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Waste water management in Al-ASR Textile factory of Dukem town

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Prepared By: **Samuel Abebe ID No: GSR/0037/12**

Advisor: Professor Belay Simane

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The researcher declare that Waste water management in Al-ASR Textile Factory at Dukem town is his own work and that all source that he has used or quoted have been indicated and acknowledged by means of complete reference and that this work has not been submitted before for any other degree at any other institutions.

Samuel Abebe ----------

Name of student Signature

This thesis has been submitted for examination with my approval as a university advisor.

Professor Belay Simane ----------

Name of advisor Signature

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Acronyms

BOD	Biological Oxygen demand
COD	Chemical Oxygen demand
EMS	Environmental management system
EPA	Environmental protection agency
ETIDI	Ethiopian textile industry development Institute
ETP	Environment Treatment Plant
EU	European Union
FEPA	Federal Environmental protection
GTP	Gross Transformation plan
ISO	International standard organization
MRSL	Manufacturing Restricted Substances list
ND	Not detected
PDCA	Plan Do Check Act
PH	Potential of Hydrogen
PPM	Parts Per Million
RSL	Restricted substances list
SOPS	Standard Operating Procedures
SPS	Statistical Package Social Science
TDS	Total Dissolved solids
TSS	Total solid substance
TVET	Technical vocational education Training
VOCs	Volatile organic Compounds
WTO	World Trade Organization
ZDHC	Zero Discharge Hazardous Chemicals

Abstract

Although textile industries have economic and social benefit in the country, they have been degrading the environment through their discharges. This problem has also manifested itself in Dukem town, where the factory is surrounded by local farm lands and polluted by the liquid effluents. Consequently, this study aims to analyze the pollution level of AL-ASR textile waste water treatment plant based on EPA standard and assesses its waste water management in accordance with ISO 14001:2015 standard. The researcher employed laboratory sample test analysis, physical observation and interviews as research methods. Accordingly, the researcher finds that *the main reason for this pollution is the factory's lack of environmental management system and environmental policy, limited knowledgeable and skilled man power in waste water management, as well as its limitations of stakeholders participation and factory local experts. Based on the findings, the researcher recommends the factory to have environmental policy, implement an environmental management system, and provide capacity building training to the local expert. Besides, training need to be offered to the monitoring and evaluation team of Dukem town environmental, forest and climate change authority, such that appropriate monitoring and evaluation takes place and constructive feedback can obtained continuously.*

Key words: Waste water management, Al-ASR, Textile factories

1. Introduction

1.1Background of the study

Textile industries have huge impacts on the Ethiopia economy. The government also has given priority for the sector aiming to get foreign currency and creation job opportunity. According to McKinsey assessment, large buyers are coming to Ethiopia and sourcing apparel products. More than 60 % of the buyers are from Germany, 10 % from the USA and the remaining 30% is from other European countries. The European brands are already starting to place orders with Ethiopian suppliers. However, the main reason of the buyers and brands is the availability of cheap labor and incentives given by the government to promote industrialization.

Although Ethiopia's garments industry has been identified as a key growth industry since 1995, its performance was weak until the implementation of the GTP in 2015. Under the terms of this development policy, industrial zones have been constructed or are being constructed across areas surrounding the capital city, Addis Ababa, and the government has drastically improved foreign investment incentives in the sector.

The sector has been contributing significantly to minimizing Ethiopia's unemployment rate. While textile factories need a huge amount of laborers, they also consume more resources such as high volumes of water, as well as energy and hazard chemicals.

However, currently there is no efficient and effective utilization of resources and waste management systems are generally underdeveloped. Consequently, many textile factories are degrading the environment and its services (Mekuyie, 2014).

Furthermore, most of Ethiopia textile factories face challenges on meeting the national effluent standards particularly with TSS, total nitrogen, phosphorus, COD and BOD. According to Dadi et al.'s (2016) study on selected textile factories in Dukem and around Gelan, most of the factories failed to achieve the standard limit on the effluents lab analysis of COD, TSS, BOD and PH.

According to the 2017 Ethiopia Textile Industry Development Institute (ETIDI) report, from the 25 textile-producing factories, only 8 factories have well attended environment treatment plants. The remaining factories do not have efficient environment treatment status and/or have no ETP. This is to show that most of the factories release their wastewater to the environment without treatment, which has a negative impact on the environment.

On the other hand, in the context of Ethiopia's textile industry, water pollution is more challenging than water scarcity (Sweden Textile Water initiative, 2017). Most of the industries use their own groundwater in their compounds. As shortage of water resources can be a threat to future growth in manufacturing industries, it is important to prevent pollution and preserve water resources. Most researchers agree that (Dadi et al.'s (2016) Ethiopian textile factories do not have proper wastewater treatment plants. The factories that have ETP are also not compatible with the actual effluent treatment capacity, as compared with the amount of wastewater produced. While some of the factories are still in the process of finalizing their wastewater treatment plant, they are simply released without treatment to the environment (Abrha & Chen, 2017). Several studies have conducted research in the area of water pollution issues. However, most of them have focused on the challenges and effects of the pollution. Hence, this study focuses on the treatment plant and waste water management of AL-ASR textile factory in Dukem town.

1.2 Statement of the problem

Despite the fact that textile industries in Ethiopia have social and economic benefits, they have been polluting the surrounding environment. Due to different reasons, they have difficulties meeting the national effluent standards: on the one hand, factories have limited financial resources to build an environment treatment plant, lack ETP design capacity, environmental policies and management systems, and skilled manpower, On the other hand, the local government does not have enough laboratory access for monitoring and evaluation, lacks enforcement of policy implementation, coordination between FEPA and Trade and Industry Minister, and skilled manpower with good experience, which can advise the industries. As the result, most of the wastewater effluents release into the environment without proper treatment. The effluents have a lot of hazardous chemicals, which has a significant negative impact on the environment (Dukem Environmental protection office, 2021)

Consequently, natural resources, mainly soil and water, are degrading. These are very important resources used for agriculture production, livestock's drink, washing of household activity, and aquatic habitats such as fish. Besides, water pollution has been creating ample problems such as decreasing agricultural products in quality and quantity, as well as health problems, ranging from skin allergies to carcinogenic, and mutagenic diseases. Factories typically have a traditional

production system, which focuses only on productivity, despite their high waste-level. Due to these reasons, they use a lot of chemicals, energy, and water.

The main reasons for the high consumption of resources and waste are the lack of an environmental policy and skilled manpower. The results of not having such a management system are: increased depletion of natural resources, increased environmental pollution, loss of community trust, lack of transparency to the management, inadequate production for the international market, and overall less profit margins.

Similarly, AL-ASR textile factory has wastewater treatment challenges. Although the factory has an effluent treatment plant, it has been facing compliance challenges with ISO 14001 standard, and national effluent limits.

Scholars such as Dadi et al. (2016), Abrha & Chen (2017) and Mekuyie (2014) studied the effluent discharge of textile industries in Ethiopia by less considering effluent treatment plant with its management based on ISO 1400 standard.

Hence, this study aims to assess the pollution limit of the effluent plant, and compares it with legal national standard limit and ISO 14001 management system standards.

1.3 Objectives:

The objective of the research is to analyze the pollution level of AL-ASR textile waste water treatment plant under the EPA standard and to assess their wastewater management under ISO 14001:2015 standard by focusing on the following specific objectives.

1. To analyze factory waste water effluent with five parameters (COD, BOD,TSS, PH and heavy metals)
2. To compare their effluent result with EPA standard.
3. To identify and compare their wastewater management in reference with ISO 14001:2015 management system.

1.4 Research question

After the analysis of the factory laboratory results, stakeholders interviews and field visits, this study will answer the following questions.

1. How does Al-ASR Textile factory manage their wastewater effluents?
2. Which parameters deviate from the national effluent standard limit?
3. How do we analyze the factory’s environment management system?

1.5 Scope of the study:

The study is focused on AL- ASR textile industry at Dukem town. The factory has three main production processes: a spinning, weaving, and finishing department. The research is mainly focused in two processes, the finishing and weaving department, since these departments have been using different chemicals, dyes and pigments as inputs. Those inputs cause negative impacts on the environment and human life, unless the factory implements an environment management system. Therefore, the study gives priority on the analysis of the waste water effluents of Al-ASR textile industry and assesses the deviation from the national standard. In addition to that, the research also observes the actual efforts of the industry's EMS implementation and identifies the gap between the standard and the existing condition.

1.6 Significance of the study

This research can be used for different purpose, among others for:

Textile industries: Results can be used to see textile industries' existing status and identify their gaps to compete with international social and environmental compliances standards. While considering their random practices, other factories can also learn from these challenges, and get into the right track with the support of international systems.

Academia: The study can also be used for future researchers as input to understand the situation of the textile industry.

Policy makers and regulators: Policy makers can use such kind of analysis to support public sector decisions, especially in the environment and industries perspective. The regulators can use this research to see the root causes of the gap rather than evaluating the end result. This will help them to give direction to the producers in the processing unit.

Community: The communities also benefit from this research by understanding the impact of mismanaging wastewater effluents. Communities can learn about their rights to access clean water and environment, whilst working together with responsible bodies on a sustainable basis. The factory will engage in environmentally friendly production processes by correcting their gaps, and by respecting mutual benefits between industry and the surrounding community.

1.7 Limitations:

One of the major limitation of this study is that it focuses on one specific factory only, namely AL-ASR textile, and explores one specific industrial waste, water, while disregarding other wastes such as solid waste. The factory has wet processing unit which is mainly processed

woven polyester fabric and it has been using 100% polyester fabric and using chemicals used for polyester which is a bit difficult to include the cotton processing chemicals and dyes for analysis in the effluent sample. The selected factory based in the Dukem town, and can be considered as a pilot for the other textile factories in the area.

1.8 Organization of the study:

The study has five chapters: the first chapter is an introduction to this study, which explains about the background of the study, objectives and relevance. The second chapter is a literature review, which reviews the different literature streams in the study area, and critically analyzes and the objectives of the study. The third chapter introduces the methodology, which focuses on the study area, and how to deviate actual evidences to support the initial theoretical evidences. The fourth chapter describes the results, which are then analyzed and discussed. The last chapter concludes this study by pointing out root causes and recommended solution for the challenges.

2. Literature review

2.1 Introduction

Most human activities that use water produce wastewater. As the overall demand for water grows, the quantity of wastewater produced and its overall pollution load are continuously increasing worldwide. In all but the most highly developed countries, the vast majority of wastewater is released directly to the environment without adequate treatment. This has a detrimental impact on human health, economic productivity, the quality of ambient freshwater resources, and ecosystems.

In the future, water is set to become an increasingly scarce and therefore extremely valuable resource. Demand for water is growing at more than twice the rate at which the world's population is growing. Over the past 100 years, the world's population has increased threefold, while water consumption has risen by a factor of seven. Since 1970, the available amount of water per capita has been reduced by 40 % as a result(Textile world,2008). It takes approximately 2,500–3,000 liter of water to manufacture a single cotton shirt. The bulk of this water is required to grow the cotton, followed in second place by the wet finishing process. The first consequences of water shortages and wastewater problems are already starting to be felt in the global textile finishing industry.

Some countries such as India do not allow setting up new textile factories unless using advanced technologies used to reduce water consumption, high-tech ETP plant need to be implemented, and water recycling systems (where more than 60% of wastewater is treated) are present. Europe also closes most of the textiles companies due to scarcity of water and moves its production to Asia and Africa. Asia also faces similar challenges, especially concerning its groundwater and sea water also necessarily goes to the salination process (salt removal process from seawater)(Textile World, 2008).

Some of the factories' wastewater effluents are still releasing into the environment without or only partial treatment. In these effluents, there is unknown status of COD, BOD, and heavy metals, which can cause a lot of degradation in the water ecosystem. The chemicals used in textile factories are different from factory to factory, and depend on their product type. The most important chemicals that need to be considered in the wastewater effluents are COD, BOD, pH, TSS, heavy metals etc. (Tufekci et al., 1998).

The developed countries treat about 70% of their municipal and industrial wastewater. In some of the developing countries, the ratio goes down to 38% and the lower class countries treated less than 28% of their wastewater. In general, 80% of the globally produced wastewater is not treated. Developed countries are using high technology to treat their wastewater properly and recycle the water for additional purposes. The releasing of wastewater is more practiced in lower-income countries due to different economical, technological and institutional capacity limitations (UN, 2017).

A large number of chemicals, dyes and pigments are used at different process stages in the textile processing units. One textile plant has the potential to use up to 2000 chemicals in the whole process (Khan and Malik, 2014). Procesings 10 meters of fabrics requires around 2270 liters of water (Dey & Islam, 2012).

The water consumption of a middle-level textile factory which has a production capacity of 8000 kg /day, and used more than 1.6 million liters of water. The production can also generate more than 300 m3 of wastewater per thousands of finished products (Govindarajalu, 2003).

Many studies have also revealed the negative impacts of such pollution. Mark (2004), Kumer et al. (2012), and Manunatha (2008), for example, have shown that industrial effluents polluting the soil can affect plant growth, including agricultural crops and, apparently, affect the livelihood of farmers in the area. Moreover, Kovaipunder (2003) studied the adverse effects of polluted water

on people's health (e.g., skin allegies, gastrics, ulcers, respiratory infections). Another study by Dadi et al. (2016) investigates the impact of four textile factories' wastewater effluents on environmental and social footprint. The results show that the released treated or untreated wastewaters are not passing the standard of the Federal Environmental Protection Authority. The chemicals used in the processing unit have a different impact on aquatic toxicity (Ammayappan et. al, 2016). The liquid waste, which is released from the factories, cause a lot of degradation on the downstream users of the river Abay (Mehari et al., 2015).

2.2 Concept and Definitions

Waste water: Water, which is generated as a by-product from process unit operations. Its constituents can cause harmful and hazardous effects on human, animal, plants, aquatic and microbial life / different life forms on the earth. (Wun Jern and Empirical College Press, 2006)

Waste Water Treatment: is a process, which is being done on the wastewater to change its quality for drinking or other purposes. Wastewater treatment takes place in a wastewater treatment plant, which should be designed under different circumstances (Kordrostami, 2015)

Pollution: Pollution is the introduction of contaminants into the natural environment that causes adverse effects. Pollution can take the form of chemical substances or energy, such as noise, heat, or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants (Wikipedia).

Dyeing: Dyeing is a process in which color is incorporated into fibrous products (fiber, yarn and fabric) to produce colorful product in a suitable dyeing machine (Ammayappan et al, 2016).

Bleaching: is a pretreatment process for dyeing, which removes the natural coloring matter present in the natural fibers by either reducing or oxidizing agents (Ammayappan et al, 2016).

Environmental Policy: this is a statement of what an organization intends to achieve from an Environmental Management System (EMS). It ensures all environmental activities are consistent with the organization's objectives (Khanna et.al, 2009)

Environment management system (EMS): An Environment Management System (EMS) is a tool for managing the impacts of an organization's activities on the environment. It provides a structured approach to planning and implementing environment protection measures (Bhutiani et al, 2015).

Effluent treatment plant (ETP): is a process design for treating the industrial wastewater for its reuse or safe disposal to the environment (Dr. Gazala, 2009).

Influent: Untreated industrial wastewater.

Effluent: Treated industrial wastewater.

Sludge: Solid part separated from wastewater by environmental treatment Plant (ETP).

Chemical oxygen demand (COD): COD is a chemical test, defined as a chemical oxidation of the sample material. The Cr (VI)-COD method measures close to the maximum possible oxygen demand of a sample, but generally, at least 50% of the demand is from organic material that is not readily degradable in short-term biological processes such as the biological oxygen demand (BOD) test

Biological oxygen demand (BOD): BOD is a biological test method that uses the analytical laboratory choice of a seed bio-culture mixed with the sample under test, to find the amount of oxygen used due to the bio-culture metabolism of substances in the sample, over a 5 day (or 7 or 10 day) period

Total solid substance (TSS): TSS measurement provides an indication of the turbidity of an effluent as well as the possible organic load. The turbidity affects clarity of the water column in a catchment and therefore potential loss of transmission of light to oxygen producing organisms in a water column (European commission final report, 2017).

2.3 Textile factories Waste water

Based on the Choudhury's (2014), across the northern and southern hemisphere survey identified that they are the most concerned on water scarcity and water pollution, according to the study china textile industry polluting 70% of their water source by the factories wastewater effluent. The textile sector is also the most significant sector in the economy and also prior polluting the environment as well. In the survey also report that the green peace environmental activists group exposed the pollution owner and the effect on the Environment and human health in their social media. The more industrialization grows, the more pollution is observed in the environment.

The textile sector needs an abundant labor force, and huge amounts of (financial) resources to manage its waste. This is the reason why the textile industries moved from Europe to Asia, and now even to Africa, which is increasingly being considered as the hub of textile producer and exporter to the remaining world. These opportunities also present some risks: by polluting and degrading our resource to produce the textile apparels, we adversely affect the sustainability of our environment. Ethiopia has more than 100 small, medium and large wet processing factories, which actively produce textile products. The textile factories use thousands of metric cube of

water, and from this amount, most of the water is released to the environment together with hazardous chemical. Most of the Ethiopia textile factories do not meet the national wastewater effluent standards due to different reasons. Textile manufacturing process is characterized by high consumption of resources such as water, fuel and a variety of chemicals, which generates a significant amount of waste in a long process sequence.

The common practices of low process efficiency results in substantial wastage of resources and a severe damage to the environment. The industry waste effluents released to the environment have a negative impact, specifically on the surface and groundwater pollution, degrading water resources for drinking and reducing the fertility of the surrounding agricultural area, e.g., by producing toxic seeds and vegetables. The agriculture products are consumed by the community and cause different carcinogenic and mutagenic diseases.

According to Chakraborty et al.'s (2012) study, India faces huge a water pollution problem, and consequently, has tried to control it at the government level; however, it is still not at a satisfactory level. Most of the time water quality is measured based on the content inside the water using lab analysis. There are many parameters like COD, BOD, TSS, PH used to test the quality level. The consumption of water by different industrial sectors is shown in Figure 1. Figure 1 shows that thermal power plants are the 'thirstiest' sectors among all others. The textile industry accounts for 2.07% of water consumption.

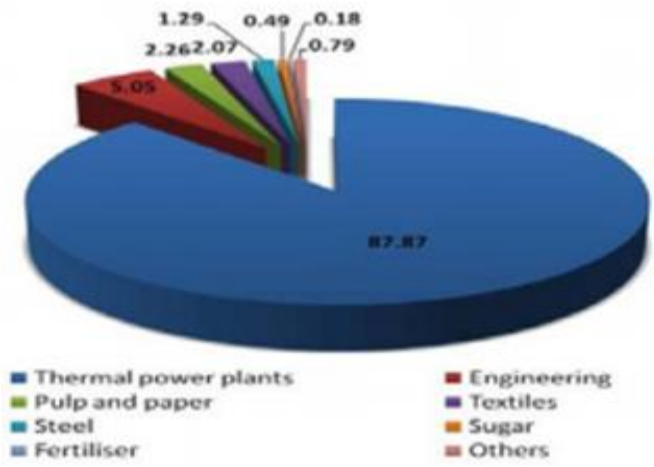


Figure 1: Consumption of water in different sector

The major problem arises when these chemicals are directly discharged into water bodies, thus causing water pollution. This water pollution not only affects human beings and

household, but also aquatic animals to the same extent. The textile fabric production consist of various stages, initially the cotton is mixed in various proportions to make fibers. The fibers then undergo the process of spinning and are convert into yarn. Subsequently, the process of dyeing takes place, where many chemical agents for coloring purpose are used. In order to avoid detaching, the yarns undergo the process of sizing, where they are washed with cellulose and amylase substances. Lastly, the processed yarns are weaved into end product (Meral et al., 2008). During this process, various pollutants are discharged as chemical waste, which is depicted in Table 1.

Table 1: **Effluents discharge from Textile factories**

s.no	Process	Chemical discharge	Pollutants	Health effects
1	Sizing	Benzene	Resins, fats ,waxes, starch and glucose	Carcinogenic, mutagenic and affects central nervous system.
2	Bleaching	Cyanide	Wax, Grease,Sodash, sodium Silcate	Prolonged exposure will affect liver and kidney goes to death.
3	Dyeing	Sulphate	Sulphides, acetic acid and Mordants	Eye and respiratory problem.
4	printing	Nitrate and Phosphate	Starch, gums and Mordant acid	Harmful health hazards
5	finishing	Lead	Starch, salts and finishing agents	Suppression of hematological system.

When wastewater is discharged without any proper treatment, then it will lead to hazardous effects to living organisms. Hence, before discharging, it should be properly treated using either biological or physical or chemical means.

2.4 Environmental pollution of the textile industry

Textile production is one of the main industries that affect global environmental pollution, as both the production and the processing of the necessary raw materials are contributing factors to pollution. Another important aspect of the problem is the waste that results from both production and consumption of the textile goods. Though technically all waste in the textile and garment

sector can be recycled, unfortunately, only a small amount is recycled. As long as the linear system currently utilized in the production goes on, it seems that we will not be able to use the resources efficiently and reduce the environmental pollution.

Given that the current global trends persist, by 2050, the textile sector is expected to represent a quarter of the world carbon budget—26%, to be precise. The figures are colossal: if the current trends do not shift, the textile and apparel sector's nonrenewable raw material usage will reach 300 million tons and the amount of micro plastic released to the oceans will reach 22 million by 2050 (Burçin et al, 2020).

Studies show that, in terms of consumption and pollution of clean water, textile and related industries are only surpassed by agriculture (Fletcher, 2009) The sheer amount of water used during textile production, especially wet processing, tells a lot: to process a kilogram of fabric, 80 to 150 liters of water is used, along with other chemicals (Bhuiyan et al, 2016). About 4% of global freshwater withdrawal, which corresponds to 93 billion cubic meters of water, is utilized annually by the textile sector, if cotton farming is included. Clothing is responsible for more than 60% of this amount (MacArthur, 2017). Textile and apparel production has a major role in this global phenomenon. In 2015, greenhouse gas (GHG) emissions from textile production were responsible for 1.2 billion tons of CO_2 equivalent of greenhouse gas (GHG). This figure exceeds the emissions that result from all international flights and maritime shipping combined.

Given that the actual trends of the sector do not alter, by 2050, 26% of the carbon budget and 300 million tons of crude oil will be consumed by the textile industry—a significant change compared with 2% and 98 million tons, respectively, in 2015 (MacArthur, 2017).

Textile manufacture is also a source of NOx and SOx emissions, solvent release during drying of coatings or cleaning operations and volatile organic compounds (VOCs) (Choudhury, 2014).

About a quarter of chemicals produced globally are used in the textile industry (Laundry, 2011). Numerous chemicals are used for textile production, mainly in the wet processing. Of these nearly 2000 different chemicals, many have adverse impacts on health. Some chemicals evaporate, while others are dissolved in treatment water—which ultimately goes back to the environment—and some chemicals remain in the product (Choudhury, 2014). Cotton clothing, which, after all, is regarded as particularly natural and healthy, calls for cotton farming, which currently needs 0.2 million tons of pesticides and 8 million tons of fertilizer globally. Although cotton cultivation accounts for only 2.5% of worldwide agricultural land, it is responsible for

16% of global pesticide utilization. About 4% of all nitrogen and phosphorus fertilizers used around the world go to cotton production, and these chemicals are a main source of clean water pollution. If merged into the rivers, these chemicals can lead to algal blooms, which starve the river of oxygen. Producing cellulose-based fibers also necessitates large amounts of chemicals and some of the chemicals used are sources of concern. However, the agricultural part of textile production is not solely responsible for the chemical use of the industry. Producing the fibers requires using chemicals too, for example for dyes or finishing treatments. This part of the production is estimated to use approximately 43 million tons of chemicals globally (MacArthur, 2017).

The waste generated by producing and consuming textiles is another major concern. Textile consumption around the world is calculated to be over 100 million tons (Harder, 2019). However, the rate of recycling is rather low: barely 13% of the total material input is in some way recycled after usage. Of this recycled 13%, a minuscule part is used to produce new clothing—less than 1%. The rest is recycled into other, lower-value items such as insulation material, wiping cloths or mattress stuffing.

Additionally, odor problems and noise pollution are also negative effects of the textile industry on the environment. Odor pollution is an indicator of environmental change that affects health and human well-being. People feel strong, unpleasant or offensive smells that can interfere with one's enjoyment of life especially if they are frequent and/or persistent (Sahu et al., 2012). When it comes to noise pollution, there are different processes in the textile chain that can produce noise level above 90 dB (A), the allowed limit, and can cause problems especially for the workers.

The world population has grown tremendously in the past few decades, and the same period has also witnessed improvements in living standards in general. These two developments have augmented the consumption of textiles, which in turn increased textile production (Wang, 2006). The effect of the rising living standards can be seen in the fact that the worldwide consumption of textiles is growing faster than the world population. The demand is expected to grow from around 30 million tons in 1980 to more than 130 million tons in 2025. The figure translates into a growth of over 400%—or an average annual growth rate of 4.3%. In the same period, the world population has been growing by only 1.7% (Qin, 2014).

Industrial solid wastes from textile production include the following:

- Ashes and sludge
- Cardboard boxes, bale wrapping film, or non-recyclable soiled fabric
- Plastic bags containing chemical raw material
- Non-reusable paper cones and tubes
- Waste fabrics, yarns, and fibers from non-recyclable processing. Unmanaged solid waste is likely to be dumped as landfill.

2.5 Environment Management systems in the textile factories

Balancing of the environment, economy and society is considered essential to meet the actual needs without compromising the future generation needs. Sustainable development as a goal is achieved by balancing the three pillars of sustainability. Societies' expectation for sustainable development, transparency and accountability have emerged from stringent legislation, and growing pressures on the environment through pollution (e.g., climate change, degradation of ecosystems and a loss of biodiversity). This has led organizations to adopt a systematic approach to environmental management by implementing environmental management systems with the aim of contributing to the environmental pillar of sustainability.

The purpose of international standards is to provide organizations with a framework to protect the environment and respond to changing environmental conditions in balance with socio-economic needs. It specifies requirements that enable an organization to achieve the intended outcomes it sets for its environmental management system (ISO 14001, 2015).

ISO 14001 is a standard of the ISO's series of environmental management standards. About 129,031 companies were using standardized environmental management systems; this number is expected to continue to grow steadily until Jan 2007 (Ammenberg and Sundin, 2005). ISO 14001 is the most common environmental system, because it can be applied in all types of organizations in manufacturing and service sectors. EMS, on the other hand, is site-specific and can only be applied in the manufacturing sector (Stephen, 2001). EMS and ISO 14001 challenges each organization to take charge of its environmental aspects and impact, to employ its resources, set its own targets, commit to continual improvement and foster awareness on employees (Cascio et al., 1996).

An EMS can assist a company in the following ways:

- minimize environmental liabilities;
- maximize the efficient use of resources;

- reduce waste;
- demonstrate a good corporate image;
- build awareness of environmental concern among employees;
- gain a better understanding of the environmental impacts of business activities;
- increase profit,
- improved environmental performance through more efficient operations.
- increased staff commitment,
- improved product quality,
- positive pressure group relations and also improved community relations,
- assured present and future compliance.

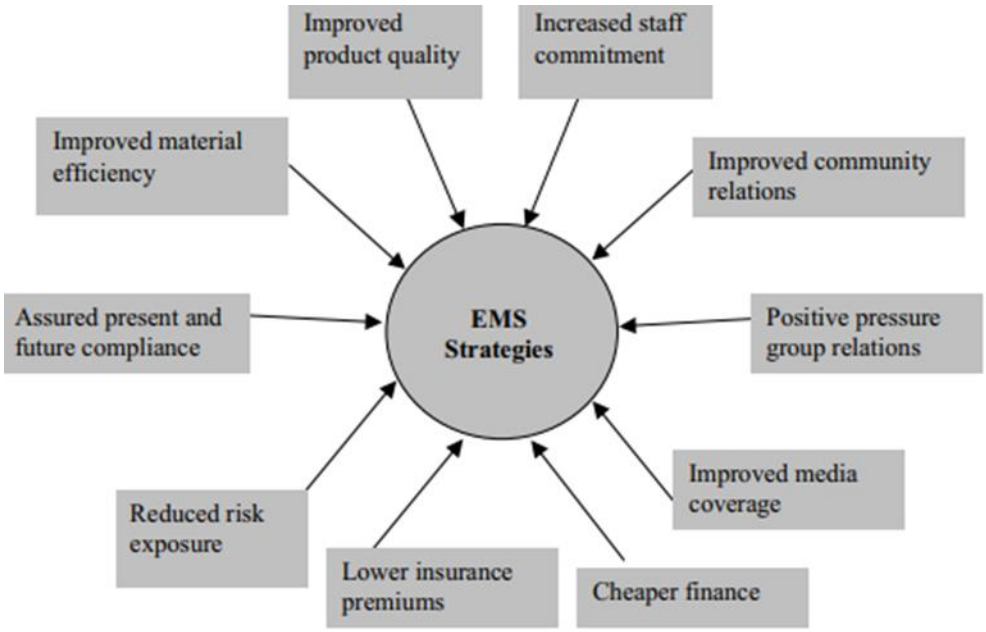


Figure 2: Benefit of the effective environment management system

The components of environmental management system that need to be considered are:-

- Environmental Impact Identification: identification and documentation of an organization's operations need to be undertaken. This can be achieved through undertaking an environmental audit.
- Objectives and Targets: an environmental audit forms the basis of determining an organization's environmental objectives and targets. An organization can find benefits in adopting more stringent longer-term objectives, which can improve its performance. To continually improve, targets should be regularly reviewed.

- Consultation: staff and community consultation should be undertaken before, during and after establishment of an EMS. This is necessary to ensure that all staff is involved in, and committed to the EMS. It can also help to improve public perception of the company, one of the benefits of implementing an EMS.
- Operational and Emergency Procedures: all procedures should be reviewed to ensure they are compatible with the organization's environmental objectives and targets. Any changes should be included with the documentation.
- Environmental Management Plan: this details the methods and procedures, which an organization will use to meet its objectives and targets.
- Documentation: all objectives, targets, policies, responsibilities and procedures should be documented along with information on environmental performance. Documentation is useful for verifying environmental performance to staff, regulators and the community.
- Responsibilities and Reporting Structure: responsibilities need to be allocated to staff and management to ensure the EMS is implemented effectively.
- Training: staff should undergo environmental awareness training to familiarize them with their responsibilities for implementing the EMS and with the overall environmental policy and objectives of the organization. This provides staff with the necessary skill and motivation for the effective implementation of the EMS.
- Review Audits and Monitoring Compliance: review audits should be undertaken regularly to ensure the EMS is achieving its objectives and to refine operational procedures to meet this goal. In order to ensure regulatory and other requirements are being met, it is often necessary to undertake regular environmental monitoring.
- Continual Improvement: an important component is continual improvement. An EMS comes into its best use when used to review progress towards the targets and objectives set by a company to protect the environment. The procedures set in place to meet these objectives should be constantly examined to see if they can be improved or if more effective systems can be introduced.

Plan-Do-Check-Act model:

The basis for the approach underlying an environmental management system is founded on the concept of Plan-Do-Check-Act (PDCA). The PDCA model provides an iterative process used by organizations to achieve continual improvement (Khanna et al., 2009). It can be applied to an

environmental management system and to each of its individual elements. It can be briefly described as follows.

- Plan: establish environmental objectives and processes necessary to deliver results in accordance with the organization's environmental policy.
- Do: implement the processes as planned.
- Check: monitor and measure processes against the environmental policy, including its commitments, environmental objectives and operating criteria, and report the results.
- Act: take actions to continually improve.

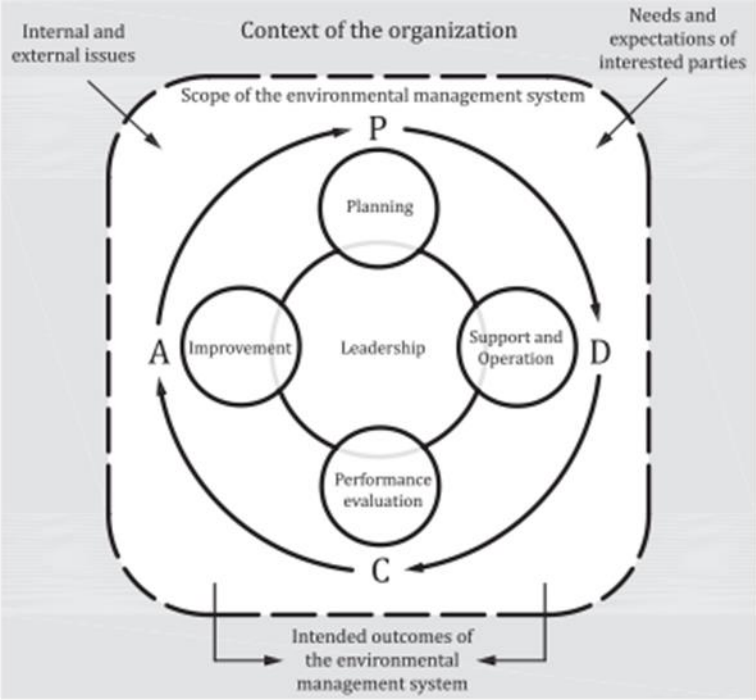


Figure 3: Relationship between PDCA and the framework in this International Standard

In Ethiopia, industries have started implementing ISO 14001, 2015 to comply with international market requests. and to manage different activities in their organizations as one, as environmentalist the reputation of the ISO 14001 is need to be more than paper work which is gone be implemented by certain time for the compliance and promotion purposes. This means that EMS needs to be compatible with the national standards on effluent to strength the environmental sustainability performance in the factory. The national effluent standards are also well organized and any factories can compare their effluent result with the national standards. However, the actual situation in the factories is as such that they are not ready to implement PDCA cycle on the wastewater effluent systems. Without the direction of environment

protection authorities, there is no as such corporate social responsibility by the factories. Therefore, in order to implement the EMS, factories owners or top management should show the necessary commitment, follow up and avail necessary resources to make them compatible with national standards and visions.

2.6 Conceptual framework

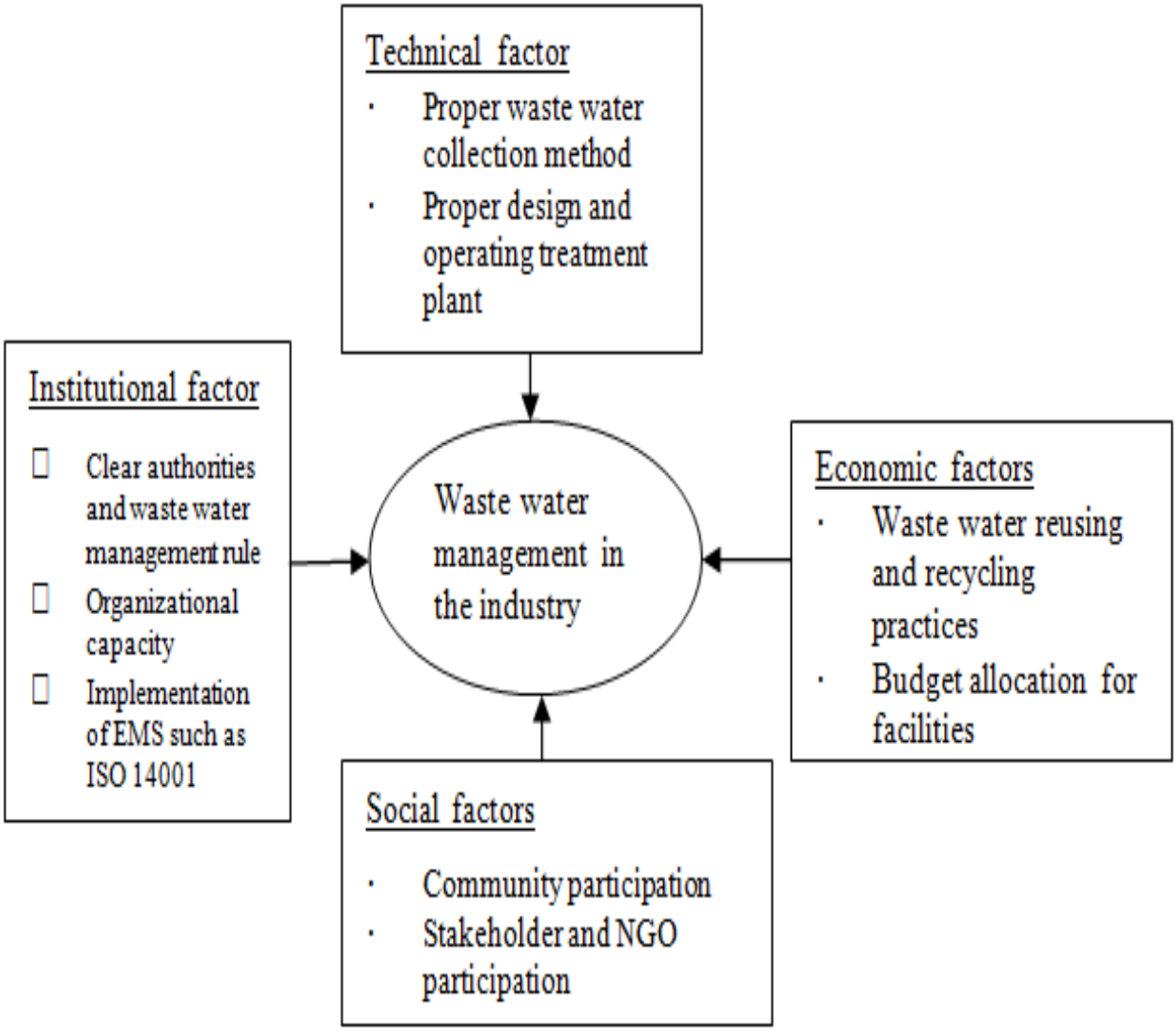
In the textile industry's wastewater management, there are several factors that need to be considered. The technical factors entail, among others, the existence of proper wastewater collection method, proper design and efficient waste water treatment plant, sufficient facilities and powder chemicals for waste water purification.

On the other hand, institutional factors consist of clear authorization and wastewater management rule, organizational capacity such as skilled man power and facilities, as well as the existence and implementation of EMS such as ISO 14001.

The economic factors include efficient resource utilization, such as waste water reusing and recycling, budget allocation for facilities. The other factor, which influences wastewater management, is social factor incorporating community participation and engagement in the waste water management, stakeholders and NGOs participation.

Hence, the existence of all these components facilitate proper waste management in the factories.

Figure 4: Conceptual Framework of the Research



3. Methodology

3.1 Description of study area:

Dukem is located in Oromia National Regional State, Oromia Special Zone Surrounding Finfine, at a distance of 37 km from Addis Ababa. Its astronomical location is 8º45’25’’-8º50’30’’ North Latitude and 38º51’55- 8º56’5’’ East Longitude.

Dukem is one of the towns in the region that is under reform and has a city administration municipality and four kebelles. The town has integrated a development plan, which was prepared in 2008.

According to the National Population and Housing Census carried out in 2007, the population of the town was 6,670. Out of this, 3,242 (48.6%) were males and 3,428 (51%) were females. The population growth rate of the town at medium variant was 2.9%, while the average household size in the town was calculated to be 3.4.

Figure 5: Dukem Town map and effluent path

Source from satellite Map

Al-ASR textile was established in 2007 with an initial capital of 1 million dollars, and is located at Dukem town. It is one of the foreign-owned textile factories, which mainly produces 100%

polyester men suiting, shirting and work wear. The company has 675 employees. The company's raw materials are almost all imported and most of the input materials are polyester yarn, dyes, pigments and chemicals. The factory production per year in meters is: suiting-958,100, shirting-1,140,100, workwear-2,951,000 (ETIDI, 2017). Their main market is Merkato, which is the largest open market center in Africa.

The factory was established following the Ethiopian government's offer to provide incentives to foreign direct investment in the manufacturing sector, e.g., import of tax free machineries, land by least lease price, tax exemption for 5years. ALASR was established with the aim of reducing raw material imports for garments. This would also save some amount of foreign currency, as the country consumes local products rather than imports garments. Moreover, establishing this factory also increases the employment rate among workers living nearby.

3.2 Research approach

The research applies a mixed study design consisting of qualitative and quantitative approaches. While the laboratory analysis compares influent and effluent data as an experimental quantitative approach, the qualitative approach used semi-structured interviews and physical observation. The interview respondents were selected through using purposive sampling to get genuine and knowledgeable information about the factory's wastewater management. The interview respondents have different roles within the factory, as well as been selected from different areas outside the factory, namely: factory workers, managers, consultants, Dukem town Administration Environmental forest and climate change authority, Dukem City Health Bureau and ETIDI experts.

3.3 Data source

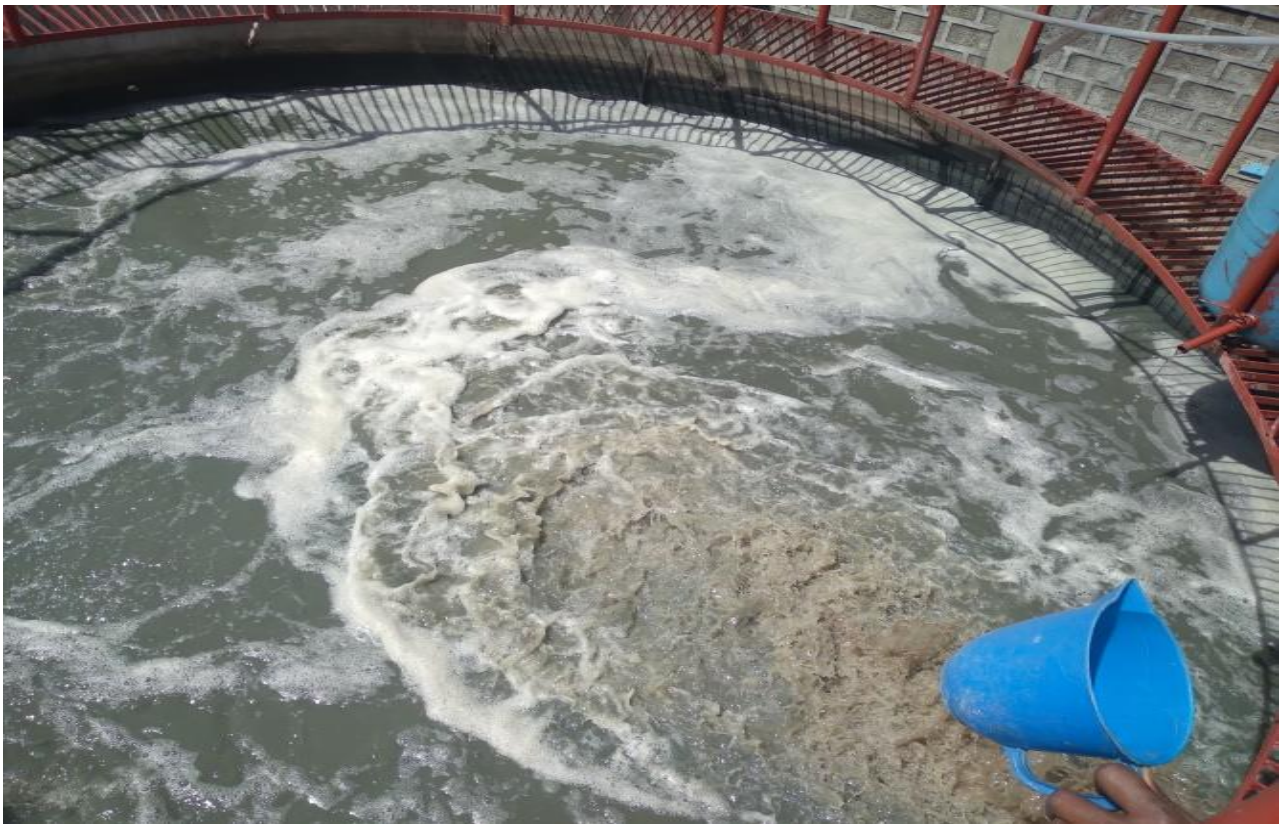
The study intends to collect qualitative and quantitative data, which is subsequently being compared with ISO 14001 standard requirements and national standard limits. The sample was collected from the Al-ASR textile factory and other secondary data sources collected from ETIDI. The sample was taken from two sites (inlet and outlet) and tested in two laboratories. Heavy metals and TSS were tested in ETIDI laboratories and COD, PH and BOD in JIJE Analytical Testing Service laboratory. The quantitative data was analyzed using descriptive statics on basic key indicators such as COD, BOD, TSS, PH and heavy metals in Mg/l and PPM (based on their concentration) using SPSS software. Qualitative data was gathered through interviews and visits to the surrounding area to analyze the impact of the pollution.

3.4 Sampling Technique

The sampling techniques used laboratory test result collected by the researcher and the previous data collected by the ETIDI. Purposive sampling technique is used for qualitative approach method. The reason why purposive sampling is used for the interviews is because answering the questions requires technical expertise related to the factory's wastewater management.

AL-ASR textile factory is also selected by purposive sampling technique and is considered as a pilot factory. The researcher had the possibility to visit the factory, and collect the necessary information from the factory, including taking raw samples. Moreover, the factory runs every year without interruption, which helps to see the effect of fully running factory.

Figure 6: Sampling raw effluents from primary tanker



Source: AL-ASR textile factory

Figure 7: sample taken at the end of treatment

Source: AL-ASR textile factory (2021)

Analytes that quickly degrade after being sampled must be tested in the field. Field testing may also be used for other samples that are reliably and cheaply measured in the field. Where possible, field measurements are undertaken in situ. In the field, the following analyses were measured: (PH and temperature): The researcher didn't measure the DO dissolved oxygen in the field due to lack of facilities

Source: AL-ASR textile factory (2021)

According to the researcher's observation, the factory's environmental expert conduct PH test in each tankers before adding different chemical for the treatment purpose.

Table 2 .Sampling containers, Preservation Methods and Holding times

Test Parameters	*Container*	*Sample size (ml)*	*Sample containers*	*Preservation*	*Max. Storage*
pH	P, G	500	G	Make analysis immediately	2 hours
TSS	P,G	500	g, c	Refrigerate	7 days
COD	P,G	100	g, c	Make analysis as soon as possible or add H_2SO_4 to pH < 2, refrigerate	7/28 days
BOD	P, G	1000	g, c	Refrigerate	6/48 hrs.
Heavy metals, general	P, G	1000	g, c	For dissolved metals filter immediately, add HNO_3 to pH <2, Refrigerate	6 months

Source: ETIDI laboratory Manual Procedure

P = Plastic (polyethylene), G = Glass g = grab c = composite

The preservation technique will depend on the method of analysis used. Other methods of preservation may be suitable and prior liaison with the analytical laboratory is required.

Refrigerate = cool to between $1^{o}C$ and $4^{o}C$. Freeze = freeze to -20^{o}_{C}

Figure 8: Sampling Containers

Source: AL-ASR textile factory (2021)

Transport and storage

The samples taken by environmental experts consider necessary procedures, which might affect the quality of the sample. During transportation of the sample, an ICE box is used to maintain samples required temperature.

3.5 Method of data collection:

The data collection used three methods, the primary data collected from laboratory experimental analysis and physical observation; secondary data collected from interviewing different stakeholder,s which can answer the questions related to the factory wastewater management activities. In addition to these, the researcher collected secondary data from ETIDI's previous laboratory results used for monitoring and evaluation purpose.

3.6 Data analysis

In this study, both quantitative and qualitative data analysis are conducted. The quantitative data is collected from 35 survey respondent, and analyzed using SPSS (Statistical package for social science) software while 5 waste water sample test are used for the laboratory test.

The qualitative data was obtained through interviews with key informants working in the factory's environment treatment plant and finishing department. Moreover, ETIDI experts (on the directory level), which follow the factory's wastewater status, were also interviewed.

3.7 Ethical consideration:

The data, which is assessed from the factory, will not be transferred to any secondary persons/entity unless explicit permission from the factory's responsible persons is granted. The data collected from the factory and other responsible persons is used only for this research purpose.

4: Result Analysis and Discussion

This chapter is the core of the thesis as it focuses on the analysis of the collected information through interviews and lab test results. In addition to that, the researcher recommends possible solutions, which can help the AL-ASR textile factories to sustain and comply with national and/or international compliance standards concerning environmental and social issues. The data was collected using two methods, namely: semi-structured interview and laboratory experiment results. In this section, the data collected by semi-structured interview are analyzed by using the SPSS software, and presented in table-form. The laboratory results presented in tables include the national standards limit, which is used to compare the results. The result analysis chapter is divided into three sections. The first section analyses the respondent's socio-economic and demographic profiles. This analysis considers the respondent's age, sex and level of education, which is also further analyzed based on the objectives. The second section analyzes the ALASR textile's wastewater laboratory results based on five parameters (PH, COD, BOD, TSS and Heavy metals). In the analysis, there is a comparison between the national standard limit with the actual laboratory result. The third section presents an analysis of the actual environmental management system, compared with ISO 14001:2015 basic requirements, based on information collected through stakeholder interviews.

4.1. Socio economic and demographic profile

Table 3: Analysis of respondents based on Sex

Respondent Sex	Frequency	Percent	Valid Percent	Cumulative Percent
Male	18	51.4	51.4	51.4
Female	17	48.6	48.6	48.6
Total	35	100	100	100

Source: Survey result by the researcher (2021)

Table 3 shows that, out of the total respondents (35), 51.4 % of the respondents are male and the remaining 48.6% are female.

Therefore, the respondents represent a balanced ratio of sex across all levels such as operators, stakeholders and management. In Ethiopia's textile and garment sector, more women employed than men.

Table 4: Analysis of respondents Based on Level of Education

Respondent Level of Education	Frequency	Percent	Valid Percent	Cumulative Percent
Adult Education	0	0	0	0
Grade 1-8	0	0	0	0
Grade 9-12	16	45.7	45.7	45.7
TVET	8	22.8	22.8	22.8
Degree	11	31.4	31.4	31.4
Total	35			100

Source: Survey result by the researcher (2021)

Table 4 depicts that, out of the total respondents (35), 45.7% of the respondent's education level is between grade 9-12, 22.8% of the respondents have an education level under TVET diploma, and the remaining 31.4% respondents have a first degree and above.

This implies that all respondents can write and read the local language, which implies that they can facilitate the implementation of the EMS, and are able to appreciate different environmental management training.

Table 5: Analysis of respondents Age

Respondent Level of Age	Frequency	Percent	Valid Percent	Cumulative Percent
18-25	12	35.3	35.3	35.3
26-35	15	44.1	44.1	44.1
36-50	7	20.6	20.6	20.6
>50		0	0	100

Source: Survey result by the researcher (2021)

Table 5 presents that out of the total respondents (34), 35.3% of the respondent's age is between 18-25 years, 44.1% of the respondents' age group is between 26 and 35 years, the remaining 20.6% respondent's age ranges between 36 and 50 years.

It implies that most of the respondents are matured enough to answer the specific questions related to Al-ASR Textile factory's environmental issues. 20.6% of the respondents are at the age of pure maturity level, and mostly work at the top management level. While the age of middle managers, which are typically considered experts on the matter, ranges between 25 and 35 years, only 35.3% are younger workers (between 18-25 years), which are mainly employed as operators in the factory.

4.2. Analysis of Al-ASR factory waste water effluent selected parameters comparison with National standard

Table 6: Result of Sample waste water in ALASR Textile with selected Parameters

No.	Key Indicators	Methodology	Unit		National Standard Limit(mg/l)
			mg/l	mg/l	
			Before Treatment	After Treatment	
1	BOD	APHA4500H+B Electromagnetic	145.6	22.4	<=50
2	COD	APHA5220B,Open reflux method	1786	38.72	<=150
3	PH	APHA5210 b.5DAY BOD TEST	8.46	8.6	7_9
4	TSS	APHA 2540 D	266	ND	30

Source: laboratory result by the researcher (2021)

Table 6 presents the laboratory result of all the parameters. We can see that all parameters are under the national effluent standard limit, which implies that AL-ASR factory's maximum effort on raw wastewater is successful, and does not harm the environment. The sample is taken from the factory ETP using APHA4500H+B Electromagnetic methodology. The results of sample test analysis revealed the raw waste with treated one changed the concentration of BOD from 145.6 mg/l to 22.4mg/l. On the other hand, the second parameter, COD, is tested by APHA5220B and Open reflux method. The comparison of the COD result revealed that raw wastewater altered from 1786 mg/l to 38.72 (after treatment) which is well below the national standard limit of less than or equal to 150 mg/l. The third parameter is PH and tested using APHA5210 b.5DAY BOD TEST method. The result comparing raw wastewater with treated one changed from 8.46 to 8.6 which are weak basic media. The fourth parameter is Total Solid substance (TSS) tested by the APHA 2540 D Method. The laboratory result comparison between raw wastewater and treated one has a big difference, i.e., it improved from 266 mg/l to ND (not detected), which is less than 0.02 mg/l , and thus very far below the minimum standard limit of 30mg/l.

This implies that the AL-ASR factory meets the national standard limit in all four parameters and also shows that the commitments and efforts of the factory management within effluent treatment is working. This is mainly because chemicals for treatment are readily used, and responsible experts are assigned. Moreover, follow up are scheduled to monitor the status of the

ETP performance. These are done together with stakeholders such as ETIDI, which test results in their laboratory, and take corrective action to boost their ETP performance.

Table 7: ALASR Textile Before and after Heavy metals analysis

NO	Heavy metals	Methodology	Unit	Before Treatment	After Treatment	National Standard
1	Nickel (as Ni)	APHA 3111 C	ppm	263	ND	2
2	Cobalt (as Co)	APHA 3111 C	ppm	-	ND	2
3	Cadmium (as Cd)	APHA 3111 C	ppm	ND	ND	1
4	Copper (as Cu)	APHA 3111 C	ppm	ND	ND	2
5	Chromium (as total Cr)	APHA 3111 C	ppm	ND	ND	1
6	Zinc (Zn)	APHA 3111 C	ppm	ND	ND	5
7	Lead (Pb)	APHA 3111 C	ppm	0.392	ND	0.5

Source: laboratory result by the researcher (2021)

Table 7 depicts laboratory result of tested heavy metals (Nickel, Cobalt, Cadmium, Copper, Chromium, Zinc) through APHA 3111.. The laboratory test result shows that most of the heavy metals are not detected, which means that there are insignificant amounts in the laboratory test, except for Nickel and lead metals. Lead, in its raw status, is 0.392ppm, which is below the national effluent standard limit (0.5ppm) and the ZDHC MRSL list standards (100 ppm), an agreed upon standard accepted by most international buyers and suppliers. The second metal, which is detected in the raw wastewater, is Nickel. Nickel, in its raw status, is 263, but then after treatment, the amount of Nickel detected is ND. This means Nickel is undetected and meets the minimum standard limit. The remaining metals are undetected, both as raw wastewater and as treated ones.

This implies that most of the heavy metals are not seen in the laboratory test result, i.e. it is not harming the environment significantly, and also compliese with the national standard limit. This means that the factory also shows good practice in using chemicals and dyestuffs, which are almost free of heavy metals. Hence, when the factory select proper chemicals and dyestuff, it will reduce the burden of ETP plant and also reduce the number of chemicals used to treat heavy

metals. In the end, the effluents will not affect the environment such as soil, water, crops and vegetation, and it also reduces the causes of different human mutagenic and carcinogenic diseases.

Table 8: AL-ASR Textile factory comparison of heavy metals by annual report

NO	Heavy metals	Methodology	2016	2017	2020	2021	National Standard(ppm)
1	Nickel (as Ni)	APHA 3111 C	--	ND	ND	ND	2
2	Cobalt (as Co)	APHA 3111 C	ND	ND	ND	ND	2
3	Cadmium (as Cd)	APHA 3111 C	ND	ND	ND	ND	1
4	Copper (as Cu)	APHA 3111 C	ND	ND	ND	ND	2
5	Chromium (as total Cr)	APHA 3111 C	ND	ND	ND	ND	1
6	Zinc (Zn)	APHA 3111 C	ND	0.35	ND	ND	5
7	Lead (Pb)	APHA 3111 C		0.07	ND	ND	0.5

Source: ETIDI recorded data (2021)

Table 8 presents the factory's heavy metals test results of different years, including this year's test results conducted by the researcher.

This consistent result shows that AL-ASR textile factory efforts and commitment to meet the national and international standards are successful. This is considered as a best practice and also a good lesson for other textile factories, which commonly face similar problems in this regard. The main reason to achieve this good performance is the selection of dyestuff and chemicals in their processing and treatment unit with fewer amounts of heavy metals. Therefore, one of the most important roles for managing an effective environment treatment plant and for getting good result regarding heavy metals is the focus on the selection of raw material. The factory supplying the raw materials used in the processing unit, should consider the manufacturing hazardous substance list (MRSL) and a restricted substance list (RSL), rather than just considering low prices of raw material.

4.3 Respondents perception on environmental management system in the company with ISO 14001:2015 requirements

Table 9: Environmental Management System Placed in ALASR Textile factory

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dis Agree	4	11.4	11.4	11.4
	Neutral	13	37.1	37.1	48.6
	Agree	11	31.4	31.4	80.0
	Strongly Agree	7	20.0	20.0	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the above Table 9 presents out of the total population (35), 11.4% of the respondents disagreed with the existence of an environmental system in the Alasar Textile factory. On the other hand, 37.1% of the respondents were neutral. The rest 31.4% and 20% of the respondents were agreed and strongly agree respectively.

This implies that the majority of respondents didn't know whether there was EMS or not.

Table10: The existence of assigned responsible team for coordinating in the factories environmental management activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.9	2.9	2.9
	Neutral	6	17.1	17.1	20.0
	Agree	21	60.0	60.0	80.0
	Strongly Agree	7	20.0	20.0	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the above Table 10 presents out of the total population (35), 2.9% the respondents disagreed with the existence of EMS responsible team in the Al-ASR Textile factory, on the other hand, 17.1% of the respondents were neutral. The rest 60%and 20% of the respondent 80% of total respondents were agreed that the factory has EMS responsible team to manage EMS activities.

Therefore: Most of the respondents are known Al-ASR Textile factory assigned EMS responsible team for coordinating the factories environmental management activities. Its shows also these teams were communicated with responsible stakeholders and staffs.

Table 11: The existence of environmental impacts and risks assessment of all significant environmental aspects in the past 12 months

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	4	11.4	11.4	11.4
	Neutral	12	34.3	34.3	45.7
	Agree	14	40.0	40.0	85.7
	Strongly Agree	5	14.3	14.3	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the Above Table 11 presents out of the respondents (35) 11.4% of the respondents disagreed on the assessment of environmental impacts and risks within the last 12 months, on the other side 34.3% of the respondents replied neutrally which doesn't know whether the factory doing assessment or not. The rest of the respondents like 40% agreed and 14.3% strongly agreed replied respectively. In this reply 54.3% of the respondents known and agreed that the Al-ASR textile factory conduct Impacts and risks assessments in past 12 months.

This implies that Al-ASR Textile conducted environmental impact and risks assessments minimum within a year the interval which helped them to tackle their challenges earlier before facing huge impact on the environment. The factories also benefitted by taking preventive mechanism to have smooth relation with their customer and surrounding community.

Table 12: The consideration of significant environmental aspects in the planning, design, development, operation and production activities of the factory

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	5	14.3	14.3	14.3
	Neutral	13	37.1	37.1	51.4
	Agree	14	40.0	40.0	91.4
	Strongly Agree	3	8.6	8.6	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the above table 12 Presents out of the respondents (35) 14.3 % of the respondents disagreed with Al-ASR Textile considered a significant environmental. On the other hand, 37.1 % of the respondents were replied whether the significant aspects are considered or not. The remaining 40% and 8.6 % agreed and strongly agreed respectively that Al-ASR Textile factory is considered all environmental significant aspects.

This implies that some of the respondents didn't know the activity of the EMS team or the EMS team didn't have any communication medium to create awareness for the workers about their interventions which help and facilitate the implementations by workers and stakeholders

Table13: ALASR Textile environmental performance of all significant aspects is regularly monitored

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	7	20.0	20.0	20.0
	Neutral	8	22.9	22.9	42.9
	Agree	14	40.0	40.0	82.9
	Strongly Agree	6	17.1	17.1	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the above table 13 presents out of the respondents (35) 20% of the respondents disagree AL-ASR textile performed all significant aspects are regularly monitored, on the other hand, 22.9 % of the respondents didn't know whether AL-ASR Textile factory performed significant aspects are regularly monitored or not. The rest of the respondents which is 57.1% are known and agreed that Al-ASR textile monitored regularly monitored significant aspects.

This implies that Most of the respondents are understand the efforts of the factory commitment to maintain the environmental pollution impacts coming from their own factory. But still needs to aware the community and stakeholders (22.9%) as much as possible which will increase the efforts of the factory.

Table 13 : ALASR Textile has a process and schedule to maintain all available equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.9	2.9	2.9
	Neutral	7	20.0	20.0	22.9
	Agree	19	54.3	54.3	77.1
	Strongly Agree	8	22.9	22.9	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the above table 14 presents out of the respondents (35) 2.9% of the respondents disagree AL-ASR textile factory doesn't have a process and schedule to maintain all available equipment, on the other hand, 20% of the respondents don't know whether the factory has a process and schedule or not to maintain their equipment. The remaining respondents which are 77.2% are known and agreed that the factory has its own process and schedule to maintain the available equipment.

This shows most of the respondents aware that the factory has their own workshop to maintain their equipment used to sustain the activity of the EMS implementation and on the other hand, the equipment's and tools will work continuously without interruption and take preventive measure on the upcoming challenges on EMS activity. The other point is that The factory has its own preventive maintenance schedule rather than firefighting activities which minimize resource and time wastage in addition to that there is no accidental environmental pollution due to equipment and tools stuck or not functional.

Table 14: Respondents perception on the delivered EMS adequate training and awareness to the employees and stakeholders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	11	31.4	31.4	31.4
	Neutral	13	37.1	37.1	68.6
	Agree	5	14.3	14.3	82.9
	Strongly Agree	6	17.1	17.1	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

As the above table 15 represents that out of the respondents (35) 31.4% of respondents disagree Al-ASR Textile factory on delivering training and awareness to the employees and stakeholders .in another part 37.1 % of the respondent's awareness to the employees and stakeholders are neutral which means they don't know whether the factory delivering training and awareness or not. The rest of the respondents 14.3 % and 17.1% agreed and strongly agreed respectively that the factory is delivering the training for employees and stakeholders.

This implies that most of the respondents didn't know or not participated in the capacity building training and awareness sessions which will affect the sustainability and transparency of the EMS activity. The EMS Team needs to deliver capacity building training to improve the performance of the EMS. It also will reduce the challenges coming from employees and stakeholders by lack of awareness. The foreign experts that are working in the company also need to transfer their knowledge to the local experts well unless otherwise, the sustainability of good performance futurity will be under a question.

Table 15: ALASR Textile Monitors, evaluates, and /or engage with suppliers and subcontractors on their environmental performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.7	5.9	5.9
	Neutral	11	31.4	32.4	38.2
	Agree	17	48.6	50.0	88.2
	Strongly Agree	4	11.4	11.8	100.0
	Total	34	97.1	100.0	
Missing	System	1	2.9		
Total		35	100.0		

Source: Field Survey (2021)

From the above table 16 presents that out of 35 respondents 2 (5.7%) of the respondents are disagreed Al-ASR Textile monitors, evaluates and/ or engages with the suppliers and subcontractors on their environmental performance, on the other hand, 31.4% of the respondents are neutral to respond whether AL-ASR Textile factory monitors evaluate and /or engages with supplier and subcontractor. The rest of the respondents 60 % agree that the factory monitor, evaluate and/or engages with the supplier and subcontractor.

This implies that most of the respondents have clear information Al-ASR Textile factory conduct monitoring and evaluation and taking corrective action, therefore, the factory has Good PDCA (Plan Do Check Act) practice in the EMS and the team also has good experience achieving their EMS target together with sub-contractors and suppliers even though they have quite small subcontractors. The researcher understand through informal discussion and their raw material container badge coming from different suppliers that the factory has their own genuine and certified a supplier like Oeko-Tex certified companies. This assurance company has internationally known laboratories which are testing and assuring the status of their product whether its under standard internationally and not, the institute also check if there is any significant impact to the environment and human beings ‘with ZDHC (Zero discharge hazardous chemicals) for the future. In addition to this also the EMS team has Good communication with

suppliers to check their performance. One point that needs to change their thought is the the factory used different chemical and dyestuff suppliers for local and export market due for the sake of price and end product market values. Even though it doesn't see the impact on the sample taken on the effluent laboratory analysis result, the researcher recommend that changing different suppliers also increase the chance to make mistake in production and also makes the effluent analysis will be difficult.

Table 16: ALASR Textile conducts and identified training needs of suppliers and subcontractors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	5.7	5.9	5.9
	Disagree	9	25.7	26.5	32.4
	Neutral	13	37.1	38.2	70.6
	Agree	10	28.6	29.4	100.0
	Total	34	97.1	100.0	
Missing	System	1	2.9		
Total		35	100.0		

Source: Field Survey (2021)

From the above Table 17 present that out of the total respondents (35), 5.9 % of respondents strongly disagree on AL-ASR textile conduct training needs of suppliers and subcontractors are identified, the other one is that 26.5% of the respondents are not agree on Al-ASR factory is conducting Training needs of suppliers and subcontractors are identified. 38.2% of the respondents are neutral which are not clear about whether the factory is conducting training needs identified or not. The rest 29.4 % of the respondents are agreed that the Al-ASR Textile factory conduct training needs for the suppliers and contractors.

This implies that the factories didn't fully conduct training needs and identified from their suppliers and subcontractors. The factory even didn't identify their supplier or subcontractors which needs training or not, while also need to assure they are running on the same page with

respect to the environmental management system by understanding and evaluate their performance of EMS. This can also affect the performance of the ALASR textile Factory EMS performance and will be non-compliance with ISO 14001; 2015 requirements.

Table 17: Factory facility has been in compliance with legal requirements/permits during the 12 months

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	7	20.0	20.0	20.0
	Agree	21	60.0	60.0	80.0
	Strongly Agree	7	20.0	20.0	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

From the above Table 18 present out of the total respondent (35) 20 % neutral due to no clue about the performance of factory facility with legal requirements. But the rest 80 % of the respondents agreed that the AL-ASR Textile factory has been in compliance with legal requirements during the past 12 months.

This implies that most of the respondents perceived that the AL-ASR factory meet legal requirements with in the past 12 months. From my perspective through discussion and laboratory analysis also the factory performed well consistently on the basic effluent parameters with respect to MRSL within ZDHC, ISO 14001:2015 and National standard limit as well. AL-ASR Textile factories wastewater effluent performance can also best practice for the Textile and other sector industries. The factories have Good achievement in meeting the legal requirement, there environment treatment plant efficiency also appreciated by reviewing the previous year performance results, In addition to that the cost of the ETP comparing to the other Textile industries are cheaper and take optimum area comparing with other textile factories ETP plant.

Table 18: ALASR Textile share information on its emissions, water discharge, and waste generation available to the public

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	8	22.9	23.5	23.5
	Neutral	11	31.4	32.4	55.9
	Agree	12	34.3	35.3	91.2
	Strongly Agree	3	8.6	8.8	100.0
	Total	34	97.1	100.0	
Missing	System	1	2.9		
Total		35	100.0		

Source: Field Survey (2021)

As the above Table 19 presents out of the total respondents (35) 23.5% Disagree that AL-ASR textile make information about pollution status to the public, on the other hand, 32.4% of the respondents are neutral, They didn't know clearly whether the factory shares information to the public or not. The rest of the respondents 44.1% totally agreed that AL-ASR textile shares information on its air emissions, greenhouse gas emissions, water discharge, and waste discharge and waste generation available to the public.

From the above presentation, the information makes and avails for the limited persons or responsible body but it's better to communicate their performance for the whole stakeholders to understand their effort to achieve EMS target and building trust by the community that ALASR textile doesn't pollute the environment and it's good to have a positive attitude by the community on the factory. The other point need to recommend that it's better to have a communication board(inside and outside)of the company to create enough awareness about AL-ASR environmental policy, strategies and activities result.

Table 19: ALASR Textile demonstrated evidence of reducing the quantity of water used at this site, such as by reusing rinsed water or capturing condensate or cooling water

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	2.9	2.9	2.9
	Disagree	2	5.7	5.7	8.6
	Neutral	12	34.3	34.3	42.9
	Agree	12	34.3	34.3	77.1
	Strongly Agree	8	22.9	22.9	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

From the above Table 20 presents that out of the total respondents (35), 5.7 % of the respondents disagreed that the factory demonstrated evidence of reducing the quantity of water used at the site, on the other hand, 34.3% of respondents are neutral and doesn't know whether they are demonstrated the evidence or not, the rest 57.2% of the respondents are agreed that AL-ASR Textile demonstrated evidence of reducing the quantity of water used at this site, such as by reusing rinsed water or capturing condensate or cooling water.

From the above data presentation, the researcher didn't see any registered data or other evidence which shows the target and achievements of reduced water from the production process (by which amount reduced and the way how can they reduced it?) and also I didn't see in the factory visits also any recycling except some of the water recycled from wastewater treatment used for plantation. So it's better to analyze and answer which part of the process consumes a huge amount of water first to give priority and then analyze the process of how can we reduce the consumption is it possible to recycle and reuse it again, how much is the budget to install the process, then also how can we use reused /recycle water, which process is suitable to use used water without any significant impact e.g. washing/rinsing water can possibly use again for the Dyeing pretreatment the process to finishing department which can decrease 15-20 % of the water consumed for the whole process, recycling of cooling water can decrease the consumption of energy relatively when you compare to heat raw water and get steam.

Table 20: wastewater that is produced at ALASR Textile treated both primary and secondary treatment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	8.6	8.8	8.8
	Neutral	10	28.6	29.4	38.2
	Agree	10	28.6	29.4	67.6
	Strongly Agree	11	31.4	32.4	100.0
	Total	34	97.1	100.0	
Missing	System	1	2.9		
Total		35	100.0		

Source: Field Survey (2021)

As Table 21 presents out of the respondents (34) 8.8% disagreed on ALASR textile Water treated with primary and secondary treatment, on the other hand, 29.4% of the respondents are replied neutrally because they didn't know exactly whether the factory doing both treatments or not. The rest of the respondents (61.8%) agreed that the AL-ASR Textile factory is treated with primary and secondary treatment.

This implies that most of the respondents are perceived that the factory treated their wastewater treatment with the proper and consecutive treatment process. The researcher physical visits observe that the factory has primary and secondary treatment. Each treatment process also used different chemicals and different recipes for each process. The laboratory result also shows that the factory used an effective and efficient treatment process to get efficient EMS practices.

Table21: ALASR Textile monitors the quantity and quality of wastewater produced

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	8	22.9	22.9	22.9
	Agree	12	34.3	34.3	57.1
	Strongly Agree	15	42.9	42.9	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

From the above Table, 22 presents out of the total respondents (35)22.9% of the respondents are neutral that whether AL-ASR Textile factory monitors or not the quantity and quality of the wastewater produced and the rest of the respondents agree and strongly agreed (34.3&42.9) % respectively perceived that Al-ASR textile factory monitors the quality and quantity of wastewater produced.

This implies that Implementation of ISO 14001:2015 standards very well and have their own PDCA cycle. From the discussion with different stakeholders, there was no non-compliance report or penalty within the last five years from this factory. The factory is willing to improve its performance and transparent for any support getting from development partners and other stakeholders.

Table: 22 ALASR Textile set and review at least annually formal targets for improving waste water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	5	14.3	14.3	14.3
	Neutral	9	25.7	25.7	40.0
	Agree	13	37.1	37.1	77.1
	Strongly Agree	8	22.9	22.9	100.0
	Total	35	100.0	100.0	

Source: Field Survey (2021)

From table 23 presents out of the respondents (35)14.3% disagree on Al-ASR Textile set and review at least annually formal targets to improve water quality, 25.7% of the respondents replied Neutral which they don't have clue whether they set / review annual formal targets or not. The rest of the respondents (60%) are agreed that Al-ASR Textile set and review at least annually formal targets for improving wastewater quality.

This implies that most of the respondents are informed or participated in the annual formal target setting to improve the factory water treatment. According to researcher observation and discussion made with the EMS team, they didn't set specific targets and countable, the target set by the team was general and not figural which is difficult to evaluate their target at the end of the year respectively even though they are achieving the standard limit set by the EPA.

5. Conclusion and Recommendation

5.1 Conclusion

Based on the primary and secondary data analysis the following conclusion made. Accordingly, the laboratory effluent sample results showed, the concentrations of certain chamicals such as BOD, COD, PH and TSS in the sampled treated waste water is below the national standard. Similarly, the concentration of certain heavy metals such as Nickel (Ni), Cobalt (Co), Cadmium (Cd), Copper (Cu), Chromium (Cr), Zinc (Zn) and Lead (Pb) in the sampled treated waste water are below the national standard. This implies that there is efficient treatment plant and consistent efforts of the factory to meet the national standards. The laboratory result is good enough as an

experimental analysis but there were problems on their Environmental management system. Most of the interview respondents even the Government monitoring body replied the answers based on the AL-ASR Textile actual profile on Effluent treatment performance and they can't see how can sustain this performance for the long run.

As field observation revealed, the factory has a foreign expert which has good experience in wastewater management and he has been following each and every single step by checking prior tests. They do have a good workshop to maintain their accessories and equipment's when there is the equipment broken or out of service. The factory also has a good relationship with the area environment authority and other federal offices and institutes.

Based on interview result and personal observation, ALASR factory has a good name even by engaging stakeholders. However, the factory doesn't implement their EMS as a system and it depends on one person (foreign expert working as environmentalist) once he is back to his country, there is no basic system which can sustain their environmental management. Besides, there is no proper documentation which can follow the process by this foreign expert successor, and also there is no documentation that can trace the process steps and necessary SOPS need to follow by the factory local experts. Therefore, this dependency on one foreign expert will affect the consistency of good environmental achievement. Furthermore, as the expert has a language barrier to transfer his knowledge to other workers, it is so difficult to sustain the existing environmental management system.

The factory Environment treatment plant reducing the pollution level which might harm the environment based on the sample lab result. However, ALASR factory has limitation with local experts so need to capacitate the local experts by different capacity building training and experience sharing visit within/outside the country. The foreign environment expert needs to share his experience and knowledge with the other staffs by a different mechanism like using a translator.

AL-ASR Textile Environment Management activities is not working as a system that can understand by all teams to manage their EMS by preparing documents and communication mechanisms with the operational and technical procedure. In the actual case, most of the technical teams didn't answer even why, when and how the system working and they are just busy and focusing on the routine operation work which doesn't sustain their Environmental management activities.

The environment treatment plant generally has effective results but, there is no ground system and skilled manpower to sustain their achievement. The factory doesn't have an environmental policy and strategy. It didn't set any goal rather just working to meet the national effluent standard limit. The factory doesn't have any water reduction strategy or plan especially in the process of dying and washing process.

As the factory has no Environment management system which can guide the skilled manpower to run by themselves rather than expecting another foreign expert. There is no effort of working to set the water, energy, chemicals and dyestuffs consumption reduction activities as a strategy which help to reduce the wastewater amount and Chemicals consumed for the treatment and finally increase the factory profit margin. The factory doesn't have a satellite wastewater laboratory that can test basic parameters at the factory level. The satellite laboratory is used for the immediate correction purpose and to prevent waiting a long time for the monitoring and evaluation purpose.

5.2 Recommendations:

Based on the finding of the study, the following recommendation forwarded:

- The company recommended having a system that can track every step of environmental management system activities in documentation.
- The factory required to implement ISO 14001:2015, the implementation of this standard help to sustain their effort for the long run without unexpected interruption. The system makes every environmental activity in the loop and understands by other skilled/unskilled persons who are working in the factory and the community around the factory.
- The company recommended to have resource management to improve consumption of their resource especially water and chemicals.
- As treatment plant has been operated by one foreign experts, the factory required to give capacity building training to local experts working around ETP area. So that knowledge and skill transferred from foreign expert.
- The company required to make need assessment of training having annual training schedule to the direct workers and middle managements.
- Need to check their supplier and subcontractors environmental and social compliance status.

- The factory should have proper Chemical handling using 5S rule (sort, set in order, shine, standardize and sustain) with secondary containers to minimize the wastage.
- The company required to communicate their EMS activity by preparing a notice board.
- The factory should aware the community about their environmental performance to create transparency and build trust in the community.
- The factory needs to have a small laboratory to test frequently the effluents to know the latest status and taking the immediate correction.

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Appendix

Survey questionnaire format used

College of Development Studies

Center for Environment and Sustainable Development

Dear/Sir/Madam,

This is a structured interview questionnaire prepared to undertake a study entitled "Waste water management in Al-ASR Textile factory at Dukem town.

Dear respondent, I am Samuel Abebe, a post graduate student in a Center for Environment and Sustainable Development, College of Development Studies, Addis Ababa University. Currently, I am planning to undertake a research in order to complete the requirements for Master of Arts (MA) degree in Development Studies (Environment and Sustainable Development) given by College of Development Studies, Addis Ababa University.

The research is conducted purely for academic purpose and all the information given are treated as confidential and will not be used for other purposes. I also assure you that no personal identity will be disclosed to third parties. I am so grateful to you by giving reliable and appropriate data and information.

Thank you for your time and cooperation

Code ----------

Date of interview ----------

I. Structured Interview Questionnaire

1. Demographic and Socio-Economic Characteristics

S.No	Items	Options
I.1.	Age of the respondents?	1. 18-25 2.26-35 3.36-50 4.>50
I.2.	Sex of the respondent?	1. Male 2. Female
I.3.	What is your level of educational?	1. Adult education and below 2. Grade 1-8 3. Grade 9-12 4. TVET Diploma 5. First Degree and above
I.4.	What is your occupation or position?	----------

2. Knowledge and training related variables

S.No	Items	Strongly dis agree	Disagree	Neutral	Agree	Strongly Agree
1.	Does Al-ASar textile has developed an environmental management strategy?					
	a. Strategy is supported by factory leadership? b. Strategy is communicated to all employees? c. Achievement of goals and targets is monitored regularly and compared with baseline? d. Strategy is reviewed at least annually by management including review of information such as results of verification and legal compliance? E. environmental performance, status of objective and targets, status of preventive & corrective actions, recommendations for improvements, etc. ?					
2.	Does Al-ASR Textile EMS Team responsible for coordinating the factory’ s environmental management activities is assigned?					
	a. Enough environmental personnel are part of the team to handle the breadth and depth of environmental impacts created by the factory? c. Organization chart of the team is prepared? d. Clear roles and responsibilities of all team members are defined and communicated across the					

	organization? e. All team members are qualified as per job requirements?					
3.	Does Al-ASR Textile has assessed environmental impacts and risks of all significant environmental aspects in past 12 months?					
	a. Includes all environmental aspects associated within the factory's control or influence? b. Includes all environmental impacts covered by local regulations? c. Provides analysis of the significance/importance of the different environmental impacts? D. Includes all compliance and conformance obligations? e. Action plan for reducing the environmental impacts and avoiding risks has been developed and implementation started? f. The process for evaluating the significance of environmental impacts is done at least once a year and results are compared?					
4.	Does Al-ASR Textile Significant environmental aspects are considered in planning for design, development, operations, and production activities?					
	a. Qualified site manager is appointed at production facilities that are responsible for the implementation of process specification requirements? b. Production processes are developed and operated while considering environmental impacts [e.g. recipes are set to optimize use of energy, water and chemical inputs?					
5.	Does Al-ASR Textile Environmental performance of all significant aspects is					

	regularly monitored?					
	a. Key performance indicators are developed for all significant environmental performance parameters b. Processes and procedures required to monitor the KPIs are established c. Monitoring of all environmental aspects is conducted as required by local laws and regulations and other compliance obligations d. Necessary equipment is available in-house to monitor significant environmental parameters e. A program or system is in place to review and monitor environmental regulations, permit status and renewals (where appropriate) and compliance is ensured {provide regulatory inventory}					
6.	Does Al-ASR Textile have a process and schedule to maintain all equipment is available?					
	a. Adequate equipment management and maintenance personnel are responsible for routine maintenance and emergency repair for each shift b. In-house facility is available containing necessary equipment for routine repair and maintenance? c. Maintenance staffs are regularly made aware of significant environmental aspects and impact of maintenance activities on these aspects?					
7.	Does Al-ASR Textile deliver Adequate training and awareness is provided to the employees and stakeholders on EMS?					
	a. Training and awareness needs are systematically assessed for employees and stakeholders b. Training and awareness plan for employees and stakeholders is developed including following aspects b. Regular trainings are provided to team responsible for EMS to ensure they have up-to-date knowledge and skills required to implement and maintain EMS					

	c. Regularly trainings and awareness are provided to workers to ensure they have necessary knowledge and skills to work according to the environmental priorities of the facility? d. Impact of training and awareness activates is evaluated and training plan is adjusted accordingly?					
8.	Does Al-ASR Textile monitors, evaluates, and/or engages with the suppliers and subcontractors on their environmental performance?					
	a. Environmental performance requirements for suppliers and subcontractors are developed? [if yes, select applicable suppliers from following categories] Raw material suppliers, Chemical Suppliers, Production sub-contractors? b. Environmental performance requirements are included in the supplier selection criteria? c. Training needs of suppliers and sub-contractors are identified? D. Training plan prepared to ensure they understand the facility's requirements and any targets they have to achieve? e. Training on EMS is provided to suppliers and sub-contractors as per training plan?					
9	Does AL-ASR conduct Training needs of suppliers and sub-contractors are identified and conducted?					
10	Does AL-ASR textile factory site facility Has been in compliance with all legal requirements/permits during the past 12 months?					
11	Does Al-Asar textile make information on its air emissions, greenhouse gas emissions,					

	water discharges and waste generation available to the public?					
12	Does Al-Asar Textile demonstrated evidence of reducing the quantity of water used at this site, such as by reusing rinse water or capturing condensate or cooling water?					
13	Is all wastewater that is produced at Al-ASR textile being treated with primary and secondary treatment?					
14	Does Al-ASR Textile monitor the quantity and quality of wastewater produced at Al-ASR textile factory?					
15	Do you set and review at least annually formal targets for improving wastewater quality for Al-Asar textile?					

Thank you for your time!