensure information flow among all levels of organization including the Federal and Regional States and the people at the grassroots level by developing a two way mechanism for data collection and dissemination:-

There is significant information gap between the FEPA and regional environmental bureaus related to information flow at all level of organization and two way data collection and dissemination. Key informants from FEPA, AAEP, and OEB confirmed that limitations in information flow are one of many problem areas to be dealt with to improve the wastewater management problems of tanneries.

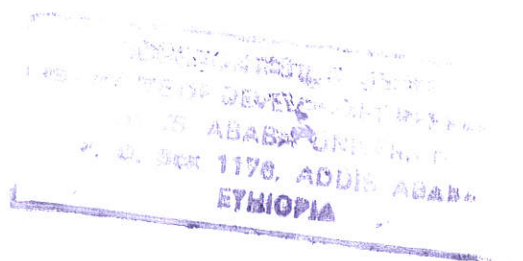
3.3.1.5 Federal and Regional environmental institutional structural incompatibility

Key informants from FEPA, AAEP and OEB all complained and argued that the structural incompatibility created among them resulted in limited common understanding and integration in environmental policy implementation. The FEPA representative added, the structural incompatibility we have with the regional environment agents prevented us from extending our supporting arm to the optimum level. Components of the new structure (BPR) installed currently in FEPA are alike and have no central theme with regional EPA apparently

autonomous structural arrangements. Numerous job vacancies created due to the new structure seeking able professionals are not efficiently filled as there is very low transparency and irresponsibility in employment when the authority is claiming it has critical professional deficiencies. The incompatibility revealed for instance in AA-EPA consists environmental research department (whose shelved research outcomes benefited no community living on damaged rivers carrying wastewater) is not available in FEPA, AA sub-city environmental protection offices and OEB. The same thing is true of EIA department. Environment unit directorate is there in FEPA arguing that this directorate will take care of the EIA issues though the key informant claim the EIA issues are already devolved to sectorial levels but observed within AA-EPA of distinct department. This clearly shows environment institutional structure incompatibility is observed that significantly limits the sense of integrative and cooperative practices and symmetrically opposes the current environment and climate change cope up initiatives.

3.3.2 Environmental policy enforcement constraints and structural incompatibility

According to the respondents environmental policy enforcement problems have rooted their cause in to incentive and budgetary constraints, EMS and effluent standard monitoring inefficiencies, evaluation feedback implementation drawbacks, low level of awareness, and technology transfer and retention arrangement scheme issues. Unclear structural arrangements are installed among environment agencies concerning EIA, monitoring and evaluation issues. AKEO representative argued that Akaki-Kality sub city environment office is given limited and ambiguous tasks despite the fact that most of the industries in Addis Ababa are concentrated in the sub- city and the most polluted river, Akaki River in Ethiopia is also located in the same sub-city. An agreement is reached between the AA-EPA and AA trade and industry bureau in certifying a proponent regarding EIA. This is a promising act to improve and realize EIA implementation. The problem now seems that AA-EPA alone progressing in this area of concern takes the overall intended outcome nowhere. Others are almost hibernating. This is a clear indication that revised structural and institutional arrangements and compatibility maintained.



3.3.3 EIA tannery associated legislative gap

EPA is given an authority to prepare regulatory laws that would maneuver the status of the development projects related to the environmental negative impacts the project will have. Accordingly development projects that require EIA as a decision making and environmental management instrument are identified. Tanneries are among these projects whose adverse impact is of the highest magnitude manifested through the wastewater they generate. Despite its intensive pollution impact however, it is very little effort made to work on the EIA implementation efficiency in leather sector for the established and the coming on tanneries so that development is sustained and the next generation will be assured that this generation has displayed responsibility. From the MOI key informant point of view, it seems that starting to talk about environment especially EIA issues is just a wastage of time and nonsense where the government of under developed countries like Ethiopia is giving attention more to transformation through economic growth enough to feed its people, eradicate poverty and most investors try to inflate their profit in expense of damaged environment, community wellbeing and health. The fact that talking about environmental negative impacts in relation to development plans and projects amounts to an investment inhibiting act should be reconsidered otherwise sustainable development will just be slogan and no more reality.

CHAPTER FOUR

1. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

BTPLC is a privately owned company engaged in the tanning of sheepskin, goatskin and cowhides with a capacity of processing 8400 sheep skins or 9000 goat skin or 1000 cowhides or a combination of the above per day. The tannery is processing hides and skin in a chain of processing machineries in the same compound. Among its short term objectives are minimizing wastage of material and increase product efficiency (productivity) and the Long Term objectives are putting in place an effective QMS and TQM ,Cleaner leather production as per the established Eco- norms/REACH protocol ,EMS as per the Government norms and exploring the options to recycle leather by-products. The vision and ambition of the company as it stands is well stated. An assessment of BTPLC wastewater management problem areas however reveals the following facts.

The tannery wastewater treatment is commonly known for its pollution load reduction method in most tanneries including BTPLC. Wastewater End-Pipe treatment as a constituting component of the wastewater management is found a dominantly practiced option. The pollution preventive approach of tannery wastewater management at the source rooted essentially in EMS in the tannery under study is less focused. Ones wastes are formed the company show reluctance to treat it because there is a cheap option of discarding waste to the river nearby arguing that waste treatment in general at individual tannery level is costly. This treatment inefficiency triggers alternative solution that this study investigated as best way out (minimizing wastewater generation at the source) in BTPLC. The wastewater waste category in tanneries carries most of the pollutants that threatens the environment. There fore it has to be properly managed in such away that the waste formation is minimized through preventive clean production technology practices that would automatically regulate wastewater generation and thus reduce pollution load. It is also revealed that there is a wastewater related environmental policy implementation gap to reduce pollution load created in tanneries. The implication is that tannery wastewater management inefficiency intensifies pollution that ultimately threatens human life.

Major findings of the study are summarized and presented as follows:

- ❖ Proper use of chemicals and maximum exhaustion, optimum water consumption, waste reduction at individual tannery process stages or at the source, use of non toxic chemicals, and efforts to elevate factory worker awareness towards pollution, adverse impact mitigation and safety issues received less consideration in the tannery under study.
- ❖ The Batu tannery wastewater treatment process lacks continuous and consistent improvement practices. Water and chemical consumption control system is inadequate. The tannery wastewater treatment plant performance efficiency monitoring system is weak. Simple process monitoring tools which indeed manage the waste generated out of each process operations are not in place.
 - ❖ Use of untreated ground water for tannery processes in Batu tannery enhances machinery inefficiency that contributes to the wastewater generation.
 - ❖ Salt used to preserve raw hide and skin is found to be washed away and no saving and reuse mechanism devised. This increases salinity effects of tannery wastewater and thus increase the salinity of river to which it is discharged. Saving and reusing the salt saves production cost and reduce river salinity
 - ❖ The finding indicated that tannery individual production process management is weakly integrated with the wastewater management practices.
 - ❖ Investigation made in Batu tannery shows that preventive options are practically inadequate in mitigating negative impacts of tannery wastewater.
 - ❖ Chrome substitution and management practices are inefficient.
 - ❖ Environmental management units and EMS active function in Batu tannery is initiated but received less emphasis.
- ❖ Clustering tanneries and installing common ETP provides better wastewater treatment practices.
- ❖ It is found out that there is environmental policy gaps related to tannery wastewater management issues concerning Public participation, Awareness, Monitoring, evaluation and institutional arrangement.

4.3 RECOMMENDATIONS

- ❖ The Batu tannery's inadequate, inconsistent and casual ETP monitoring process now in practice has to be improved.
- ❖ The knowledge and commitment of BTPLC owner as regards to environment should be improved. In collaboration with primary and secondary stakeholders under study they should intensify their concern related to tannery wastewater management problems in reducing pollution load
- ❖ Environmental policy and legislative compliance evaluation related to tannery wastewater management problem issues require strong institutional arrangement and regulatory measures considering influential factors such as incentives, supporting measures, and relationships between industrial players.
- ❖ Practices that would improve tannery wastewater management efficiency like minimizing waste water generation through preventative approaches, isolating wastewater produced using appropriate treatment systems, then reuse and recycle has to be adapted.
- ❖ Wastewater management proclamation and its efficient implementation strategy should be set. This area requires major focus and calls for immediate attention and intensive investment. It is recommended that improvements before wastewater discharge be undertaken. This has the potential to reduce the pollutant.
- ❖ Reinforced commitment to build capacity and resources maintenance to implement national policy and strategies effectively on pollution reduction related to tannery wastewater should be strengthened.
- ❖ Regulations on wastewater management, pollution control, environmental quality and pollution control standards need to be effective.
- ❖ Monitoring systems as a descriptive evaluation tools that complement, inform and support more methodologically rigorous evaluation studies should be capacitated and revise its systems for efficiency and adequacy. In this regard, FEPA has to design an

improved strategy to provide meaningful and consistent support for the regional and sectorial environment agents regarding the attention seeking wastewater management problems in tanneries. Thus, EEPA bodies at regional level should on regular basis evaluate and monitor the performance and compliance of manufacturing industries in general and tanning industries in particular as per environmental laws and regulations and accordingly act up on the results.

- ❖ Wastewater management problems should be geared in to a public agenda that could facilitate critical stakeholder concern to safeguard community wellbeing and maximize their satisfaction. Tannery process manufacturing company owner's participatory assistance in supporting the surrounding society in safeguarding the environment shall be appreciated and naturally expected. A clear and defined wastewater management roadmap should also be set.

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Annex I

Questionnaire, checklists, guiding interview questions for key informants and focused group discussions involving different stakeholders.

Questionnaire:

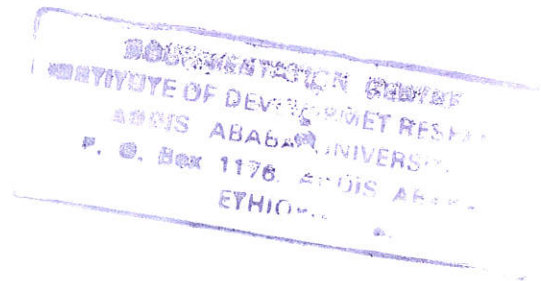
The essence of this study on tannery wastewater management problems is aimed at triggering the improvement of wastewater management status in tanneries to contribute to sustain development through environmental protection and maintenance. This requires your genuine response for the research questions posed in any form. It is worthwhile to confirm that any information you give us is maintained confidential. Your contribution is highly appreciated.

Instruction:- Please mark 'X' of your preference/choice/ in the blank space where it exists.

General

Questionnaire for Batu tannery Respondents :-

- a/ production and quality managers
- b/ Effluent treatment plant manager
- c/ Tannery process shift leader
- d/ Supervisors , operators, workers



Name-----

Section/Department-----

Wastewater Management Issues

Wastewater Treatment

1. What do you think is the main purpose of installing wastewater treatment plant in the tannery?

1. To protect the environment____ 2.to secure tannery penalty____ 3.I don't understand____

2. How is the wastewater discharged in the tannery you are working? 1. Directly to the soil
2.directly to the river nearby 3.to the river through the treatment plant

3. Is there any sludge disposal site you know post tannery processing? 1. Yes____ 2.No____

4. If yes, is that site free of another environmental threat? 1. Yes____ 2. No____

5. Do you think that preventing pollution at the source is the best option in tanneries?
1. Yes__ 2. No__
6. Is there any scheduled awareness creation program on waste water management issues in the tannery? 1. Yes__ 2.No__

Chemical Use

Do you know kinds of chemicals used in tannery production processes dissolved in water?
1. Yes__ 2. No__

Can you tell the most toxic chemical composing the wastewater in the tannery?
1. Yes__ 2. No__

If yes, how do you think is the toxicity reduced?

1. Reducing the concentration__
2. Substituting the chemical__ 3.Optimizing the recipe__
4. Which tannery production stages use large amount of water and chemicals?
1. Beam house__ 2. Tanning__ 3.finnishing__
5. What tannery production stage you think requires modifications to minimize wastewater generation? _____
6. Where are the tannery chemical stored?
1. in separate store away from the tannery__. 2. in the processing area in the tannery__ 3. There is no defined organized chemical store I know. _____
7. Is the tannery chemical weighing materials checked and standardized for accuracy?
1. Frequently__ 2.Sometimes__ 3.Not at all__
8. Do on job training given to the tannery chemical weighers concerning safety and recipe optimization?
1. Yes__ 2. No__
9. If yes, is there any certificate awarded for the specific capacity built?
Please justify.-----
10. How is about the adequacy of chemical recipe monitoring system installment in the tannery?
1. Efficient__ 2.satisfactory__ 3.inadequate__

B. Water Use

1. Do you exactly know the source of water the tannery uses for production prossess?
1. Rain water__ 2.Ground water__ 3.Municipal water__ 4.Iam not sure__
2. Is the water used for tannery processing pre-treated? 1. Yes__ 2. No__
3. If No, what effect it has on machinery performance and efficiency?
4. Is water left running between production stages? 1. Yes__ 2. No__

5. Is fresh water used in every new bath? 1. Yes____ 2. No____
6. Have you ever seen water reuse and recycling in any tannery production processes?
1. Yes____ 2. No____
7. Are hides pre-cleaned before they are washed? 1. Yes____ 2. No____
8. Have you ever thought of water scarcity sometime in the future used for industrial (tannery) production? 1. Yes____ 2. No____

C. Excessive Waste

1. Which production processes are most prone to mistakes and wasted products in water utilization? _____
2. Which production processes are easier to modify with respect to wastewater generation?
3. Do you feel comfortable with the odor from the tannery? 1. Yes____ 2. No____
4. If No, did you ever projected to other community and strive to solve the problem?
1. Yes____ 2. No____
5. If yes, comment-----

Worker health hazards

1. Is there any safety measure in place and significant commitment from the management to improve health condition? 1. Yes____ 2.No____
2. How often are workers exposed to chemicals dissolved in water?
Frequently____ 2.Sometimes____ 3.Not at all____
3. Is the tannery structure well installed to let efficient wastewater outflow under the floor?
1.Yes____ 2.No____ 3. I don't have an idea

Comments on the little Akaki River status/ passing by/

What do you think is the reason that most of the tanneries in Ethiopia are established along the courses of rivers? _____

Can you imagine the contamination level of the river passing by the tannery you are working? _____

If you think it is polluted, whatever the level, what is your personal effort to protect the environment

Annex-II

Research stakeholders:- key informant interview questionnaire guide.

The essence of this study on tannery wastewater management problems is aimed at triggering the improvement of wastewater management status in tanneries to contribute to sustain development through environmental protection and maintenance. This requires your genuine response for the research questions posed in any form. It is worthwhile to confirm that any information you give us is maintained confidential. Your contribution is highly appreciated

Ministry of Industry/MOI/-Leather section, Person in charge of the Leather sector.

Checklist for discussion

What are the key issues with respect to industrial /environmental/ policy executions and implementation status?

Understanding related to quality industrial/ tannery/products and services in relation to global market requirements and standards.

Compliance with current global perception on pollution prevention and effective natural resource management.

How is the implementation of the program on the best available technology/BAT/ transfer and retention accomplishments in Ethiopia tanneries?

Is there organized and structured effluent/wastewater /management system installed to assure efficiency and production process integration in tanneries?

How are the sectorial and institutional government's bodies integrated to execute policies, regulations and legislations?

Is there any wastewater treatment plant performance monitoring and empowerment system in cooperation with non- governmental development organizations?

Commitments towards EIA and Environmental Audit issues.

Justification why industries/tanneries/ are let to establish plants along river courses.

Capacity building in relation to tannery wastewater management accomplished so far if any.

Leather Industry Development Institute/LIDI/-Model Tannery Head

Mission and objectives of the institute

In what sense is the tannery in the institute a model especially concerning tannery wastewater management?

What is your perception concerning the position of the model tannery along the little Akaki River?

Explanation on any limitations of wastewater treatment plant performances.

Waste discharge and disposal procedure before and after wastewater treatment.

Commitment indicators to protect environment and tangible measures taken to abate pollution?

Comments on the preference of either the cleaner production or the end-pipe wastewater treatment approach of tanneries in mitigating environmental adverse impacts.

How is the model tannery working with other private tanneries?

Perception towards machinery status and process modification.

Challenges and opportunities of working with private tanneries and sectorial government bodies with respect to environmental protection, mitigation options and BAT transfer institutional performances.

C. Federal Environmental Protection Authority/EPA/ -Pollution prevention section

1. Basic role that Federal EPA plays with respect to pollution control in industries/tanneries/.
2. How do you evaluate implementations compliance and enforcements of environmental policies, regulations and legislations?
3. How is tannery wastewater management problems addressed in your section?
4. How is the federal EPA integrated with Ethiopia and Oromiya environmental protection bureau to prevent river pollution shared among the regions to assure community welfare?
5. Facilitation schemes as to awareness creation on how to effectively manage wastewater in tanneries if any.
6. What is your perception on sustainable development issues in relation to waste management in general and wastewater management in particular?
7. Is there any response to the previous research comments and recommendations on little Akaki river?

D. Ethiopia Leather Industries Association-Person in charge

1. Mission of the association
2. Role of the association to safeguard the community welfare
3. Do reluctance of private tannery owners to mitigate environmental adverse impacts recognized as a problem by the association?
4. How do you evaluate river pollution as the result of wastewater discharge in to rivers?
5. What is the contribution of BAT retention in relation to wastewater management problems?

E. Ethiopian Investment Agency-Leather and Textile investment Desk

1. Role of the agency
2. Environment concern status
3. Investment attracting practices vs environmental concerns
4. Foreign investment incentives in relation to pollution issues and EIA.

F. Akaki-Kality subcity Environment protection office.-Representative

1. Objective of the office

2. Industrial wastewater pollution reduction measures taken
3. EIA implementation status
4. Akaki river pollution and vegetable irrigation scheme

G. Focused Group Discussion with Heechuu kebele dwellers/Oromiya/-immediate recipients of little Akaki River from Ethiopia.

1. What does this river mean to you?
2. Did you participate in discussions conducted with other parties concerning environmental pollution/river pollution/?
3. What is your understanding about the right of living in a clean environment?
4. As a farming community did you face unresolved challenges related to the wastewater?
5. What do you think is your own role other than different parties in creating quality life?
6. Mostly prevailing disease in the Heechuu kebele.
7. Your perception about tannery?
8. How do you describe tannery in terms of environment and development?

Thank you.

Annex-III

Batu Tannery PLC, Addis Ababa, Ethiopia

Preliminary assessment report /Benchmarking EMS Report-Document/

Assessment of the existing Effluent Treatment Plant (ETP) has been made and the following are the observations based on the field visits and discussions:

1. All the effluents (chrome, sulphide and other streams) are collected through a common drain. But as per design of ETP, chrome, sulphide and other streams are to be collected separately and treated separately. Chrome, sulphide and other streams are to be segregated, collected and conveyed separately to chrome recovery system and ETP respectively.
2. During power failure, the pumping of effluent from receiving sump to equalization tank is stopped leading to stagnation of wastewater in the sump and drain. Under this circumstance, the operator is diverting the effluent into nearby river directly without treatment by passing the ETP. All by-passes and diversions are to be closed and effluent should pass through ETP only.
3. During power failure, essential equipments such as brush screens, pumps in receiving sumps and mixer in equalization tank are to be provided with standby power (Generator).
4. Brush screen is to be cleaned with water jet or manually every day.
5. It is observed that the ETP is operated during day time only. ETP is to be operated continuously (at least 20 hours).
6. In sulphide collection tank, ejector is to be operated continuously.
7. Pumping of sulphide liquor from sulphide collection tank to equalisation tank is to be operated continuously. Pumping is to be stopped when the water level goes below 1.2 m depth as per design for operation of the ejector.
8. Pumping of all waste streams from collection tank to equalisation tank is to be operated continuously atleast for 20 hours with minimum depth (0.6-1 m) required as per the pump manufacturers requirements.
9. It is observed that the mixer is being tripped after 30 to 45 minutes of operation. This may be due to over load and accumulation of sludge in the equalization tank. This is to be attended immediately by the supplier.
10. Submersible Mixer and aeration through blower in equalisation tank are operated continuously. These are to be operated continuously to avoid settling of solids in equalisation tank.
11. It is observed that the effluent is not pumped continuously from equalisation tank to flocculation tank. Pump is to be operated continuously for pumping effluent from equalisation tank to flocculation tank. Pumping is to be stopped when the depth of wastewater reaches the minimum depth required for operation of mixer (0.2 m above mixer height).

12. It is observed that the alum and polyelectrolyte solution are not pumped continuously. Continuous operation of dosing pump for pumping alum and polyelectrolyte as per the design is to be ensured. Pumping of alum and polyelectrolyte dosing solution are to be stopped whenever the pumping of effluent from equalization tank to flocculation tank (equalisation tank submersible pump) is stopped.

13. It is observed that sludge is not withdrawn from primary settling tank. Regular removal of sludge from primary settling tank to sludge conditioning/ holding tank is to be done (at least 2 times in a day).

14. Continuous operation of sludge conditioning/ holding tank mixer to avoid settling of solids and to reduce the emission of obnoxious gases like H₂S which is very dangerous.

15. It is suggested to install flow meter in effluent pipeline from equalisation tank to primary settling tank to measure the quantity of effluent generated in the tannery.

16. It is observed that filter press is not used. Regular operation of filter press to dewater the sludge generated in primary settling tank on daily or once in two days basis is to be carried depending upon the sludge generated.

17. It is observed that pressure pipeline is damaged and temporarily arrangement has been made. Replacement of temporarily joint in dewatering sludge pump with SS pipe to withstand pressure above 10 bars so that proper dewatering can be done with 10 bars pressure leading to formation of sludge cake.

18. Though chrome recovery plant is installed, chrome liquor is not segregated and hence this plant is not used. After installing dedicated drain pipe for chrome liquor, the chrome recovery plant is to be operated for recovery and reuse of chrome. About 25% of chrome added during chrome tanning drained with chrome liquor can be recovered and reused with operation of chrome recovery plant. This will reduce the cost of production and also amount of chrome content in the effluent being discharged and safe environment.

19. All the chemical drums (empty) stored around the ETP is to be removed immediately for easily accessibility of treatment units and regular maintenance.

20. All the drains and manholes are not closed. It needs to be closed with gratings with mild steel/ stainless steel or perforated concrete slabs.

21. Currently all the solid wastes generated from tannery is collected in container, transported and disposed along with municipal solid wastes on land. It is possible to find potential use for solid wastes if they are segregated. For example, if organic fractions are segregated it is possible to recover energy.

Concluding Remarks

In the existing ETP, provision for treatment of lime and chrome liquor has been provided in addition to primary treatment and mechanical dewatering of sludge. However, the tannery is not segregating lime and chrome liquor and treating liquors properly. For further treatment the tannery can choose any suitable scheme from the various options given in the project report

Annex -IV

LIDI/LLPTI/ Model Tannery, Addis Ababa, Ethiopia Preliminary assessment report /Benchmark Document/

Assessment of the existing Effluent Treatment Plant (ETP) has been made and the following are the observations based on the field visits and discussions:

1. All the effluents (chrome and other streams) are collected through a common drain as the chrome liquor collection pipe is damaged. But as per design of ETP, chrome and other streams are to be collected separately and treated separately. Chrome and other streams are to be segregated, collected and conveyed separately to chrome recovery system and ETP respectively.
2. It is observed that the ETP is operated during day time only. ETP is to be operated continuously (at least 20 hours).
3. Rotary brush screen of chrome line is not working and the same is to be repaired.
4. Rotary brush screen of general line is also not working properly as screenings (solid) from screen are pushed out as the brush and its position is to be repaired.
5. Brush screen is to be cleaned with water jet or manually every day.
6. Level switches in both rotary screens are not working.
7. It is suggested to have manual bar screen of 10 mm before fine rotary screen (2 mm openings) to avoid accumulation of very solid particles in the fine screen.
8. Existing dewatering of screenings using wooden planks may be replaced with SS gratings or perforated reinforced concrete slabs.
9. Both venture ejectors are not working in the equalisation tank.
10. Alum, lime and poly-electrolyte dosing lines from preparation tanks to flash mixer are chocked.
11. pH meter in flash mixer is to be calibrated.
12. One Submersible mixer in de-nitrification tank is not working.
13. There is no uniform aeration in aeration tank, blower and diffusers require maintenance or replacement.
14. Bridge and scrapper in secondary settling tank is damaged.
15. Sludge re-circulation line from secondary settling tank to aeration tank and equalisation is damaged.
16. Filtration media in the sludge drying beds are to be placed.

17. Filtrate line for collection of filtrate from SDBs is damaged.

18. In chrome precipitation tank, pump for pumping supernatant and sludge is not working and requires maintenance.

19. During power failure, essential equipments such as brush screens, venturi ejectors in equalisation tank, submersible mixer in denitrification tank and blower in aeration are to be provided with standby power (Generator).

20. Currently all the solid wastes generated from tannery is collected in container, transported and disposed along with municipal solid wastes on land. It is possible to find potential use for solid wastes if they are segregated. For example, if organic fractions are segregated it is possible to recover energy.

Concluding Remarks

In the existing ETP, provision for treatment of chrome and lime liquor has been provided in addition to ETP and dewatering of sludge in sludge drying beds. However, the tannery is not segregating lime and chrome liquor and treating liquors properly. ETP has primary as well as secondary treatment scheme to meet the standards except for TDS and Chlorides. The existing ETP is not getting the design flow of waste water.

Annex V

List of names of stakeholder key informants

1. Ato Shimelis Wolde,MOI
2. Ato Shimelis Sima,EPA
3. Ato Dereje Agonafir,EPA
4. Ato Mohammed Ali,EPA
5. AtoWondwessen Sintayehu,EPA
6. Ato Mebrhatu,LIDI
7. Ato Seid Abdela,EPA
8. Ato Ahmed Hussein,OEB
- 9.Ato Solomon Getu,ELIA
10. Ato Abdissa Adugna,ELIA

-----/-----

Annex VI
Batu tannery 'untreated' wastewater discharging...



Declaration

I, the undersigned, declare that this thesis is my original and real work that has not been for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

Declared by

Confirmed by

Zeleke Abebe 
Candidate

A. S. Helli
Advisor

