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Impact of Industrial Effluents on Surface Water, Groundwater, and Soil in Kombolcha, Ethiopia: A Systematic Review

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ABSTRACT

Dumping of pollutants into water body result in rapid deterioration of water quality and affect the ecological balance in the long run. Water is life without pollution, but death when it is polluted. The objective of this study is to conduct a literature review of industrial effluent on Surface water, Groundwater, and Soil quality in and around the Industrial area of Kombolcha town. The method used for this study is a review of academic journal articles, internet materials, textbooks, conference papers, project reports and publicly available materials. Kombolcha town is known for various industries like a brewery, steel iron, textile, and tannery have been installed near the Borkena River that crosses Kombolcha town, which comes under the Awash River basin. The town is one of the fast-developing and emerging leading industrial town in Ethiopia and is selected as an industrial zone by the government. Uncollected Industrial effluents are also a serious environmental hazard for all, especially in areas where agricultural land and groundwater are nearby. Industries use a large quantity of water and produce a huge amount of wastewater, which is generally discharged into a common effluent drain of industrial areas and farmland. Local farmers in the Borkena watershed use the wastewater to irrigate their agricultural fields for the cultivation of vegetables. Hence, they suffered from loss of productivity and skin injury because of their direct exposure to the wastewater during irrigation practices. Different Physico-chemical parameters were recorded by various researchers hence, groundwater samples of the kombolcha tow show excellent (20%), good (60%), and Marginal (20%). Heavy metal Evaluation depicts that, Lower Borkena river below effluent has more high concentration than the upper river catchment and it means the comparison of heavy metals concentration is increasing as the industrial effluent is increased. The findings showed metal concentrations in irrigation water are within the permissible limits of FAO/WHO standards and not significant for the time being, but the result of below the effluent showed that it is expected to be a challenge in the near future if not well addressed. This review may assist in the extended support to new researchers and developing strategies for policymakers for the sustainable management of water and soil resources in industrial land use patterns.

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Introduction

It is one of the greatest challenges of Agenda 2030 for Sustainable Development to provide clean and potable water for human and agricultural purposes in order to prevent environmental and human health risks. This includes aspects of water quality, accessibility and availability to further address the normative criteria of the human right to water [1]. Water pollution is a major threat to human population and dumping of pollutants into water body result in rapid deterioration of water quality and affect the ecological balance in the long run [2].

Rapid urban growth induces global environmental change, particularly when it comes to production, consumption, and the generation of waste. Industrialization plays a vital role in the growth and development of any country. This rapid industrialization is also having direct and indirect adverse effects on environmental pollution [3].

Due to the side effect of industrialization on environments, environmental protection is the main need of the society to control generation of industrial wastewater that contain appreciable amount of metallic cation like zinc, copper, iron, lead, nickel, cadmium etc [4]. Long term exposure of these effluents into the environment gives increased electrical conductivity, organic carbon content and heavy metals accumulation in the soil and achance of their entrance in food chain which ultimately causes significantly health concern The wide array of pollutants discharged into aquatic environment may have physico-chemical, biological, toxic and pathogenic effects [5,6]. Freshwater bodies (e.g., rivers) are the major source of water to fulfil the daily water demand for household, agriculture and industrial activities Urbanization and industrial advancement deteriorate water quality of freshwater bodies in the current world and provoked serious research concerns to safeguard natural resources and promote sustainable environmental management [7]. The impact of nitrogen and phosphorus on surface water quality is an increasing problem in developing countries [8].

The quantity and quality of fresh water resources are decreasing due to global warming, climate change, urbanization,

industrialization and agricultural activities Direct discharge of industrial wastewater to soil surface or water bodies severely contaminates the environment [9]. Therefore, it is necessary to give treatment to disposed water before letting it off as effluent, to avoid contamination of natural system. Soil and water quality are issues, which affect the quality of our food, health and environment in general [10]. Water quality monitoring has one of the highest priorities in environmental protection policy [11].

In many low-income countries, wastewater is discharged commonly into water bodies with little and no treatment as there are limited treatment facilities. &use of wastewater for agriculture has become a common reality in three-fourth of the cities of Asia, Africa, and Latin America [12]. In many parts of Ethiopia, there is a practice to use wastewater which is disposed to wells, ponds, streams, and treatment plants as a source of irrigation water. Due to the rapid population growth and the uncertainty over climate change, wastewater use in the agricultural sector may face many challenges. Long-term irrigation with poor-quality water damages the balance of nature, causing ecological deterioration on farmland Due to the rapid growth of industrialization, the environment especially the atmosphere and the water body or hydrosphere are largely exposed to pollution [13]. Insufficient treatment or improper disposal of those wastes can vastly affect or even damage the living organism [14].

Wastewater treatment is not given the necessary priority and therefore, industrial waste is discharged into receiving water bodies without treatment. As a result, proper management of wastewater is essential [14].

Due to the rapid increase in the urban population, urban agricultural activities are being recognized as an important source of food, nutrition, and income for the urban poor [15]. However, irrigation is challenged by lack of water, and the experience of using polluted rivers for irrigation is becoming a common practice near urban areas [16]. In Kombolcha town of Ethiopia, the "Worka" and "Leyole" rivers, tributaries of the "Borkena" river, have been receiving untreated industrial effluents directly or indirectly, and local farmers are irrigating without any treatment [17].

The textile industry in Ethiopia might be the largest source of water contamination because many textile industries operate without treatment plants and discharge their effluents directly into river bodies [18]. The key environmental issues associated with textile manufacture are water use, treatment, and disposal of aqueous effluent [19]. The risk factors are primarily associated with wet processes - scouring, bleaching, and dyeing [20]. All these processes produce large quantities of wastewater and the dyeing process usually contributes heavy metals like chromium, lead, zinc, cadmium, and coppe [14].

Most of the industry promoters in Ethiopia misconceived as costly to prepare and implement Environmental impact assessment (EIA) [21]. As a result, many factories in the Kombolcha industrial zone had not appropriately managed their industrial effluents and disposed of their wastes to the immediate environment without any precaution [22].

The tannery is categorized as one of the highly polluting industries and it hurts the environment because of the generation of liquid, solid, and gaseous wastes [23]. The tanning process involves an important consumption of water and generates complex pollution consisting of a mixture of organic and inorganic substances that are difficult to treat and also the chemical reagents consumption is very high, including sodium chloride, lime, sodium sulfide, sulfuric acid, sodium sulphate, basic chromium and it causes a carcinogenic effect when it enters the human body through the food chain [13].

Figure 1: Water Uses in Tannery

The steel industry is classified among the largest users of water due to high temperature within manufacturing processes. Starting with cooking and sintering processes, continuing with furnaces and steel plants to steel mills all these processes use large quantities of water carcinogenicity [24]. lacks a proper waste disposal system, these industrial discharge or wastes include, polychlorinated biphenyls (PCBs), dioxins, poly-aromatic hydrocarbons (PAHs), petrochemicals, microorganisms, and the various heavy metals, which are a real threat to the environment. Therefore, the removal of toxic metals such as chromium, cadmium, copper, lead, nickel, zinc, and mercury from wastewaters becomes a necessity due to their toxicity and carcinogenicity [24].

Figure 2: Iron and Steel Industry

Statement of the Problem

There are major existing industries in the Kombolcha town, which include: Steel product industry, Flour factory, Amir Sac and Plastic factory, Industrial Park, Textile factory, ELFORA meat processing factory, BGI-brewery factory, and Tannery factory. This indicates that industrial activity in the area has been developing rabidly. However, most of the industries in the city don't have a treatment plant (TP), and some industries even if they have TP, these TP are not functional.

Therefore, industrial effluents, municipal wastes (solid and liquid wastes) from uncontrolled urbanization are discharged and mixed with streams and Borkena River water almost exclusively without adequate treatment which results in nutrient enrichment, the accumulation of toxic compounds, and sediments, and loss of dissolved oxygen in surface water.

Generally, the studies in the area by some researchers have made studies on surface water pollution, Groundwater pollution and Soil pollution, but it is not as such enough to make policy makers focus on that area. therefore, this reviewing is to understand how many researchers and in which area they have discussed.

Objective of the Review

The objective of this seminar is to review of Impact of Industrial effluents on Surface Water, Groundwater and Soil and to provide

concrete information on the magnitude of the industrial liquid wastes and help farmers and policy makers to take the necessary corrective measures.

Conceptual Framework

This Seminar is based on the concept of availability and sustainable management of water and sanitation and pollution control Strategy. SWM is a critical component of sustainable development, and accounts for similar issues as sustainability. Mays (2006) defined SWM as meeting current water demand for all water users without impairing future supply [25]. More specifically, SWM should contribute to the objectives of society and maintain ecological, environmental, and hydrologic integrity [26]. A more holistic objective of water management is provided in Agenda 21 (United Nations Conference on Environment and Development, Rio de Janero, Brazil, 3–14 June, 1992) which ensures that adequate supplies of water of good quality are maintained for the entire population of the planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and to combat vectors of water-related diseases.

By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing the release of hazardous chemicals and materials, halving the proportion of untreated waste water and substantially increasing recycling and safe reuse globally [27].

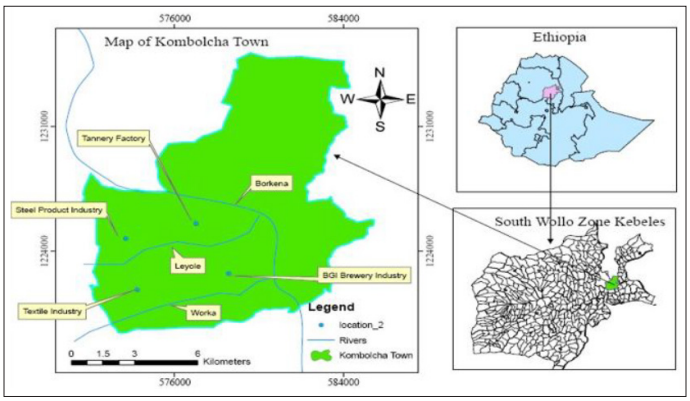

Figure 3: Map of the Study Area

This seminar made use of a review of academic and journal articles. I developed a search strategy to identify relevant literature. This search strategy was tailored to three databases: Web of sciences, Scopus, Google and Google scholar, and the search terms used were the following: water quality, Impact of water quality, water pollution, industrial pollutants, and heavy metals. All searches included journal articles, books and book chapters. The search mainly focused on the mapping existing literature on the impact of water quality, water and soil pollution, and heavy metals in the field of environmental sciences, and earth sciences. The search span was from the year 2000–2022 in English only. The search was mainly focused on Ethiopia. There were 45 records extracted at this stage.

Literature Review

Kombolcha town is one of the fast developing and emerging as a leading industrial town in Ethiopia and it is one of the towns selected as industrial zone by the government. The town is one of Ethiopia's towns with comparatively more large-scale manufacturing plants as compared to the size of the town. Steel Product Industry, Flour Factory, Textile Factory, Meat Processing Factory, Brewery Factory and Tannery are the major industries existed in the study area. In this town, the industrial effluents are directly discharged to surface water and toxic organic and inorganic chemicals were taken by crops and vegetables when the surface water is used for irrigation [28]. More ever, groundwater reserve depletion and well interferences are significantly high in the well-field [29].

Eskinder Zinabu and Johannes van der Kwast (2017) conducted lab research on physio-chemical quality Estimating Total Nitrogen and Phosphorus Losses in a Data-Poor Ethiopian Catchment and asserted that the electric conductivity (EC) for the steel processing effluent was found to be higher compared to the other industries (i.e., steel products industry =4000µS/cm, textile industry = 800µS/cm, tannery industry =2200µS/cm, and BGI brewery industry =2100µS/ cm).

conducted field research on Assessing the Industrial Effluent Effect on Irrigation Water Quality and Farm Soil near Kombolcha Town, Ethiopia has been considerably contaminated by heavy metals, physio- chemical and biological pollutants. In addition, they opined that In Kombolcha town of Ethiopia, the "Worka" and "Leyole" rivers, tributaries of the "Borkena" river, have been receiving untreated industrial effluents directly or indirectly, and local farmers are irrigating without any treatment. For instance, the electric conductivity (EC) for the steel processing effluent was found to be higher compared to the other industries (i.e., steel products industry = 4000µS/cm, textile industry = 800µS/cm, tannery industry = 2200µS/cm, and BGI brewery industry = 2100µS/ cm) [15]. They evaluated various industrial effluents' effect on irrigation water quality and farm soil near Kombolcha town. Several industries such as brewery, steel iron, textile, and tannery have been installed near the Borkena River that crosses Kombolcha town. Representative samples of irrigation water and farm soil were collected from the upper and down part of Borkena river. The upper site was used as a control as it was not contaminated by industrial effluents. The analysis for selected parameters showed that the downstream irrigation water quality had mean concentrations of pH = 8.54, magnesium (Mg^{+2}) = 5.27 mg/l, carbonate (CO_3^{-2}) = 1.25 mg/l, bicarbonate (HCO_3^{-}) = 9.10 mg/l, copper (Cu) = 0.21 mg/l, chromium (Cr) = 0.31 mg/l, and cadmium (Cd) = 0.03 mg/l which were above the permissible limit of the Food and Agriculture Organization's (FAO's) irrigation water quality standard. The mean concentrations of electric conductivity (EC) = 0.96 ds/m, sodium (Na^{+}) = 3.35 mg/l, chloride (Cl^{-}) = 7.67 mg/l, and total dissolved solids (TDS) = 612.98 mg/l were slightly and moderately restricted for irrigation. Moreover, the concentration of heavy metals, calcium (Ca^{+2}) = 16.61 mg/l, iron (Fe) = 4.25 mg/l, manganese (Mn) = 0.18 mg/l, and lead (Pb) = 0.47 mg/l, was below the permissible limit of the FAO and nonrestricted. However, the mean concentration of EC, HCO_3^{-}, Cu, Cr, Cd, and TDS for downstream-irrigated farm soil samples was above the permissible limit of the FAO. The concentration of most selected parameters in downstream farm soil was also decreasing along with depth except pH, CO_3^{-2}, and HCO3-.

The urbanization process has always changed the quality and quantity of the local aquifer systems in various ways. Considering the changes in the hydrological cycle due to urbanization, it is important to study the effect of urbanization on local water resources and especially, on easily available groundwater sources in proximity [7]. Mostly surface water bodies are vulnerable to contamination and affecting the groundwater resource quality when there is an interconnection between surface water and groundwater. Hence, discharging of untreated industrial and municipal wastes to surface water increase with increasing urbanization and deteriorates and degrades the water quality [30].

The chemical pollution of groundwater with heavy metals caused by two factors, one is from the rock or sediment which contained heavy metals, and the other case is some particular feature of the water or the aquifer which allows the contaminant to build up to significant levels [29]. Soils and rocks that are porous and permeable tend to transmit water and certain types of contaminants with relative ease to an aquifer below. Even though, trace metals are found in the earth's crust, contamination in groundwater could be an outcome of natural and/or anthropogenic sources.

have made the hydrogeological investigation of the Upper has Middle Borkena River catchment. The study was aimed at assessing the general hydrology, water balance, and hydrogeology of the catchment. The study showed the pollution was there, and bacteriological and trace element analysis was recommended to make sure the danger from a pathogenic organism and trace elements is safe.

examined the dissolved metals: chromium, zinc, copper, and lead in the effluents of five industries with the aim to the quantifying the metal concentrations and loadings from these industrial effluents [31].

Made numerical groundwater flow modeling of the Kombolcha catchment in northern Ethiopia. The study was aimed to develop a numerical groundwater flow model using MODFLOW-OWHM and showed that the sources of groundwater inflow to the Kombolcha aquifer system are direct rainfall, recharge from mountains, subsurface inflow (zonal through faults and fractures), and seepage from the Borkena River.

Aimed to carry out a comprehensive appraisal of the quality of groundwater resources using the water quality index (WQI) technique to assess its suitability for drinking and the irrigation water quality of surface water and groundwater. However, the present study focuses water quality with respect to heavy metals [32].

Studied pollution of surface water, soil, and vegetables: Challenges to growing cities of Bahir Dar and Kombolcha, Amhara Region, Ethiopia. The study elaborated that the maximum permitted metal concentrations in leafy vegetables, soil, and surface water were higher for zinc, iron, manganese, nickel, and lead. The studies also have shown that the Borkena River is highly contaminated due to untreated and/or partially treated industrial and domestic effluent discharge from the factories and city. The studies recommended conducting heavy metals concentration analysis in industry effluents for future work to quantify the types and strength of the pollution in detail, and to predict its impact on the environment.

Has examined the concentration of cadmium, chromium, and lead from industrial wastewater in Kombolcha town using FAAS. The author assessed the concentration of heavy metals from the effluents, streams, and plants and got that the concentrations are above the maximum permissible limits.

He concluded that the concentration of chromium was higher than cadmium and lead in treated and untreated wastewater of tannery industry. In BGI brewery, however, the level of cadmium and chromium were higher after treatment than before treatment. This might be due to the internal corrosion of wastewater pipe that has been used. In the case of textile industry concentration of lead was higher than chromium and cadmium both in untreated and treated. The concentrations of trace heavy metals in treated effluent have exceeded the recommended values of EPA of Ethiopia and WHO. However, from the overall aspects of the study, the treated effluent was considered unsuitable and cannot be used as an alternate means of irrigation purpose.

estimated the combined loads of diffuse and point-source pollutants into the Borkena River and this study showed that higher nutrients downstream compared with the rivers' upstream. The study recommended More studies are needed to understand the influence of effluent and treatment technologies of the factories in Kombolcha city [13].

Determined the total chromium and chromium species in Kombolcha Tannery wastewater, surrounding soil, and lettuce plant samples. The total Cr species determined in the sample collected from the discharging point were much more concentrated than the downstream sample (at a distance of400m from the junction point) due to adsorption by various plants in the watershed classical treatment method and dilution as the wastewater joins the river [33].

Due to the release of wastewater from the town to the river, boron concentration was found to be higher than the allowable irrigation limits at Borkena River and analysis results of vegetables also showed that cabbage accumulated more Fe at Kombolcha agricultural areas [12]. Furthermore, in the leafy vegetables, high concentrations of Zn, Fe, Mn, Ni, and Pb were detected. It also was found that the chemical parameters in irrigation water had accumulated and modified the soil characteristics of the farmlands, and higher soil pH values were found in irrigated farmland soils [34].

In Ethiopia, most industries and urban areas are located near rivers/streams and in areas that have greater potential to easily access sufficient waters for their demand and to dispose of their untreated and partially treated wastewater into them. Likewise, in Kombolcha town the industrial Therefore, this review is aimed to assess the different journals on the quality of groundwater and surface water concerning industrial effluents

Table 1: Summary of Characteristics of some of the Studies on Industrial Effluents Impact

S/N	Author with Year	Topic of the research	Method	Results	Recommendation	Conclusion
1	[15]	Assessing the Industrial Effluent Effect on Irrigation Water Quality and Farm Soil near Kombolcha Town, Ethiopia	Statistical Analysis. Laboratory analysis	The mean values of CO_3^{-2} and HCO3- for downstream irrigation water were 1.75 mg/l and 10.22 mg/l during the dry period and 0.95 mg/l and 8.15 mg/l for the wet period. & Results were above the permissible limit of the FAO's irrigation standard. High alkalinity concentration in irrigation water causes Ca^{+2} and Mg^{+2} ions to form insoluble minerals, leaving sodium as the dominant ion in the solution	To alleviate the problem, industries should be forced to treat their wastewater to the standard.	The industrial effluent drained to the Borkena River has affected the quality of irrigation water and farm soil. River water quality of downstream showed higher concentrations of EC, Mg^{+2}, pH, CO_3^{-2}, HCO_3^{-2}, Cu, Cr, Cd, and TDS which were above the permissible limit of the FAO. soil analysis showed higher concentration of CO_3^{-2}, HCO^{3-} , Cr, Cd, and Ni which was above the permissible limit of the FAO
2	[2]	Assessment of Industrial Waste Load of River Borkena and Its Effects on Kombolcha Town and the Surrounding Communities	Laboratory analysis of river water and vegetables	The result showed that metal concentrations in leafy vegetables and irrigation water are within the permissible limits of FAO/WHO standards and not significant for the time being, but is expected to be a challenge in the near future if not well addressed.	Fills the gaps in information for concerned regional and federal governmental offices and may use it as an input to design regulations and policies which benefits the communities in the watershed. The local authorities should make provisions for task forces to ensure strict compliance by the factory on water quality standard.	The data clearly shows that the downstream is more polluted than upstream. The continuous monitoring of the soil, vegetable plant and irrigation water quality are prerequisites for the prevention of potential health hazards to human beings.
3	[35]	Assessment of Heavy Metals in Borkena River in South Wollo Ethiopia	Laboratory analysis, Physical observation,	The highest concentration of both toxic metals, Pb and Cd, were released from KOSPI. Only Pb was found in BGI and Textile waste effluents. The least polluted effluent both in quality and quantity discharges out from textile. The concentrations of each metal ion in the river at the site just after the junction point of the drain system were found much higher than the other site.	Agricultural activities, such as use of excessive number of fertilizers, pesticide and contaminated water for irrigation causes contamination of crops. Thus, the Pb and Cd contamination of BOAE by industrial wastes at Kombolcha should come from their applicability in the nearby industries	Borkena River water gets polluted highly due to toxic metals Pb and Cd when it reaches Kombolcha. The quality of the river water is not safe for domestic use. The largest contributor of the pollutants Pb and Cd was **Kombolcha steel products industry**. Kombolcha brewery and Kombolcha textile factory was the second and third in their lead content,

4	[16]	Urban impact on ecological integrity of nearby rivers in developing countries: the Borkena River in highland Ethiopia	laboratory analysis	At the urban-impacted sites, dissolved oxygen was also depleted to 0.5 mg/l and BOD5 values were reached to a level of above 1,000 mg/l, with extremely low biological diversity of pollution-sensitive taxa. These patterns are the result of a combination of rampant dumping of untreated wastes exacerbated by geologic, topographic, climatic and land use factors	The mean concentrations of ammonia, nitrate, chloride, BOD5, total phosphate, conductivity and turbidity were more elevated at all sites than at the upstream	The Borkena River obtains high pollution levels and its water quality deteriorated as a result of untreated domestic and industrial wastes discharged by the towns of Dessie and Kombolcha,
5	[33]	Determination of (total Cr), Cr (III), and Cr (VI) in Kombolcha leather industrial wastewater and the surrounding (soil and lettuce plant) samples, South Wollo, Ethiopia,	FAAS, UV/V is spectrophotometer, Lab and physical Observation	Among all samples taken, the maximum amounts of total Cr, Cr (III), and Cr(VI) were obtained at the discharging point and the minimum amounts of total Cr and Cr(III) were found downstream (400 m from the junction)of Kombolcha leather industrial wastewater. The amounts of total Cr in all samples except soil sample were above the permissible limit as set by WHO/FAO	Effective treatment methods should be applied to the wastewater for the well-being of the surroundings.	The result showed that a remarkable elimination of total Cr and Cr species has not been achieved by Kombollcha leather industry as its level was not much decreased when entered into the water systems
6	[36]	Studyon Physico-chemical Parameters of Waste Water Effluents from Kombolcha and Debreberhan Industrial Area, Ethiopia	laboratory analysis	PH, EC, TDS, Chlorides, Sulphate, Nitrate, Alkalinity, TSS, BOD and, COD are very high in concentration compared to the standards prescribed by WHO and EPA.	Such effluent should not be discharged in to the nearby water body or soil without treatment. They are unfit for irrigation. The high-level pollution of the industrial effluents cause's environmental problems which will affect plant, animal and human life	The physicochemical parameters studied in this work were varied between the samples and almost all parameters studied were higher compared with the permissible limit prescribed by the United States Environmental Protection Agency and World Health Organization.

7	[34]	Assessment of the Impact of Industrial Effluents on The Quality of Irrigation Water and Changes in Soil Characteristics: The Case of Kombolcha Town	laboratory analysis	The result showed that electrical conductivity, sodium, chloride, bicarbonates, boron, pH and SAR concentration were found to be higher in the effluent-mixed irrigation water of the Worka River The increased level of sodium in the lower areas and farmland soils can be attributed to the presence of caustic soda, which is used for washing, in the effluents of the textiles, ELFORA meat processing and BGI brewery factories Higher soil pH (9.08–9.36) values were found in the Leyole River irrigated farmland soils. Such values of pH in farm soils may have a profound effect on availability of plant nutrients like iron, manganese, zinc, copper and cobalt, which are less available at pH>8.5	Soil permeability problems (excessive Na+ and SAR) can be improved by blending the fresh water of the Borkena River with the effluent-contaminated water, particularly in the Leyole River. Reports from the town's health office (2006) indicate that the nearby community is frequently exposed to upper respiratory tract infection, asthma, malaria and skin diseases. Studies also need to be conducted on the emission value of particulate matter into the surrounding air to assess their clear impact on health. Since Kombolcha has been chosen as a city of industrialization by the Federal Government of Ethiopia, stakeholders must focus on preparing an appropriate industrial waste management strategy	It is found that the waste from the Kombolcha factories has substantially changed the irrigation water quality of the two tributaries of the Borkena River. It has also resulted in an increment of some chemical elements in the soil of the irrigated farmlands. EC of the Leyole and Worka rivers was found to be slightly restricting. Based on Ayers' (1977) prediction, if irrigation water is used continuously the prevailing EC values might cause a potential 10% decline in yield in which is a major growing vegetable in the town. Leaching is needed to avoid the associated associated long-term risks.
9	[32]	Evaluation of groundwater and surface water quality suitability for drinking and agricultural purposes in Kombolcha town area, eastern Amhara region, Ethiopia	WQI, Suitability, lab analysis dry season (May 2017) and wet season (Nov, 2017)	most of the groundwater and surface water samples were suitable/excellent for irrigation with some places in the study locations that belong to the good and permissible. The higher concentration of Na+ and Cl− is observed from the groundwater sample located within the Tannery Factory), surface water WS (effluent discharged from BGI-Brewery Factory) and surface water sampled from Eyole stream where it gets discharge from Tannery Factory and ELFORA-Meat Processing Fac tory	The result of the study suggests there is urgent need for systematic monitoring along with remediation to reduce pollutant inputs and by developing functional sewage treatment plant. It is suggested to exercise all the necessary precaution before the water is used for drinking and irrigation. Otherwise, it may lead to much adverse health effect.	Effluents from the different factories and industries of the area are the main cause for pollution of groundwater and surface water.

10	[12]	Pollution of Water, Soil and Vegetables: Challenges to Growing Cities of Bahir Dar and Kombolcha, Amhara Region, Ethiopia	Interview, laboratory Analysis field works were	The concentrations of heavy metals in soils samples for Kombolcha sites were found to be within the permissible levels. The results of vegetable analysis indicated that cabbage accumulated more Fe at Kombolcha.	Raising awareness of the public on environmental health is critically important.	proper environmental monitoring and reclamations should be done to avert adverse effects on the environment
11	[3]	Evaluating the effect of diffuse and point source nutrient transfers on water quality in the Kombolcha River Basin, an industrializing Ethiopian catchment		Emissions from brewery and meat processing were rich in nutrients (median TN: 21–44 mg L−1; TP: 20– 58 mg L−1) . The Kombolcha factories, especially the brewery, meat processing, the textile factory, provided considerable TN and TP discharges into the Leyole and Worka rivers, exceeding, for some or all of the time, emission guidelines (EMoI, 2014) of 40 and 5 mg L−1 for TN and TP,1 respectively Nutrient concentrations in the rivers exceeded environmental quality standards for aquatic life protection, irrigation, and livestock water supply.	Attention is needed to fill gaps in monitoring of nutrient pollution in rivers and use information to reconcile development with land use and its degradation	Future development plans for industry and agriculture present a major risk for surface water quality. Human resources, expertise, and infrastructure remain a major gap in monitoring, so attention to greater, and verifiable, use of land and water quality models is of major importance to guide monitoring and management The impact of nitrogen and phosphorus on surface water quality is an increasing problem in developing countries [8].
12	[28]	Bioadsorption and membrane technology for reduction and recovery of chromium from tannery industry wastewater	saw dust, coffee husk and eucalyptus bark was used as adsorbent material.	Chromium plays dual role for industry and environment, one side it is important to im- prove the quality and second side it damages the life. To come out from this problem sub- stitution will be required to maintain both the faces. carry out the experiment for reduction and then recovery of chromium from tannery wastewater	So it is mandatory to treat the wastewaters before discharge treatment of chromium and recovery of chromium are possible with specific condition and parameters.	eucalyptus shows 99% of adsorption at pH 4, contact time 240 min and mass load- ing 3.5 g/l. Recovery of chromium was carried out with three different types of membrane among them AFC 99 reverse osmosis membrane shows 99.9% of recovery at optimum pH 6.8, inlet flow rate 0.72 m3 /h, working pressure 40 bars.

13	[37]	Assessment of Major Sources Controlling Groundwater Chemistry in Kombolcha	Gibbs diagram, correlation analysis, scatter plots of ionic molar ratio relations, saturation index values	The strong correlation Ca^{2+} and Mg^{2+} in the dry season and Ca2+ and Na^{+} in the wet season with HCO_3^- could be an indication of silicate weathering and ion exchange processes. The correlation of Ca^{2+} with Cl-, NO_3^-, PO_4^{3-} and F- is very strong and ranges from 0.8to 0.93, NO_2^- with K^+, Mg^{2+} and PO4 3- ranges from 0.74 to 0.84, PO_4^{3-} with F- (r=0.99), and NO_3^- with Na^+, Cl^-, HCO_3 - ranges from 0.89 to 0.97 and is very high. This could result from the poor sanitation municipal and industrial liquid wastes, and agricultural activities like fertilizer, pesticides and herbicides	Liquid waste treatment problems may be the main source of the anthropogenic effects in the area and the author recommended to the administration of the town that all liquid wastes from the industrial should be treated and controlled.	The chemical composition of groundwater of the study area is strongly influenced by rock water interaction and weathering of silicates minerals as well as ion exchange processes The hardness of the groundwater is almost similar in both wet and dry season. Results shows that most of the Waters fall under moderately hard and hard category and 16.7% of the waters fall under very hard group. No water was grouped as soft water.

Conclusions

From Table 1, all the topics reviewed are relevant to Impact of Industrial effluents on Surface Water, Groundwater and Soil. Previous studies by authors showed that pollution arises from Industries from different land uses into nearby surface water bodies. Various authors were of convergent view that surface water parameters such as PH, BOD, COD, TDS and turbidity varies with season of the year (i.e.) dry and rainy season.

Rapid industrialization have resulted in serious point source water contamination in the near industrial area socio-economic and ecological values. The majority of the factories in the basin lack wastewater treatment facilities, simply discharge their toxic wastewater into nearby rivers. There is also untreated domestic discharge. Exept Textile Factory in Kombolcha, they haven't built any treatment plants, nor have they set up suitable storage or discharge pathways for their waste [3,15]. had similar view that BOD and COD of surface water has reduce because of the quantum on organic and inorganic wastes deposited inside rivers [37]. Authors such as have unity of opinion that sensitizing people on the dangers of dumping refuse inside the river should be adopted for to reduce the level of pollution and contamination in surface water bodies while others were of the view that task forces should be employed to ensure strict compliance by the natives to maintain water quality standard [28].

Generally, it is of common knowledge that regions with high human population and high rate of industrialization tends to suffer more of surface water pollution because individuals and industries has a mindset that surface water bodies are dumpsite for disposing off their waste. This is because, in global context, many people see water body as industrial dustbin since they channel out their industrial effluents in them for easier waste discharge which is of great environmental cost.

Research Gaps

This review identifies several impact-related contaminated water research efforts, but it also identifies research gaps. The most important relates to the scope and delimitation of the study. Much of the reports are either separate graduate thesis research limited to specific location and or time. Consequently, there is no thorough integrated spatial and temporal water quality impact mapping to portray the overall picture of the sub watershed or the entire basin. There is little evidence-based research on the effects of contaminated water on agriculture, health, and socioeconomics. There is limited research on the socio-economic effects of water contamination and their estimated costs, human and animal health-related impacts of contaminated water and all vegetables species grown by contaminated river waters.

Recommendations

From the reviewed literatures and based on the results the following recommendations are made not only to enhance the water quality and the environment, but also to protect the health of the people who depend on these ground and surface water bodies for their living:

1. Management plan to restrict the dumping of wastes into surface water bodies is needed in order to reduce the impact on water quality and pollution related health problems. This can be achieved through effective waste management strategy and provision of reliable public water supply
2. Regular monitoring exercises should be carried out by enforcement agencies and the locals on the activities along the river bank in order to ensure those effluents standards and other sanitary conditions are complied with.
3. Regulators of environmental and public health standards should put in place functional measures to enforce the already established standards not just only by punishing offenders, but also by rewarding/acknowledging compliance.
4. Regular review of environmental effects of surface water pollution should be conducted by researchers to indicate the trend in pollution loads of rivers, stream and lakes across the globe.
5. Treatment of heavy metals in industrially released wastewater is important to keep good environmental health, human and aquatic life. Unfortunately, the BGI Brewery industry of Kombolcha, Ethiopia does not have efficient treatment plant that treat heavy metals of wastewater discharge. So, it is expected to create awareness for an administrator of the BGI Brewery industry to use another treatment plant that treat the discharge of heavy metals.
6. The environmental agencies or other responsible bodies should control this by testing such discharges starting from its point source up to the way that can be diminished at maximum from time to time.
7. All the researchers believed that there studies are not complete and finalized. But it can be taken as an initiative or can be used as a base for further investigation of environmental pollution.

Generally, the studies in the area by some researchers have made studies on surface water pollution in the city [13,31]. A few have studied only physiochemical parameters [33,36] while few have studied the suitability of groundwaters and surface water for agriculture and drinking using a water quality index [32]. Therefore, researchers should focus working on the area as it has been done in addis ababa.

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