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Review

Impact of improper municipal solid waste management on fostering One Health approach in Ethiopia — challenges and opportunities: A systematic review

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ABSTRACT

Improper disposal of solid waste, predominantly illegal dumping, can lead to severe air and water pollution, land degradation, climate change, and health hazards due to the persistence of hazardous materials. As a result, it is threatening public and animal health, environmental sustainability, and economic development. The One Health approach, which acknowledges the interconnectedness of human, animal, and environmental health, offers a comprehensive solution. This systematic review examines the impact of improper municipal solid waste on fostering One Health approaches at the national level of Ethiopia by identifying key challenges and opportunities. Publications were retrieved from peer-reviewed, indexed journal publications, government documents (policies, proclamations, regulations, and guidelines), and credible non-governmental organization publications from selected electronic databases (Google scholar, PubMed, EMBASE, Global Health, Web of Science, etc.), and governmental offices. Despite efforts to advance the One Health approach in Ethiopia through the formation of the National One Health Steering Committee and technical working groups, implementation is hindered by challenges such as poor sectoral integration, insufficient advocacy, financial constraints, and limited research. These challenges contribute to worsening zoonotic and infectious diseases and environmental issues due to inadequate solid waste management. Nonetheless, opportunities exist through One Health integration via holistic programs, interdisciplinary collaboration, community engagement, policy enhancement, institutional capacity building, and public-private partnerships. Therefore, enhancing sectoral integration and increasing advocacy efforts and securing financial support is necessary to back waste management initiatives and related research. Further research is crucial to understand the impact of solid waste management and the potential benefits of the One Health approach in Ethiopia.

1. Introduction

Solid waste (SW) refers to any unwanted or discarded material that is not in liquid or gaseous form. This includes a wide range of items typically discarded by households, businesses, and industries [1]. It comprises various components categorized by their origin and characteristics, including municipal SW (MSW) (household, commercial, and yard waste), industrial waste (manufacturing by-products and construction debris), hazardous waste (chemical and biomedical waste), agricultural waste (organic residues and inorganic farming materials), electronic waste (discarded electronic devices and their components), mining waste (tailings and overburden), organic waste (food scraps and biodegradable materials), and recyclable materials (metals, plastics, glass, and paper) [2–4].

SW poses a significant threat to human health and the ecological environment because of its toxicity, mutagenic activity, and carcinogenicity [5]. It affects all spheres of life [6], making sustainable SW management (SWM) critical for urban management [6]. Effective SWM

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focuses on the collection, transportation, treatment, and disposal of these wastes while emphasises reduction, reuse, and recycling to mitigate environmental impacts [7,8].

The world generates 2.01 billion tons of wastes annually, and this is expected to rise to 2.2 billion tons by 2025 and to double by 2050 [9–11]. The increased interaction between humans, animals, and ecosystems has elevated the risk of emerging and re-emerging diseases, causing over one billion cases, a million deaths, and hundreds of billions of US dollars in economic damage annually [12].

Current MSW management (MSWM) practices in Ethiopia have severe health, economic, social, and environmental impacts [13–16]. Municipalities struggle to meet the demand for urban services [6,17], and the unbalanced waste management has exacerbated the issue [13,18]. Ethiopia suffers from poor MSWM [19,20] and inadequate sanitary conditions [21]. Consequently, the health status of the population is low compared with that of other low-income countries, primarily because of preventable infectious diseases and nutritional deficiencies [22,23].

Conversely, the One Health approach involves the collaborative efforts of multiple disciplines working locally, nationally, and globally to achieve optimal health for humans, animals, and the environment [24, 25]. This approach promotes interdisciplinary cooperation among researchers and practitioners [26,27], and advocates for a public health model that holistically deals with diseases affecting human, animal, and environmental health [26,28], facilitating timely and effective responses to public health threats at the human-animal-environment interface [28]. One Health offers a comprehensive solution by acknowledging the interconnected nature of health across these domains, aiming to improve health and environmental policies, expand scientific knowledge, enhance healthcare training and delivery, and address upstream public health issues [29]. Especially, over 80 percent of households in Ethiopia maintain livestock [12,26], making the country particularly vulnerable to zoonotic diseases because of the close interaction between livestock and humans. With the rising prevalence of endemic and emerging zoonosis and communicable diseases, One Health approach is increasingly recognized as effective for mitigating zoonotic risks at the human-animal-environment interface [26,29].

Effective waste management is crucial for primary prevention, enabling timely and effective containment and response to public health threats [28]. The poor SWM in Ethiopia poses significant health risks to humans and animals, degrades land and aquatic ecosystems, and undermines environmental sustainability [30]. Inadequate sanitation facilities and the impacts of anthropogenic activities on public health further degrade the ecosystems of Ethiopia's rapidly urbanizing centres [31].

Overall, MSWM is a major concern in Ethiopia, with significant implications for public and animal health, environmental sustainability, and economic development. The One Health approach, which emphasises the interconnectedness of human, animal, and environmental health, is essential to address these issues. This systematic review examines the impact of MSW in promoting the implementation of One Health approach in Ethiopia and identifies key challenges and opportunities. It highlights the weak MSWM practices and lack of integration of the One Health concept, noting the absence of national-level studies of the impact of MSW on fostering One Health approaches in Ethiopia (Figs. 1 and 2).

2. Methods

This systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [32,33] which is used by researchers predominantly [13,27,34,35]. The review aimed to evaluate the impact of MSWM on fostering the One Health approach in Ethiopia, addressing both challenges and opportunities. Secondary source documents, primarily in Amharic (the working language) and English, published post-2014, formed the foundation. This review retrieved peer-reviewed, indexed journal publications,

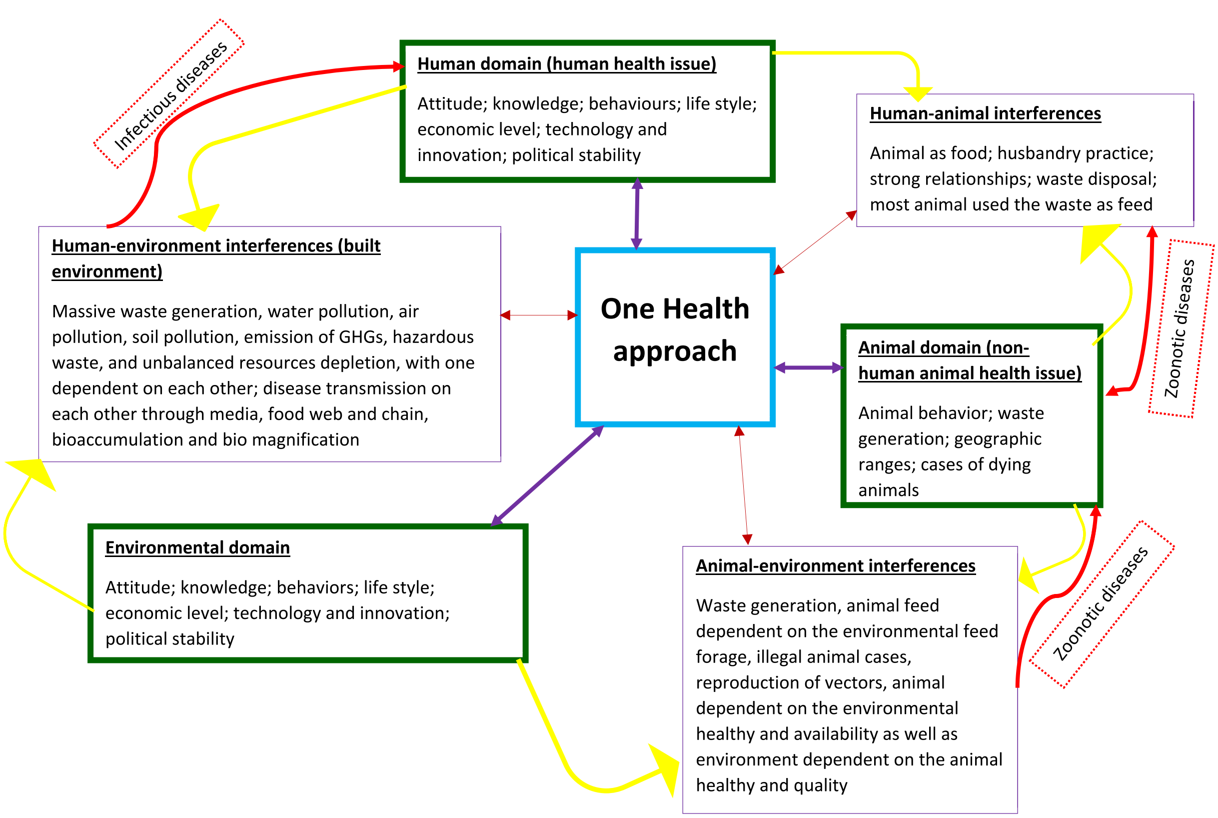

Fig. 1. The theoretical framework of the One Health approach, and the relationships across the human, animal, and environmental domains; Abbreviation: GHGs, greenhouse gases.

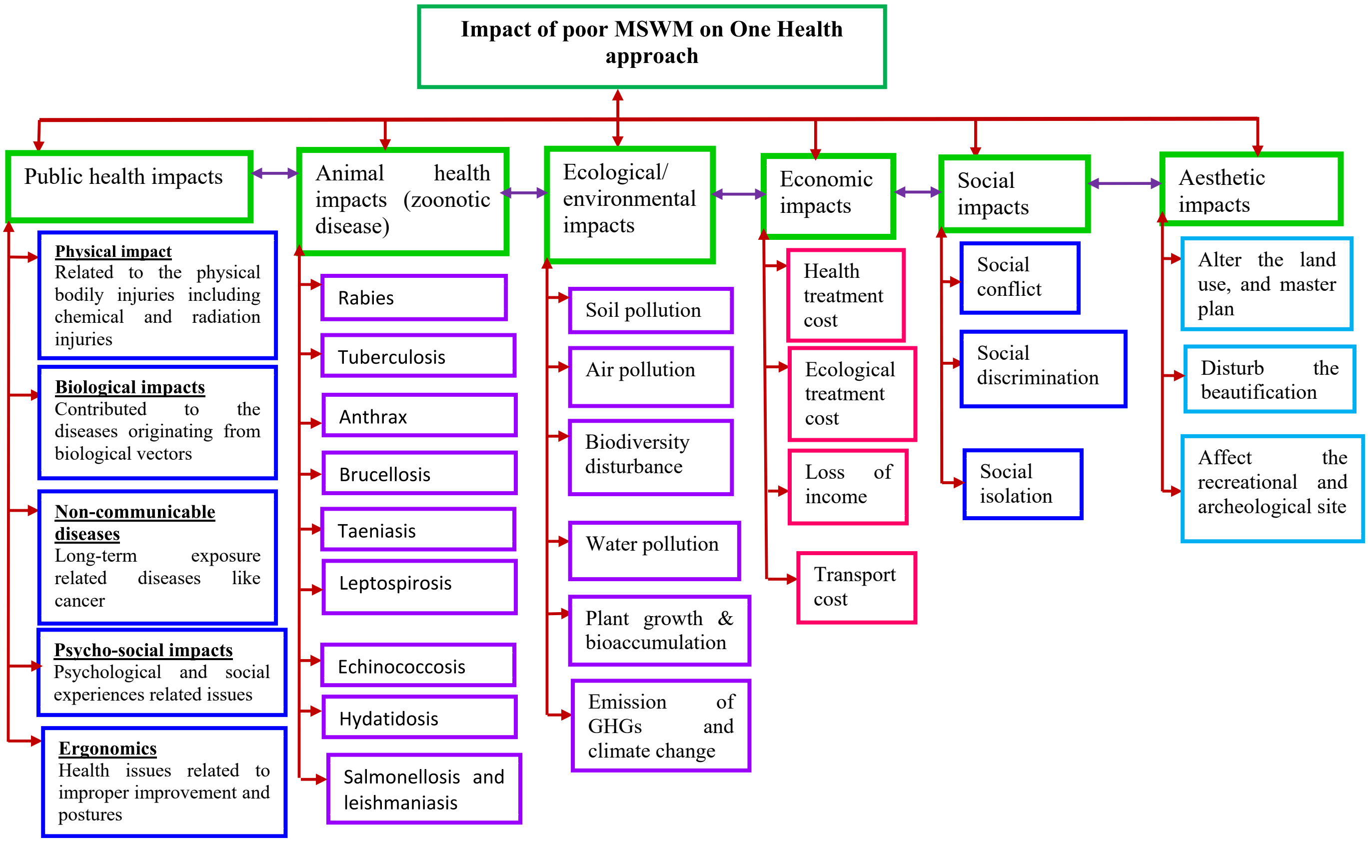

Fig. 2. Conceptual framework of poor MSWM on One Health approach. Abbreviations: MSWM, municipal solid waste management; GHGs, greenhouse gases.

governmental documents including policies, proclamations, regulations, guidelines, etc.), and credible non-governmental organization publications from selected electronic databases (including Google Scholar, Cochrane Library, African Journals Online [AJOL], PubMed, EMBASE, Global Health, and Web of Science, and from governmental offices (Fig. 3).

2.1. Selection of publications

This study followed a rigorous selection process. Topic relevance, content, scope, and publication date were screened initially. Irrelevant and duplicate content was excluded based on criteria including language (English and Amharic), availability of full text, title relevance, abstract content, study scope (focusing on MSWM practices, impacts on human and animal health, environmental health and sustainability, and the role of One Health in combating infectious and zoonotic diseases), and publication date (post-2014).

As shown in Fig. 3, the online database search yielded 275 records. One hundred eighty-five studies were removed through a step-by-step process for the following reasons: 75 were determined to be irrelevant by title and abstract, 85 were duplicates, 23 had unavailable full texts. Therefore, 92 published reports were assessed for eligibility and included in the quantitative analysis.

This study independently reviewed the selected documents and discussed and evaluated their titles, relevance, and abstracts to ensure that they met the criteria (focusing on the questionnaire checklist). The full contents of the selected papers were then scrutinised to confirm their alignment with this review's objectives: high relevance to MSWM and the One Health approach in Ethiopia, published in reputable journals, as up-to-date as possible, and written in English or Amharic.

This study developed a questionnaire checklist to guide reviews and the selection of relevant documents:

1. What is the MSWM practice in Ethiopia?
2. What are the common impacts of MSWM on One Health (human, animal, environmental health, and sustainability) in Ethiopia?
3. What are the challenges faced by MSWM in fostering a One Health approaches in the country?
4. Are there any opportunities for MSWM to foster One Health approaches in Ethiopia?

Using these questions, relevant journals were selected and analysed to address the issues raised.

Inclusion criteria: Studies related to the impact of improper MSWM on fostering One Health approaches in Ethiopia, which meet one or more of the above research questions and are published either in English or Amharic after 2014.

Exclusion criteria: Studies that are not related to the impact of improper MSWM on fostering a One Health approach in Ethiopia, not available in full text, meet none of the research questions, or published in languages other than English and Amharic.

2.2. Quality and risk of bias assessment

Quality and risk of bias assessments are essential in any systematic review to ensure the reliability and validity of the included studies. Quality assessment involves scrutinizing the methodological rigor of the included studies to ensure robust and well-conducted research [36]. The quality of the cohort and cross-sectional studies was assessed using the Newcastle–Ottawa scale [37,38]. Key criteria, such as study design,

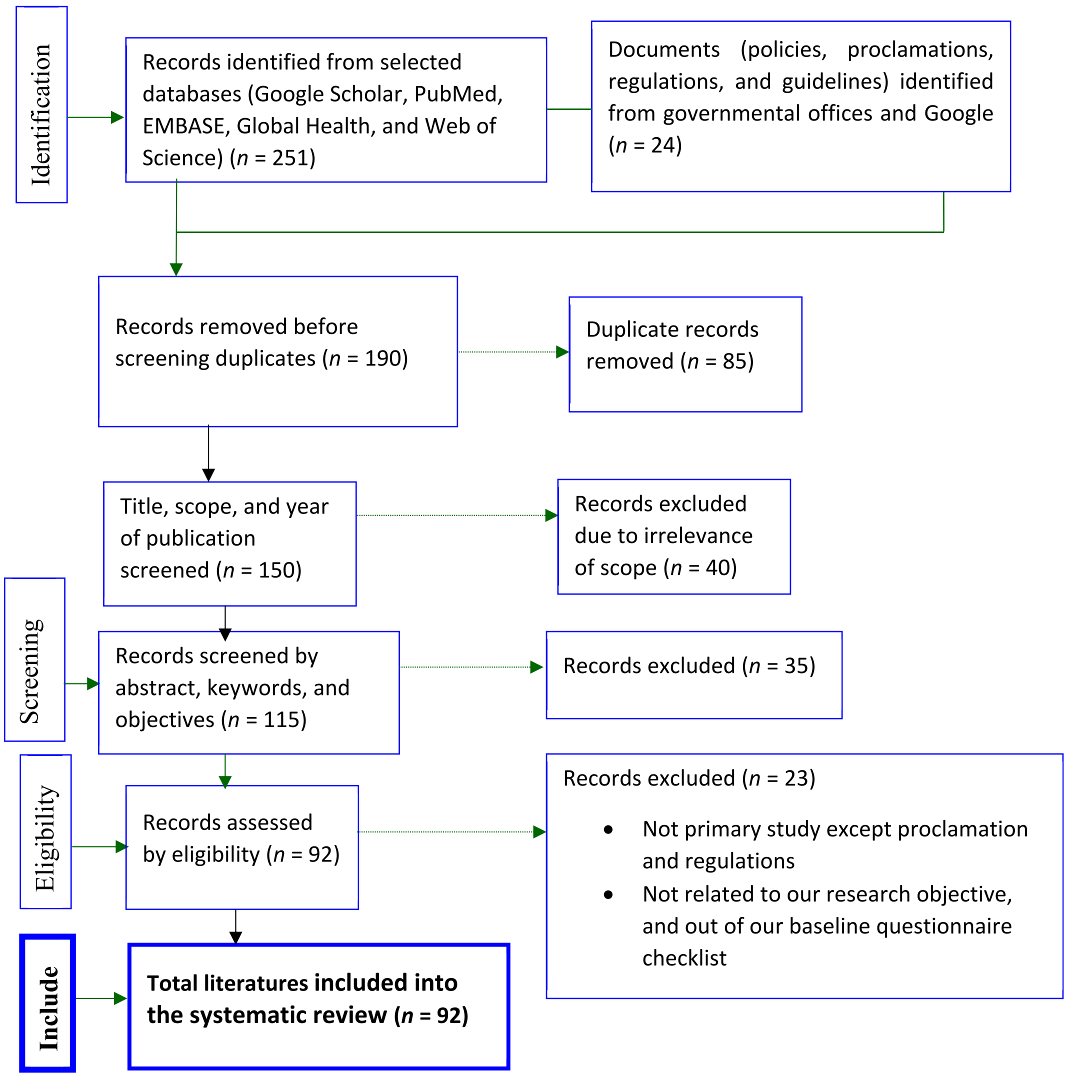

Fig. 3. The flow chart for the selection and screening of documents for this study.

sample size, data-collection methods, data analysis, outcome measurement, and reporting transparency, were assessed. The studies were then scored (rated) for quality control. The maximum score was 9 points, and literatures scored $\geq$7 were considered as high, 3–6 as moderate, and $<$3 as low quality. For the purpose of this study, we included literatures with high to moderate quality.

In addition, risk of bias assessment identifies potential biases that could distort the study results, ensuring that the findings are not systematically skewed. Various types of bias including selection bias, performance bias, detection bias, attrition bias, and reporting bias were evaluated using the tools of ROBINS-I for non-randomized studies, and low risk of bias was detected. Overall, this study had lower risk of bias and higher methodological quality.

3. Results and discussion

3.1. Current status of MSWM practice in Ethiopia

In Ethiopia, a significant proportion (70%) of SW is disposed of illegally in drainage systems (as shown in Fig. 4), roadside areas, rivers, common lands, and open dumps [23]. This leads to the scattering of hazardous waste, biomedical waste, and bio-degradable and non-biodegradable materials that persist in the environment for hundreds of years [39].

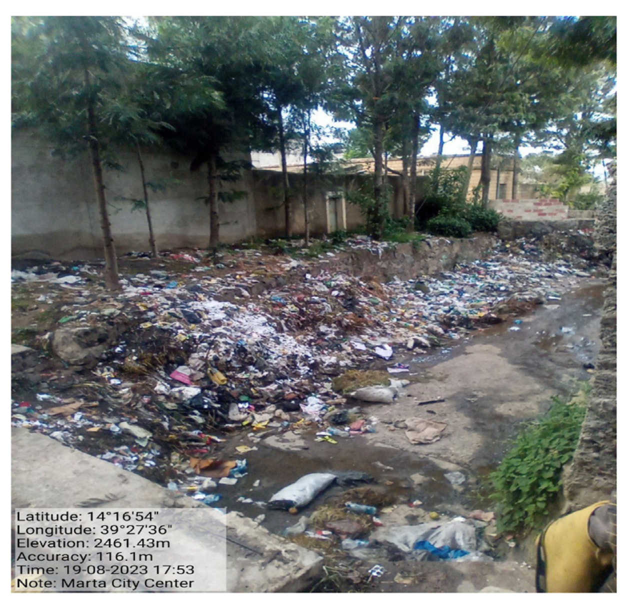

Fig. 4. Poor solid waste management and disposal at the drainage and rivers in Adigrat town, Tigray, Ethiopia. (photographed by the authors).

Effective SWM requires strong political commitment, adequate budget allocations, a well-trained workforce [40], a clear regulatory framework, SW reduction strategies, infrastructure development [41], public awareness and education, effective collection and transportation, proper disposal and treatment, stockholder collaboration, and evaluation and monitoring [42].

Proper and integrated MSWM is vital in urban areas due to its multifaceted benefits. It plays a crucial role in preventing the spread of diseases by ensuring that SW is collected, segregated, and disposed of in a manner that does not attract pests or rodents which are common carriers of pathogens. Additionally, proper MSWM significantly reduces pollution by preventing the release of harmful gases from burning waste and avoiding the contamination of water and soil from improperly disposed materials. By maintaining cleanliness in urban environments, it enhances the quality of life and the visual appeal of cities [19,43]. Integrated MSWM also promotes resource recovery by encouraging recycling, composting, and energy production, thus conserving natural resources and fostering a circular economy. Moreover, the sector creates employment opportunities, particularly in waste collection, recycling, and energy generation, contributing to economic development [30,43–45]. Overall, an effective MSWM system is essential for urban sustainability, protecting public health, preserving the environment, and supporting economic growth.

However, MSWM practices in Ethiopia are generally poor [13,19,20] with inadequate waste segregation and treatment of infectious materials [46]. MSWM practices in Addis Ababa from 2016 to 2020 revealed minimal efforts in waste segregation at the source [15], and the sanitation services in Addis Ababa are notably deficient in terms of status, spatial coverage, and waste-management facilities [47].

Ethiopia faces challenges in delivering effective and efficient SWM services owing to socio-economic constraints, infrastructural limitations, and cultural factors [48]. Weak institutional capacity and governance [49], along with a lack of trained personnel and inadequate service delivery, exacerbate this situation [47]. The implementation of SW segregation practices is generally ineffective, highlighting the need for comprehensive public awareness campaigns and community-level training initiatives [50]. Efforts should focus on enhancing the knowledge, attitudes, and behaviours of households and residents regarding proper SWM practices [51].

The adverse health effects associated with improper SW handling are significant and varied. For instance, the open burning of waste releases harmful particulate matter, dioxins, and other chemicals into the air, contributing to respiratory issues such as asthma and bronchitis [1,52]. Accumulated waste, especially in unmanaged dumps, creates breeding grounds for vectors such as mosquitoes and flies that can transmit diseases such as malaria and dengue fever [31,45]. Additionally, leachate from decomposing waste can contaminate water sources, leading to waterborne diseases such as cholera and dysentery [53–55]. Improper disposal of hazardous waste also results in soil contamination, impacting food safety and potentially causing cancer and neurological disorders [27,47]. Moreover, decomposing waste emits unpleasant odours that can worsen respiratory problems and lead to stress-related health issues [56]. Effective MSWM practices like implementing regular waste collection, safe disposal methods, recycling, and composting is crucial for mitigating these health risks, ensuring a healthier urban environment, and enhancing urban liveability [30].

Unfortunately, a significant number of households engage in improper SWM practices such as backyard disposal, roadside dumping, and burning, which can severely impact the environment, animal health, and public health [57]. In Assela, a study found that 82.8% of households practiced improper SWM because of insufficient knowledge and lack of access to door-to-door waste collection services [58]. Similarly, in Blue Hora, open-air burning (42%) and open-field dumping (36%) are the predominant waste disposal methods, indicating the prevalence of traditional and inappropriate SWM practices [39].

Despite legal provisions such as Ethiopian Proclamation No. 300/2002, which mandate the use of sound technologies to minimise waste generation and facilitate recycling, difficulties persist in enforcing these regulations effectively [59]. Issues such as poor awareness among residents, inadequate waste segregation at the household level, and lack of proper landfill facilities contribute to ongoing problems in SWM [60]. A study in Debre Birhan revealed that the potential for recycling and integrated MSWM activities remains largely untapped owing to deficiencies in financial, technical, and personnel capacities and the absence of well-designed dumping or landfill sites [61]. Consequently, urban residents are vulnerable to air pollution and surface and groundwater contamination [61,62].

Poor SWM in Ethiopia is a major contributor to both air pollution and surface and groundwater contamination. The open burning of household and industrial waste releases particulate matter ($PM_{2.5}$ and PM_{10}) that can cause severe respiratory and cardiovascular issues. The decomposition of organic waste in unmanaged landfills emits methane (CH_4), a potent greenhouse gas (GHG), and carbon dioxide (CO_2), both of which contribute to climate change and deterioration of air quality [63]. The breakdown of organic SW and burning of plastics release volatile organic compounds [63,64], which contribute to the formation of ground-level ozone and smog, further exacerbating respiratory problems. The incomplete combustion of SW, especially plastics containing chlorine, produces highly toxic dioxins and furans, posing serious risks such as cancer and immune system damage. Ammonia released from the decomposition of food and animal waste also contributes to secondary particulate matter in the atmosphere.

Surface and groundwater contamination poses significant threats due to leachates from poorly managed landfills [65], which introduce harmful substances into water bodies. Surface water contamination often occurs when rainfall runoff carries improperly disposed solid waste from open dumps or streets into rivers and lakes, polluting them with plastics, chemicals, and organic matter [22,62]. Direct dumping of solid waste into water bodies, particularly in areas lacking formal disposal infrastructure, aggravate the issue. Erosion from poorly managed landfills during heavy rains can also allow solid waste to slide into water bodies, degrading water quality further. Groundwater contamination arises from leachate formation, a liquid produced when water percolates through solid waste in unlined landfills or dumps [2,31,40,47]. This leachate contains harmful substances like heavy metals, pathogens, and organic pollutants that can seep into the ground and pollute groundwater. Pollutants from surface waste, as a result of improper disposal of electronic waste and industrial materials, can infiltrate the soil over time, contaminating groundwater with nitrates, phosphates, and toxic chemicals that accumulate in aquatic ecosystems and the food chain. Nutrient runoff from agricultural and sewage solid waste leads to eutrophication, depleting oxygen in water and harming aquatic life [55,65]. Chemical contaminants from hazardous waste further compromise water quality, making it unsafe for consumption and agriculture. Pathogens from untreated sewage and healthcare waste contaminate water sources, resulting in waterborne diseases such as cholera and typhoid [46,53,55,65]. To address these challenges, substantial improvements in solid waste management practices are essential, including proper segregation, recycling, safe disposal, treatment, and the development of infrastructure that can effectively mitigate these environmental impacts.

In Gambella, poor MSWM practices persist owing to impediments such as a lack of skilled workers, open burning of waste, limited community awareness, malfunctioning equipment, inadequate collection systems, insufficient budget allocation, and illegal dumping [66]. Studies conducted in Addis Ababa identified several factors contributing to the city's inadequate MSWM performance, including shortages of waste-collection trucks, poorly designed collection routes and schedules, low public awareness, and inadequate involvement of the private sector and community [41,67]. Technical issues such as inadequate and malfunctioning operational equipment, open burning of waste, poor

Table 1
Proposed effective strategies based on One Health framework to address the interactive impacts across human, animal, and environment.

Proposed strategies	Explanation of the strategies	Rationale
Integrated SWM Systems	Implement comprehensive SWM systems that integrate the collection, segregation, recycling, and disposal of waste from households, industries, agriculture, and healthcare facilities	Proper segregation and recycling to reduce the amount of SW sent to landfills, minimizing environmental contamination and protecting human and animal health
Environmental surveillance and monitoring	Establish continuous monitoring of environmental pollutants, including soil, water, and air quality, especially near waste disposal sites and populated areas	Regular monitoring can detect hazardous substances early, preventing their spread and reducing the risk of exposure to humans and animals
Community education and awareness programs	Develop and implement education campaigns to raise awareness about proper waste disposal, recycling, and the impact of solid waste on health and the environment	Empower communities with knowledge to improve grassroots waste management, reducing environmental and public health burdens
Regulation and enforcement of SWM laws	Strengthen and enforce SWM regulations, including household-level implementation of the "4R" principles and proper handling of hazardous waste, with penalties for non-compliance	Effective regulation and enforcement to ensure responsible waste-management, using SW as a resource, preventing illegal dumping, and minimizing environmental harm
Promotion of eco-friendly technologies	Encourage the adoption of eco-friendly waste-treatment technologies, including composting, waste-to-energy plants, and bioremediation techniques	Use eco-friendly technologies to reduce waste volume, convert SW into useful products, and detoxify hazardous materials, protecting the environment and public health
Zoonotic disease surveillance and control	Integrate SWM with zoonotic disease surveillance for disease outbreak focusing on areas where SW may attract vectors or reservoirs of disease (e.g., rodents and insects)	Proper SWM reduces habitats for disease vectors, lowering the risk of zoonotic disease transmission between animals and humans
Sustainable agricultural practices	Promote the use of organic waste as compost in agriculture while ensuring that waste does not contain harmful pollutants that could affect soil and crop health	Sustainable practices enhance soil health and productivity, reduce waste's environmental impact, and ensure safer food production for humans and animals
Cross-sectoral collaboration	Foster collaboration between health, environmental, agricultural, and veterinary sectors to address waste-related impacts through the One Health framework	A multi-disciplinary approach to ensure holistic interventions, addressing the interconnectedness of human, animal, and environmental health
Incentives for adopting the "4R" principles	Implement incentive programs to encourage individuals, businesses, and industries to adopt the "4R" principles, prevent waste generation, and embrace sustainable practices	Incentives to motivate stakeholders to engage in "4R" principles efforts, leading to a cleaner environment and healthier communities
Research and innovation	Invest in research to explore SW's impact on One Health and develop innovative SWM solutions that prioritize the health of humans, animals, and the environment	Continuous research offers new insights and technologies to enhance SWM practices and address emerging challenges

Abbreviations: SW, solid waste; SWM, solid waste management. Note: "4R" principles, Reduce, Reuse, Recycle, and Recovery.

conditions at disposal sites, and littering around skip areas also intensify these problems [13,19,68].

Despite these setbacks, the high organic content of the waste highlights the importance of frequent collection and presents an opportunity to prioritise organic waste recycling through composting as a viable SWM strategy [48,57]. To this end, a series of SWM strategies were proposed in this study (Table 1). However, the efficiency of waste composting and recycling remains low, and waste transportation and disposal management lack standardization and environmental soundness [43,69].

Under Ethiopian Proclamation No. 513/2007, Article 11(1), every household is mandated to separate recyclable SW from the waste designated for final disposal and transport it to designated collection sites [70]. Similarly, Proclamations No. 300/2002 and No. 513/2007 emphasise the establishment of integrated MSWM systems by urban administrations to ensure proper collection and transportation and, where feasible, recycling, treatment, or safe disposal of municipal waste, alongside frameworks to encourage investment in MSWM services [59,70]. However, in practice, challenges such as inadequate financial and human resources, insufficient political commitment [13], community knowledge gaps and irresponsibility [14,60], lack of source-specific waste segregation [71], institutional weaknesses and oversight gaps [49], limited service delivery, and a shortage of skilled labour [47] hinder effective SWM procedures.

Although Ethiopia's SWM policies, led by Proclamation No. 513/2007, Proclamation No. 300/2002, and the Environmental Policy of 1997 emphasise the "4Rs" (Reduce, Reuse, Recycle, and Recovery) and sustainable development [59,70,72], the country faces difficulties in its implementation owing to limited resources, infrastructure, and public awareness. Compared to developed nations like those in the European Union and the United States, where stringent regulations and advanced infrastructure support effective SWM [73], Ethiopia's system is still developing, similar to other developing countries facing enforcement and infrastructure gaps. While innovative approaches in countries such as Rwanda and India offer useful lessons [74–76], Ethiopia needs to strengthen policy enforcement, invest in infrastructure, and enhance public participation to advance its waste-management efforts.

Moreover, the increasing generation of MSW, coupled with a high proportion of organic waste and its improper disposal, contributes to GHG emissions such as CH_4 and CO_2 [77]. The current weak MSWM system results in the illegal disposal of waste in open spaces, roadsides, and drains [30], characterised by irregular, inadequate, and inefficient practices indicating sporadic collection, low coverage, technical deficiencies, and a lack of law enforcement [20]. Household environmental awareness regarding SWM issues remains low [33,78], contributing to improper practices, such as illegal dumping and the use of unsuitable landfills, owing to limited access to door-to-door waste collection services and infrequent waste pickups [60].

3.2. Poor MSWM-related environmental problems in Ethiopia

Unsustainable MSWM practices have profound negative impacts on ecological, environmental, and socioeconomic costs, including links to climate change and Sustainable Development Goals [79,80] as well as public health and environmental sustainability [30]. Studies employing various models to quantify GHG emissions, leachate production, and the eutrophication potential have revealed significant environmental impacts. For example, waste disposal sites emitted approximately 46 Gg of GHGs annually in 2020, whereas the eutrophication potential of organic waste reached 0.0594 kg N-equivalent or 59.4 g N-equivalent. The daily average leachate production amounted to 1112 mm annually, posing severe risks to human health, ecosystems, and overall environmental integrity [43]. Furthermore, physiochemical analyses at landfill sites have identified unacceptable components in leachate, including pH, hardness, and alkalinity, which contribute to soil and water contamination and adversely affect local vegetation [81].

In a word, in Ethiopia, SW pollution, especially in urban areas, leads to various environmental issues including land pollution through illegal dumping and landfill leachate [40,81], water pollution from SW contaminating surface and groundwater [1,53,54], air pollution from waste burning and CH_4 emissions, visual pollution from unsightly waste accumulation, and biological pollution that attracts pests and spreads diseases [7,53,82]. Improving SWM practices such as better collection, disposal, recycling, and public awareness initiatives are required to address these issues.

For instance, in Addis Ababa, improper disposal and inadequate collection of SW frequently leads to clogged drainage systems, exacerbating flood risks, diminishing the aesthetic value of green spaces, and increasing the prevalence of vector-borne diseases such as malaria, rift valley fever, and cholera. Additionally, these practices contribute to elevated concentrations of toxic heavy metal ions and microbial pollutants (coliforms and pathogens) in surface and groundwater, due to poor sanitation [83]. The concentrations of these toxic heavy metals and microbial pollutants in Ethiopia's surface water and groundwater vary significantly because of factors such as proximity to pollution sources, waste types, and environmental conditions. The commonly found heavy metals include manganese (Mn), chromium (Cr), nickel (Ni), cadmium (Cd), copper (Cu), zinc (Zn), and iron (Fe) with higher concentrations often found near industrial areas. For example, manganese levels range from 0.02 to 1 mg/L in surface water and 0.01–2 mg/L in groundwater [84]. Microbial pollutants, such as total coliforms, faecal coliforms, and pathogens like *Giardia* and *Cryptosporidium*, also vary widely with higher levels near septic systems [85]. Surface water typically exhibits higher contamination levels than groundwater [53,84,85]. These concentrations often exceed the health guidelines set by organisations such as the World Health Organization, emphasising the need for detailed site-specific water quality assessments in Ethiopia.

Toxic heavy metals, such as Mn, Cr, Ni, Cd, Cu, Zn, and Fe, along with microbial pollutants, such as coliforms and pathogens, can have serious toxic effects on human and animal health and the environment [84,85] when present in surface water and groundwater at significant concentrations. These metals can cause neurological issues, organ damage, and cancer and disrupt aquatic life, while microbial pollutants can lead to waterborne diseases and environmental degradation [53,65,84,85]. Managing and monitoring these contaminants is essential for preventing long-term health risks and protecting ecosystems.

Poor MSWM practices result in air and water pollution, land degradation, CH_4 emissions, hazardous leachates, and consequential impacts on climate change [30]. The continuous release of toxic gases into the atmosphere increases environmental and public health costs, disproportionately affecting marginalised social groups [30,86].

Research in Assela has shown that poor SWM causes environmental pollution (34.2% water pollution, 31.6% air pollution, 13.4% soil pollution, and 20.8% global environmental problems) [86,87]. Other studies have investigated the environmental and health impacts of inadequate SWM practices in Assela [68,86,87]. Similarly, open dump sites for SW adversely affect soil and water quality and pose a risk to human and animal health via the food chain [21,88] and environmental sustainability [30]. Inefficient MSWM increases the accumulation of MSW in open lands, in open drainage systems, and in the vicinity of many households, causing nuisance and foul-smelling pools, environmental pollution through leaches from piles (water and soil), burning of waste (air pollution), clogging of drains, and the possible spread of anthropogenic diseases [39]. Hence, improper and weak MSWM causes hazards to ecological habitats, human health, and safety and affects the economic and social interactions of the whole community [11].

Environmental issues (environmentalism) are not yet fully integrated into the One Health approach in Ethiopia [26], and there is a lack of interdisciplinary cooperation, collaboration, and coordination between animal and human health practitioners in operationalizing the One Health framework [26,89]. One Health is uniquely poised to tackle the pressing challenges facing the 21st century—climate change, pandemics, neglected zoonoses, and biodiversity collapse—by providing a unifying theoretical framework essential for generating the evidence needed to overcome these issues [27]. However, despite interest by professionals in academic and non-academic institutions and organisations in implementing the One Health approach, culture constraints, lack of interdisciplinary training, understaffing and underfunding of institutions are major setbacks to the implementation of a One Health approach [26].

The One Health framework is particularly designed to address the management of hazardous and biomedical waste within the broader context of SWM, recognizing the interconnectedness of human, animal, and environmental health [80,90,91]. This approach emphasises the safe handling and disposal of SW that poses risks such as spreading infectious diseases, contaminating water and soil, and impacting ecosystems [28,89,92]. Key areas include the proper disposal of biomedical waste, management of hazardous materials, and the handling of organic SW to prevent zoonotic diseases and environmental contamination [25,28,93]. By integrating health perspectives across sectors, One Health promotes a comprehensive and collaborative approach to reduce the health risks associated with improper waste-management.

3.3. Poor SWM-associated human health problems in Ethiopia

There is a clear correlation between inadequate SWM and negative health outcomes [94]. Ethiopia grapples with frequent disease outbreaks, and approximately 80% are communicable diseases, which are largely preventable with basic sanitary measures, such as safe water supply, waste disposal systems, vector control, and hygiene promotion [22,54]. Ineffective SWM practices have been associated with significant environmental and health impacts [86], contributing to diseases such as acute respiratory infections, malaria, and diarrhoea [54].

MSW serves as a reservoir for potentially harmful microorganisms that pose health risks to hospital patients, healthcare workers, and the general public, causing gastrointestinal, respiratory, eye, and skin infections as well as diseases such as anthrax, meningitis, and influenza [95]. Appropriate MSW is essential for mitigating these risks to human and animal health and the environment [96]. A study in Assela revealed that poor SWM is associated with 49.5% of respiratory diseases, 18.2% of bronchitis cases, 15.8% of diarrhoea diseases, 14.8% of protozoan diseases, and 1.7% of cancer cases [86,87]. Similarly, studies in Addis Ababa identified typhoid, typhus, diarrhoea, common cold, and tuberculosis as major health issues resulting from improper MSWM practices in areas like Koshe “Lastic Suffer” [44,47]. Dysentery, common cold, and typhoid are prevalent among children because of improper waste handling in communities near Gondar University [45]. Furthermore, inadequate MSWM in Addis Ababa has been associated with health problems including typhoid, typhus, diarrhoea, common cold, and tuberculosis [87].

Dump sites for MSW also provide breeding grounds for mosquitoes, rats, carnivorous animals, and houseflies, thereby increasing the risk of infections and diseases such as parasitic infections, diarrhea, respiratory illnesses, asthma (bronchitis), and cancer [86]. Residents living near these sites face significant health risks from insects and animals that are attracted to the waste [39,41,45,54,86,87]. Moreover, studies examining the socio-economic and health status of street sweepers in Mekelle City and Addis Ababa have revealed occupational health challenges among MSW collectors. These workers suffer from allergies, cuts, respiratory issues, eye problems, musculoskeletal disorders, skin ailments, lower back pain, joint pain, coughs, asthma, and dysentery with deteriorating health conditions over time and inadequate access to medical care from employers [97,98].

3.4. Poor SWM-associated zoonotic diseases in Ethiopia

Zoonotic diseases are transmitted between animals and humans through direct or indirect contact, vectors, and the consumption of contaminated food [99]. These diseases pose significant threats to livestock industries and human health, and approximately 75 % of newly-emerged infectious diseases are zoonotic and influenced by anthropogenic, environmental, socio-economic, and climatic factors [89,100,101].

In countries where household income depends on livestock, there is a strong correlation between poverty and high burden of zoonotic diseases [12]. Ethiopia, with the second highest burden of zoonotic diseases in Africa, faces numerous animal diseases caused by bacteria, viruses, protozoa, and parasites [92]. Obstacles such as poor environmental protection and limited access to healthcare for humans and livestock contribute to the widespread transmission of these pathogens [102,103], posing additional strains on social bonds and protective networks [102].

Quantifying the exact percentage of zoonotic diseases caused by SW attributable to environmental factors is complex because of the interplay between various elements [104]. Nonetheless, research has underscored that environmental factors contribute significantly to the spread of zoonotic diseases associated with SW. Poor SWM practices, such as open dumps and improper disposal, foster environments that promote the breeding of disease vectors, such as mosquitoes and rodents, that transmit zoonotic diseases [105]. Additionally, climate and weather conditions, including temperature and rainfall, can facilitate the proliferation of these vectors and pathogens; for example, warmer temperatures and stagnant water from poorly managed SW can boost mosquito populations carrying diseases such as dengue fever and West Nile virus [93,104]. Leachates from decomposing waste can contaminate water sources and potentially spread waterborne zoonotic diseases if consumed by humans or animals [40,81,93,106]. Although exact figures may vary, improving SWM practices and addressing environmental conditions are crucial for mitigating health risks [105].

Ethiopia has committed to controlling prioritised zoonotic diseases such as rabies, anthrax, brucellosis, leptospirosis, and echinococcosis through a One Health approach [93,99], which also targets diseases such as Q fever, salmonellosis, and leishmaniasis [90,99]. Bovine tuberculosis, caused by *Mycobacterium bovis*, is a chronic bacterial disease that thrives in polluted environments and persists in acidic milk, making it a significant zoonosis among Somali pastoralists who consume unpasteurized milk [107,108]. Anthrax, a soil-borne bacterial disease, spreads through contact with the carcasses of infected animals that contain *Bacillus anthracis* [109]. These are one of the major zoonotic diseases that need to be tackled in Etheopia.

Recent studies have indicated significant knowledge gaps, unfavourable attitudes, and high-risk behaviours concerning zoonotic diseases [82,110]. Current methods for the disposal of animal carcasses in Ethiopia include burial, rendering, incineration, composting, alkaline hydrolysis, and emerging technologies. However, because of resource shortages and lack of awareness, these methods are underutilised, leading to widespread improper disposal in open spaces [111]. This practice significantly affects environmental, human, and animal health, contributing to about 75%–78% of the overall health, economic, social, and environmental impacts related to poor waste management from slaughter and animal production activities in Ethiopia [112].

Despite advancements, Ethiopia faces ongoing obstacles in implementing the One Health initiatives, as highlighted by Epiz [93], Erkyihun et al. [12], and Food and Agriculture Organization (FAO) [99]. Efforts include establishing a National One Health Steering Committee to enhance multi-sectoral communication, coordination, and collaboration, alongside Technical Working Groups tasked with developing disease prevention strategies, conducting joint disease surveillance, and prioritising zoonotic diseases. However the progress is slow due to persistent challenges, such as inadequate sector integration in data sharing and communication, insufficient institutionalisation of One Health approaches, limited community advocacy, inadequate government financial support, and restricted funding and research activities in One Health [93].

3.5. Challenges and opportunities of MSWM in fostering a One Health approach in Ethiopia

In Ethiopia, MSW contributes significantly to pollution and threatens the ecological balance, human and animal health, and sustainable development [48]. Existing limitations such as inadequate sanitary infrastructure [13,48], disease transmission, occupational hazards, health risks [40,97], and deficiencies in waste collection and disposal services [13] highlight the complexities of managing MSW. Factors such as insufficient human resources, limited research funding, and inadequate financial and logistical resources [12,13] further compound this issue [12,13].

Additional problems include inadequate governance and institutional capacity, inconsistent regulatory frameworks, and lack of coordination among government agencies [13,34]. Issues such as minimal financial and technological resources, coupled with variable political commitments [34,43,71], contribute to inefficiencies in MSWM. The increasing production of MSW, particularly organic waste, along with practices such as illegal dumping and open burning of garbage, exacerbates pollution and contributes to climate change through the release of GHGs into the atmosphere [77].

GHGs are gases in the earth's atmosphere that trap heat or radiation emitted by the earth (like CO_2, CH_4, N_2O, SF_6, O_3, CFCs, and H_2O, etc.) [113,114]. MSW generation rates and their management are closely associated with GHG emissions [115,116]. Owing to the rise in MSW production and the high percentage of organic waste, unscientific disposal method contribute to the release of GHGs like CH_4 and CO_2 into the atmosphere [77,117].

SW is particularly prone to GHG production due of its decomposition processes. Organic waste, including food scraps, yard trimmings, and other biodegradable materials, generates CH_4 (a potent GHG which is much more effective at trapping heat in the atmosphere than CO_2) when decomposed anaerobically (without oxygen). In addition, the burning of organic waste releases CO_2 into the atmosphere [64]. Green wastes such as grass clippings and leaves also contribute to CH_4 emissions when decomposed in landfills with limited oxygen. Animal manure from livestock produces both CH_4 and N_2O, with improper storage and handling increase these emissions [118]. Similarly, sewage and industrial sludge that contain organic matter generate CH_4 and other GHGs during anaerobic digestion [118,119]. Therefore, when SW is disposed of illegally and in unmanaged landfills, a significant quantity of CH_4 is released and poses a critical risk of climate change and its multiple impacts, which is among the most critical and global issues for environmental protection both now and in the future [120]. To mitigate these emissions, reducing the amount of organic waste in landfills through composting and enhancing waste-management practices are essential steps.

The challenges of MSWM in Ethiopia, which are closely linked to the One Health approach, emphasise the interconnectedness between human, animal, and environmental health [12,26]. Issues such as limited data sharing and communication, the lack of institutionalisation of One Health approaches, and insufficient community advocacy further hinder progress [12]. Similarly, limited research funding hinders the development of innovative solutions, and augments the health risks associated with vector-borne diseases and environmental pollution [26,29]. Inadequate financial and logistical resources further complicate waste-management, increasing the risk of disease transmission through vectors, such as rodents and insects.

Weak governance and institutional capacity result in ineffective waste-management policies, leading to environmental degradation that affects air and water quality and directly impacts human and animal health. Inconsistent regulatory frameworks create disparities in waste-management practices across regions, worsening health hazards. Moreover, the lack of coordination among government agencies has led to fragmented efforts, complicating the resolution of complex MSWM issues. The scarcity of financial and technological resources forces reliance on outdated waste-management methods, increasing pollution and health risks. Variable political commitments aggravate these issues, resulting in inconsistent policies and inadequate support for waste-management programs.

The One Health approach, which recognises the interdependence of human, animal, and environmental health, provides a comprehensive framework for tackling the challenges of improper MSWM in Ethiopia.

This involves developing comprehensive programs and fostering interdisciplinary collaborations among health professionals, environmental scientists, and waste-management experts [34]. Strategies such as having a reference framework for One Health activity, community engagement through awareness campaigns and behavioural incentives [27,34,89], effective coordination across different sectors at various levels, and advocating for the One Health approach in joint and multi-sectoral meetings are crucial [34,121].

Additionally, the availability of sufficient funds and resources, supported by technical and financial partners, plays a pivotal role [29,89]. Innovations in integrated MSWM technologies and investments in waste reuse, recycling, and energy recovery technologies are also significant [65,122,123]. Ensuring health and safety measures through adequate protective equipment, regular health monitoring, and medical support for workers involved in MSWM is essential [21,97]. The proper disposal of animal carcasses using scientifically approved methods is critical [111]. Strong engagement from technical experts in ministries, the establishment of the National One Health Steering Committee, and Technical Working Groups focusing on prioritised zoonotic diseases, along with active participation from various non-governmental organizations (NGOs), are facilitating factors [12].

Furthermore, over 85% of the MSW in Ethiopia is reusable and recyclable with 73% organic (biodegradable) and 11.78% recyclable. These methods include composting biodegradable waste to produce nutrient-rich compost, which enhances soil fertility and promotes sustainable urban agriculture. This also includes utilising biogas, briquettes, and thermal or gasification energy sources for cooking, heating, and electricity generation [13,19,20]. These initiatives serve as enablers for improving the One Health approaches in Ethiopia.

Improving MSWM in the country requires a blend of policy interventions supported by strong socio-economic and political commitments, as well as the adoption and adaptation of best practices from developed countries. To address the challenges of inadequate infrastructure and limited recycling capacity, the Integrated Waste Management System that includes waste minimisation, recycling, composting, and energy recovery can help reduce the volume of waste sent to landfills [42]. Countries like Germany and Sweden offer models for producer responsibility regulations and waste-to-energy initiatives [124,125], which could be tailored to Ethiopia's needs.

Environmental surveillance and monitoring are crucial for identifying and handling pollution sources and health risks associated with MSWM [126]. Ethiopia currently lacks a robust system for tracking environmental pollutants from waste. Adopting comprehensive monitoring networks, similar to those of the United States' Environmental Protection Agency [127], could help identify pollution sources and their impact on public health.

Public awareness regarding the health and environmental impacts of improper waste disposal is low in Ethiopia. Singapore's and Japan's success in MSWM is largely due to their comprehensive public education campaigns [128,129], which emphasise the importance of waste segregation and recycling. These campaigns have led to high levels of public participation in waste-management, a strategy that could be highly effective in Ethiopia as well.

Weak enforcement of existing waste-management laws in Ethiopia has led to widespread non-compliance. Strengthening regulations and enforcement are essential for improving waste-management practices. For example, Singapore's strict enforcement of waste-management regulations, including heavy fines for littering and illegal dumping [129], has resulted in a clean and well-managed urban environment. This approach can also be adapted to the Ethiopian context.

The adoption of eco-friendly technologies in Ethiopia is hindered by cost and limited availability. For instance, South Korea's success in implementing advanced recycling technologies and waste-to-energy plants, coupled with government incentives for businesses to adopt green technologies [130,131], offers a model for Ethiopia to follow. Ethiopia's current surveillance system for zoonotic diseases is inadequate and lacks integration with waste-management efforts, thereby increasing the risk of disease outbreaks. An integrated surveillance system, as used in the Netherlands [91], can improve early detection and control by coordinating efforts across the public health, veterinary, and environmental sectors.

Agricultural waste is a significant component of MSW in Ethiopia, particularly in rural areas. The promotion of sustainable agricultural practices can reduce waste generation and enhance soil health. Denmark's successful integration of sustainable agricultural practices with waste-management, including the use of organic waste for composting and biogas production [132] could serve as a model for Ethiopia. Effective SWM in Ethiopia requires collaboration across sectors. However, such collaborations are often lacking, leading to fragmented and inefficient efforts. Canada's approach, which involves coordination between federal, provincial, and municipal governments as well as the private sector and civil society, ensures a comprehensive and coordinated approach for SWM [133]. This model can serve as an example for Ethiopia.

Economic incentives are crucial for promoting sustainable waste practices. Ethiopia could implement programs like the “Pay-As-You-Throw” initiative, which charges residents based on the amount of waste they produce, thereby incentivising waste reduction and recycling. Recycling deposit schemes in Switzerland, similar to those in Germany, can also encourage consumers to return packaging for recycling [134].

Finally, investment in research and innovation is essential for developing new waste management technologies and strategies tailored to Ethiopia's unique challenges. It is necessary to invest in technological innovations for waste management [75,76]. For instance, in Barcelona, smart waste bins that communicate when they are full have been used to optimise collection routes and reduce costs [135] and offer a valuable model for fostering collaboration between academia, industry, and government in Ethiopia.

4. Conclusion and recommendations

MSW contributes significantly to pollution, endangering ecological balance, human and animal health, and sustainable development. It poses substantial toxicity, carcinogenicity, and mutagenicity risks owing to the widespread illegal disposal of 68% of the waste in drainage systems, roadsides, common land, and open dumps. These hazardous materials, including non-biodegradables, persist in the environment for centuries, causing air and water pollution, land degradation, climate change (via CH_4 and CO_2 emissions), leachates, and eutrophication, severely impacting human and animal health, ecosystems, and environmental quality.

The One Health approach, which recognises the interconnected nature of human, animal, and environmental health, offers a logical solution. In Ethiopia, progress includes establishing a National One Health Steering Committee to address gaps in multi-sectoral communication, coordination, and collaboration. Technical Working Groups are also developing disease prevention and control strategies, implementing disease-focused public health activities, and providing recommendations and control documents for prioritised zoonotic diseases. However, challenges persist, such as poor sectoral integration in data sharing and communication, the lack of institutionalisation of One Health, insufficient community advocacy, limited government financial support, and inadequate research funding. Consequently, zoonotic diseases (e.g. rabies, anthrax, brucellosis, leptospirosis, echinococcosis, salmonellosis, leishmaniasis, and bovine tuberculosis) and various infectious diseases (e.g. acute respiratory infection, gastrointestinal infections, typhoid, tuberculosis, cholera, eye and skin infections, meningitis, influenza, malaria, and diarrhoea) are serious problems in Ethiopia, exacerbated by poor SWM and sanitation practices.

Despite these constraints, opportunities exist through the One Health approach using holistic programs and interdisciplinary collaboration, engaging communities through awareness and behavioural incentives, enhancing and enforcing policies, building institutional capacity, innovating technology for integrated MSWM, fostering public-private partnerships, and ensuring good coordination among sectors at various levels. Joint and multi-sectoral meetings advocating the One Health approach along with the availability of adequate funds and support from technical and financial partners are crucial.

Overall, Ethiopia faces significant challenges related to MSWM. Most MSW (68.2%) is illegally disposed of with only 31.8% collected lawfully, leading to irregular, inadequate, and inefficient MSWM practices that impact the environment and human health. Integrating the One Health approach in managing MSW in Ethiopia offers a viable pathway for addressing the intertwined hindrances of human, animal, and environmental health. Enhancing MSWM in Ethiopia through the One Health approach requires a comprehensive strategy that integrates best practices from developed countries with local adaptations. These efforts will not only address immediate waste management issues but also contribute to the long-term health and sustainability of the environment and population. Ethiopia can improve its waste management practices and promote sustainable development and health by leveraging strategic opportunities and overcoming existing hurdles. Therefore, the widespread implementation of One Health strategies and interventions is essential to tackle emerging infectious and zoonotic diseases and ensure environmental health sustainability. This requires concerted efforts from the government, communities, private sector, and international partners to achieve a cleaner and healthier environment. Further research on the impact of MSWM in fostering the One Health approach, its barriers, and opportunities in Ethiopia is expected to provide more insights in the future management of MSW.

CRediT authorship contribution statement

Tsegay Kahsay Gebrekidan: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Niguse Gebru Weldemariam:** Writing – review & editing, Resources, Methodology, Conceptualization. **Hagos Degefa Hidru:** Writing – review & editing, Resources, Methodology, Conceptualization. **Gebremariam Gebrezgabher Gebremedhin:** Writing – review & editing, Resources, Methodology, Conceptualization. **Abraha Kahsay Weldemariam:** Writing – review & editing, Resources, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] M.H. Dehghani, G.A. Omrani, R.R. Karri, Solid waste—sources, toxicity, and their consequences to human health, in: Soft Computing Techniques in Solid Waste and Wastewater Management, Elsevier, 2021, pp. 205–213, https://doi.org/10.1016/B978-0-12-824463-0.00013-6.

[2] S. Nanda, F. Berruti, Municipal solid waste management and landfilling technologies: a review, Environ. Chem. Lett. 19 (2) (2021) 1433–1456, https://doi.org/10.1007/s10311-020-01100-y.

[3] O. Buenrostro, G. Bocco, S. Cram, Classification of sources of municipal solid wastes in developing countries, Resour. Conserv. Recycl. 32 (1) (2001) 29–41, https://doi.org/10.1016/S0921-3449(00)00094-X.

[4] H.I. Abdel-Shafy, M.S. Mansour, Solid waste issue: sources, composition, disposal, recycling, and valorization, Egyptian journal of petroleum 27 (4) (2018) 1275–1290, https://doi.org/10.1016/j.ejpe.2018.07.003.

[5] Y. Zhu, Y. Zhang, D. Luo, Z. Chong, E. Li, X. Kong, A review of municipal solid waste in China: characteristics, compositions, influential factors and treatment technologies, Environ. Dev. Sustain. 23 (2021) 6603–6622, https://doi.org/10.1007/s10668-020-00959-9.

[6] M. Tilaye, M.P. van Dijk, Sustainable solid waste collection in Addis Ababa: the users? Perspective, Int. J. Wine Res. 4 (3) (2014) 158–168, https://doi.org/10.4172/2252-5211.1000158.

[7] S. Chaturvedi, A. Khare, Solid wastes: characteristics, composition and adverse effects on environment and public health, Asian Journal of Advanced Research and Reports 16 (7) (2022) 9–30. http://dx.doi.org/10.9734/ajarr/2022/v16i730483.

[8] K. Mostaghimi, J. Behnamian, Waste minimization towards waste management and cleaner production strategies: a literature review, Environ. Dev. Sustain. 25 (11) (2023) 12119–12166, https://doi.org/10.1007/s10668-022-02599-7.

[9] WHO, Compendium of WHO and Other UN Guidance on Health and Environment, World Health Organization. https://www.who.int/publications/i/item/WHO-HEP-ECH-EHD-22.01, 2022 (accessed 1 April 2022).

[10] J.N. Jebaranjitham, J.D. Selvan Christyraj, A. Prasannan, K. Rajagopalan, K.S. Chelladurai, J.K.J.S. Gnanaraja, Current scenario of solid waste management techniques and challenges in Covid-19–A review, Heliyon 8 (7) (2022) e09855, doi.:10.1016/j.heliyon.2022.e09855.

[11] H. Roy, S.R. Alam, R. Bin-Masud, T.R. Prantika, M.N. Pervez, M.S. Islam, et al., A review on characteristics, techniques, and waste-to-energy aspects of municipal solid waste management: Bangladesh perspective, Sustainability 14 (16) (2022) 10265, https://doi.org/10.3390/su141610265.

[12] G.A. Erkyihun, F.R. Gari, B.M. Edao, G.M. Kassa, A review on One Health approach in Ethiopia, One Health Outlook 4 (1) (2022) 8, doi:10.1186/s42522-022-00064-z.

[13] L. Hirpe, C. Yeom, Municipal solid waste management policies, practices, and challenges in Ethiopia: a systematic review, Sustainability 13 (20) (2021) 11241, https://doi.org/10.3390/su132011241.

[14] L. Godfrey, M.T. Ahmed, K.G. Gebremedhin, J.H.Y. Katima, S. Oelofse, O. Osibanjo, et al., Solid waste management in Africa: governance failure or development opportunity, in N. Edomah (Eds.),Regional development in Africa, IntechOpen, Rijeka (2020), https://doi.org/10.5772/intechopen.86974.

[15] E. Gelan, Municipal solid waste management practices for achieving green architecture concepts in Addis Ababa, Ethiopia, Technologies 9 (3) (2021) 48, https://doi.org/10.3390/technologies9030048.

[16] D. Wilson, Global Waste Management Outlook: Summary for Decision-Makers, 2015. https://repository.udca.edu.co/handle/11158/3009.

[17] J. McAllister, Factors Influencing Solid-Waste Management in the Developing World, 2015, https://doi.org/10.26076/2c24-5944.

[18] M.D. Meena, M.L. Dotaniya, B.L. Meena, P.K. Rai, R.S. Antil, H.S. Meena, et al., Municipal solid waste: opportunities, challenges and management policies in India: a review, Waste Management, Bulletin 1 (1) (2023) 4–18, https://doi.org/10.1016/j.wmb.2023.04.001.

[19] Z.T. Teshome, Z.T. Ayele, M.I. Abib, Assessment of solid waste management practices in Kebridehar city Somali regional state, Ethiopia, Heliyon 8 (9) (2022) e10451, https://doi.org/10.1016/j.heliyon.2022.e10451.

[20] F.B. Teshome, Municipal solid waste management in Ethiopia; the gaps and ways for improvement, J. Mater. Cycles Waste Manag. 23 (2021) 18–31, https://doi.org/10.1007/s10163-020-01118-y.

[21] B. Mekonnen, A. Haddis, W. Zeine, Assessment of the effect of solid waste dump site on surrounding soil and river water quality in Tepi town, Southwest Ethiopia, Journal of environmental and public health 2020 (1) (2020) 5157046, https://doi.org/10.1155/2020/5157046.

[22] G. Bereda, G. Bereda, Assessment of health and health related problems in the community of Mettu town, south western, Ethiopia, 2021: a community based descriptive cross sectional study, International Journal of Pharmacy and Chemistry 7 (3) (2021) 37–44, https://doi.org/10.11648/j.ijpc.20210703.11.

[23] B. Tekleyohannes, Assessment of household waste management and hygienic practice in Yirgalem Town, Dale Woreda, Sidama Zone, south nation nationalities and peoples of region, Ethiopia, Int. J. Environ. Res. Publ. Health 5 (2) (2019) 41–49, https://doi.org/10.11648/j.jher.20190502.12.

[24] D. Musoke, C.Machalaba, P. Daszak, R.H. Salerno, W.B. Karesh, The role of environmental health in One Health: a Uganda perspective, One Health 2 (2016) 157–160, doi:10.1016/j.onehlt.2016.10.003.

[25] A.A. Hassan-Kadle, A.M. Osman, A.M. Ibrahim, A.A. Mohamed, C.J.B. de Oliveira, R.F.C. Vieira, One Health in Somalia: present status, opportunities, and challenges, One Health (2023) 100666, https://doi.org/10.1016/j.onehlt.2023.100666.

[26] N.S. Nyokabi, H. Moore, S. Berg, J. Lindahl, L. Phelan, G. Gimechu, et al., Implementing a One Health approach to strengthen the management of zoonoses in Ethiopia, One Health 16 (2023) 100521, https://doi.org/10.1016/j.onehlt.2023.100521.

[27] J. Meisner, H. McLeland-Wieser, E.E. Traylor, B. Hermesh, T. Berg, A. Roess, et al., Relational One Health: a more-than-biomedical framework for more-than-human health, and lessons learned from Brazil, Ethiopia, and Israel, One Health (2024) 100676, https://doi.org/10.1016/j.onehlt.2024.100676.

[28] F. Abunna, G. Mamo, B. Megersa, One Health–A holistic solution for sustainable management of globalization-driven public health challenges, Ethiop. Vet. J. 26 (2) (2022) 107–131, https://doi.org/10.4314/evj.v26i2.7.

[29] T.T. Yitayih, Applications and Challenges of One Health Approach in Relation to Ethiopian Context, J. Med. Physiol. Biophys. 31 (2017) 27–40.

[30] I.R. Abubakar, K.M. Maniruzzaman, U.L. Dano, F.S. AlShihr, M.S. AlShammariMaher, S.M.S. Ahmed, et al., Environmental sustainability impacts of solid waste management practices in the global South, Int. J. Environ. Res. Publ. Health 19 (19) (2022) 12717, doi:10.3390/ijerph191912717.

[31] E. Mazhindu, T. Gumbo, T. Gondo, Waste Management Threats to Human Health and Urban Aquatic Habitats–A Case Study of Addis Ababa, Ethiopia. Waste Management—An Integrated Vision, IntechOpen, Rijeka, 2012, pp. 21–54, https://doi.org/10.5772/48077.

[32] M.J. Page, D. Moher, P.M. Bossuyt, I. Boutron, T.C. Hoffmann, C.D. Mulrow, et al., PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews, BMJ 372 (2021) 372, https://doi.org/10.1136/bmj.n160.

[33] E. Ahn, H. Kang, Introduction to systematic review and meta-analysis, Kor. J. Anesthesiol. 71 (2) (2018) 103–112, https://doi.org/10.4097/kjae.2018.71.2.103.
[34] T.K. Gebrekidan, Environmental education in Ethiopia: history, mainstreaming in curriculum, governmental structure, and its effectiveness: a systematic review, Heliyon (2024) e30573, https://doi.org/10.1016/j.heliyon.2024.e30573.
[35] D.S. Yopa, D.M. Massom, G.M. Kiki, R.W. Sophie, S. Fasine, O. Thiam, et al., Barriers and enablers to the implementation of One Health strategies in developing countries: a systematic review, Front. Public Health 11 (2023) 1252428, https://doi.org/10.3389/fpubh.2023.1252428.
[36] S.V. Katikireddi, M. Egan, M. Petticrew, How do systematic reviews incorporate risk of bias assessments into the synthesis of evidence? A methodological study, J. Epidemiol. Community Health 69 (2) (2015) 189–195, https://doi.org/10.1136/jech-2014-204711.
[37] G.A. Wells, B. Shea, D. O'Connell, J. Peterson, V. Welch, M. Losos, et al., Newcastle-Ottawa Quality Assessment Scale Cohort Studies, University of Ottawa. https://scholar.google.com/scholar?q=Wells,+G.,+et+al.,+Newcastle-Ottawa+quality+assessment+scale+cohort+studies.+University+of+Ottawa,+2014.&hl=en&as_sdt=0&as_vis=1&oi=scholart, 2014 (accessed 6 Jun 2024).
[38] M.B. Mengesha, T.T. Chekole, H.D. Hidru, Uptake and barriers to cervical cancer screening among human immunodeficiency virus-positive women in Sub Saharan Africa: a systematic review and meta-analysis, BMC Wom. Health 23 (1) (2023) 338, https://doi.org/10.1186/s12905-023-02479-w.
[39] A. Ali, Misconceptions and inappropriate solid waste management in small towns of Ethiopia: bule hora town, Oromia region, Ethiopia, Int J Waste Resour 8 (324) (2018) 2, https://doi.org/10.4172/2252-5211.1000324.
[40] Y.S. Kebede, M.M. Alene, N.T. Endalemaw, Urban landfill investigation for managing the negative impact of solid waste on environment using geospatial technique. A case study of Assosa town, Ethiopia, Environmental Challenges 4 (2021) 100103, https://doi.org/10.1016/j.envc.2021.100103.
[41] F. Abuye, T. Jegora, F. Gamachu, Assessment of solid waste management practices in Bedele town, Oromia, Ethiopia, Ethiopian Journal of Environmental Studies & Management 12 (5) (2019) 520–529. https://ejesm.org/doi/v12i5.4.
[42] Y. Jani, M. Odlare, Integrated waste management system for environmental protection and sustainability of resources, in: Solid Waste Management in Delta Region for SDGs Fulfillment: Delta Sustainability by Waste Management, Springer Nature Switzerland, Cham, 2024, pp. 187–213, https://doi.org/10.1007/978-3-031-58253-0_8.
[43] A. Misganaw, Assessment of potential environmental impacts and sustainable management of municipal solid waste using the DPSIRO framework: a case study of Bahir Dar, Ethiopia, Environ. Monit. Assess. 195 (2) (2023) 297, https://doi.org/10.1007/s10661-023-10929-z.
[44] A. Taye, E. Assefa, B. Simane, Analysis of practices and factors of solid waste management among urban households of Addis Ababa city, Ethiopia, Environmental Challenges 14 (2024) 100811, https://doi.org/10.1016/j.envc.2023.100811.
[45] H. Wondimu, The impact of poor waste management practice on the campus students: the case of Gondar University of "Tewodros" Campus, Ethiopia, International Journal of New Economics and Social Sciences IJONESS 12 (2) (2020) 45–58, https://doi.org/10.2139/ssrn.3877232.
[46] S. Abebe, R. Raju, G. Berhanu, Health care solid waste generation and its management in Hawassa Referral Hospital of Hawassa University, southern, Ethiopia, Int. J. Innov. Res. Dev. 6 (5) (2017) 126–132, https://doi.org/10.24940/ijird/2017/v6/i5/MAY17079.
[47] D.B. Diriba, X.Z. Meng, Rethinking of the solid waste management system of Addis Ababa, Ethiopia, J. Adv. Environ. Health Res. 9 (1) (2021) 7–22, https://doi.org/10.32598/JAEHR.9.1.1198.
[48] Z. Zhang, Z. Chen, J. Zhang, Y. Liu, L. Chen, M. Yang, et al., Municipal solid waste management challenges in developing regions: a comprehensive review and future perspectives for Asia and Africa, Sci. Total Environ. (2024) 172794, https://doi.org/10.1016/j.scitotenv.2024.172794.
[49] M. Hailemariam, A. Ajeme, Solid waste management in Adama, Ethiopia: aspects and challenges, Int. J. Environ. Eng. Ecol. Sci. 8 (9) (2014) 670–676, https://doi.org/10.5281/zenodo.1096335.
[50] S.C. Teferi, The status of household solid waste management and its associated factors in Fiche Town, North Shewa Zone, Ethiopia, Environ. Health Insights 16 (2022) 11786302221117007, https://doi.org/10.1177/11786302221117007.
[51] W. Adefris, S. Damene, P. Satyal, Household practices and determinants of solid waste segregation in Addis Ababa city, Ethiopia, Humanities and social sciences communications 10 (1) (2023) 1–10, https://doi.org/10.1057/s41599-023-01982-7.
[52] E. Selin, Solid Waste Management and Health Effects: A Qualitative Study on Awareness of Risks and Environmentally Significant Behavior in Mutomo, Kenya, 2013.
[53] M. Pal, Y. Ayele, A. Hadush, S. Panigrahi, V. J. Jadhav, Public health hazards due to unsafe drinking water, Air Water Borne Dis. 7 (1000138) (2018) 2, doi: 10.4172/2167-7719.1000138.
[54] T. Aklilu, G. Sahilu, A. Ambelu, Public health risks associated with drinking water consumption in the upper Awash River sub-basin, Ethiopia, sub-Saharan Africa, Heliyon 10 (3) (2024) e24790, https://doi.org/10.1016/j.heliyon.2024.e24790.
[55] T. Gashaw, A. Jambo, Typhoid in less developed countries: a major public health concern, in: Hygiene and Health in Developing Countries-Recent Advances, IntechOpen, 2022, https://doi.org/10.5772/intechopen.108109.
[56] T.H. Tulchinsky, E.A. Varavikova, Environmental and occupational health, The New Public Health (2014) 471, https://doi.org/10.1016/B978-0-12-415766-8.00009-4.
[57] H. Eshete, A. Desalegn, F. Tigu, Knowledge, attitudes and practices on household solid waste management and associated factors in Gelemso town, Ethiopia, PLoS One 18 (2) (2023) e0278181, https://doi.org/10.1371/journal.pone.0278181.
[58] G. Lema, M.G. Mesfun, A. Eshete, G. Abdeta, Assessment of Status of Solid Waste Management in Asella Town, Ethiopia 19 (1) (2019) 1261, https://doi.org/10.1186/s12889-019-7551-1.
[59] FDRE, Environmental pollution control proclamation (Proc. No. 300/2002), A.A. Federal Democratic Republic of Ethiopia, Ethiopia, Federal Democratic Republic of Ethiopia, Addis Ababa , Ethiopia. https://www.vertic.org/media/National%20Legislation/Ethiopia/ET_Environmental_Pollution_Control.pdf, 2002 (accessed 3 December 2002).
[60] W.M. Fereja, D.D. Chemeda, Status, characterization, and quantification of municipal solid waste as a measure towards effective solid waste management: the case of Dilla Town, Southern Ethiopia, J. Air Waste Manag. Assoc. 72 (2) (2022) 187–201, https://doi.org/10.1080/10962247.2021.1923585.
[61] V. Tyagi, S. Fantaw, H. Sharma, Municipal solid waste management in Debre Berhan city of Ethiopia, J. Environ. Earth Sci. 4 (5) (2014) 98–103.
[62] G. Begashaw, Community health, water supply and sanitation, Integrated water and land management research and capacity building priorities for Ethiopia 98 (2003).
[63] W. Tefera, A. Kumie, K. Berhane, F. Gilliland, A. Lai, P. Sricharoenvech, et al., Source apportionment of fine organic particulate matter (PM2. 5) in Central Addis Ababa, Ethiopia, Int. J. Environ. Res. Publ. Health 18 (21) (2021) 11608, https://doi.org/10.3390/ijerph182111608.
[64] T.W. Bulto, Impact of open burning refuse on air quality: in the case of "Hidar Sitaten" at Addis Ababa, Ethiopia, Environ. Health Insights 14 (2020) 1178630220943204, https://doi.org/10.1177/1178630220943204.
[65] B. Hassen, S. Leta, A. Hussen, T. Alemu, et al., Physicochemical and compositional analyses of household solid wastes: opportunities for bioenergy production and sustainable waste management in Ethiopia, J. Mater. Cycles Waste Manag. 25 (4) (2023) 2350–2364, https://doi.org/10.1007/s10163-023-01700-0.
[66] G. Wako, Solid waste management practices and its challenges in Gambella town, Gambella regional States, Ethiopia, Acad. Res. J. Agric. Sci. Res 8 (2020) 37–43, https://doi.org/10.14662/ARJASR2019.213.
[67] E. Amdebrhan, The Assessment of Solid Waste Management in Addis Ababa:-The Case of Kirkos Sub-cities, St. Mary's University, 2014.
[68] G. Lema, M.G. Mesfun, A. Eshete, G. Abdeta, Assessment of status of solid waste management in Asella town, Ethiopia, BMC Publ. Health 19 (2019) 1–7, https://doi.org/10.1186/s12889-019-7551-1.
[69] K. Tassie Wegedie, Households solid waste generation and management behavior in case of Bahir Dar city, Amhara national regional state, Ethiopia, Cogent Environmental Science 4 (1) (2018) 1471025, https://doi.org/10.1080/23311843.2018.1471025.
[70] FDRE, Solid waste management proclamation (Proc No. 513/2007), in: Negarit Gazeta (Ed.), 13th Febrary,2007, A.A. Federal Democratic Republic of Ethiopia, Ethiopia, 2007 Addis Ababa , Ethiopia https://chilot.wordpress.com/wp-content/uploads/2011/01/proc-no-513-solid-waste-management-proclamation.pdf, 2007 (accessed 12 February 2007).
[71] D. Erasu, T. Feye, A. Kiros, A. Balew, et al., Municipal solid waste generation and disposal in Robe town, Ethiopia, J. Air Waste Manag. Assoc. 68 (12) (2018) 1391–1397, https://doi.org/10.1080/10962247.2018.1467351.
[72] EPA, Environmental policy of Ethiopia, in: E.p. Authority (Ed.), Addis Ababa, Ethiopia. https://plasticsdb.surrey.ac.uk/documents/Ethiopia/Republic%20of%20Ethiopia%20(1997)%20Environmental%20Policy%20of%20Ethiopia.pdf, 1997 (accessed 2 April 1997).
[73] M. Batista, R. Caiado, O. Quelhas, G. Lima, W. Filho, I.R. Yparraguirre, A framework for sustainable and integrated municipal solid waste management: barriers and critical factors to developing countries, J. Clean. Prod. 312 (2021) 127516, https://doi.org/10.1016/j.jclepro.2021.127516.
[74] G. Twagirayezu, A. Uwimana, H. Kui, C.S. Birame, O. Irumva, J.C. Nizeyimana, et al., Towards a sustainable and green approach of electrical and electronic waste management in Rwanda: a critical review, Environ. Sci. Pollut. Control Ser. 30 (32) (2023) 77959–77980, https://doi.org/10.1007/s11356-023-27910-5.
[75] M.A. Ramírez-Moreno, S. Keshtkar, D.A. Padilla-Reyes, E. Ramos-López, M. García-Martínez, M.C. Hernández-Luna, et al., Sensors for sustainable smart cities: a review, Appl. Sci. 11 (17) (2021) 8198, https://doi.org/10.3390/app11178198.
[76] I.V. Osokina, I.V. Afanasyev, S.A. Kurbanov, T.N. Lustina, D.I. Stepanova,Tax regulation and attraction of investments in the waste management industry: innovations and technologies, Amazon. Invest. 8 (23) (2019) 369–378. https://amazoniainvestiga.info/index.php/amazonia/article/view/880
[77] T. Ramachandra, H.A. Bharath, G. Kulkarni, S.S. Han, Municipal solid waste: generation, composition and GHG emissions in Bangalore, India, Renew. Sustain. Energy Rev. 82 (2018) 1122–1136, https://doi.org/10.1016/j.rser.2017.09.085.
[78] T. Gebrekidan, G. Gebremedhin, Integration and effectiveness of formal environmental education in Africa and India: review, European Journal of Sustainable Development Research 8 (2) (2024) em0253, doi:10.29333/ejosdr/14368.
[79] R. Kumar, A. Verma, A. Shome, R. Sinha, S. Sinha, P. Jha, et al., Impacts of plastic pollution on ecosystem services, sustainable development goals, and need to focus on circular economy and policy interventions, Sustainability 13 (17) (2021) 9963, https://doi.org/10.3390/su13179963.
[80] P.J. Collignon, S.A. McEwen, One health—its importance in helping to better control antimicrobial resistance, Tropical medicine and infectious disease 4 (1) (2019) 22, https://doi.org/10.3390/tropicalmed4010022.

[81] E.J. Sisay, S. Sahai, T. Tesfay, Characterization and Toxicity Effect of Leachate from Municipality Landfill, 2021, https://doi.org/10.21203/rs.3.rs-416033/v1.
[82] A.M. Beyene, T. Andualem, G.G. Dagnaw, M. Getahun, J. LeJeune, J.P. Ferreira, Situational analysis of antimicrobial resistance, laboratory capacities, surveillance systems and containment activities in Ethiopia: a new and One Health approach, One Health (2023) 100527, https://doi.org/10.1016/j.onehlt.2023.100527.
[83] Z.A. Alemu, M.O. Dioha, Modelling scenarios for sustainable water supply and demand in Addis Ababa city, Ethiopia, Environmental Systems Research 9 (2020) 1–14, https://doi.org/10.1186/s40068-020-00168-3.
[84] A. Ewusi, E.D. Sunkari, J. Seidu, E. Coffie-Anum, Hydrogeochemical characteristics, sources and human health risk assessment of heavy metal dispersion in the mine pit water–surface water–groundwater system in the largest manganese mine in Ghana, Environ. Technol. Innovat. 26 (2022) 102312, https://doi.org/10.1016/j.eti.2022.102312.
[85] C. Gerba, I. Pepper, Microbial contaminants, Environmental and pollution science (2019) 191–217, https://doi.org/10.1016/B978-0-12-814719-1.00013-6.
[86] A. Eshete, A. Haddis, E. Mengistie, Investigation of environmental and health impacts solid waste management problems and associated factors in Asella town, Ethiopia, Heliyon 10 (6) (2024) e28203, https://doi.org/10.1016/j.heliyon.2024.e28203.
[87] K. Berhanu, D. Ayana, B. Megersa, H. Ashenafi, H. Waktole, *Cryptosporidium* in Human-Animal-Environment Interphase at Adama and Asella Areas of Oromia Regional State, Ethiopia, 18(2022) 402, doi:10.1186/s12917-022-03497-w.
[88] T. Gondo, A hierarchical cluster-based segmentation analysis of potential solid waste management health hazards in urban Ethiopia, Jàmbá: Journal of Disaster Risk Studies 11 (2) (2019) 1–13, https://doi.org/10.4102/jamba.v11i2.716.
[89] E. Husein, One Health and it's practical implementation in Ethiopia, Op Acc J Bio Sci & Res 3 (2) (2020), https://doi.org/10.46718/JBGSR.2020.03.000068.
[90] S. Cleaveland, J. Sharp, B. Abela-Ridder, K.J. Allan, J. Buza, J.A. Crump, et al., One Health contributions towards more effective and equitable approaches to health in low-and middle-income countries, Phil. Trans. Biol. Sci. 372 (1725) (2017) 20160168, https://doi.org/10.1098/rstb.2016.0168.
[91] A. Garcia-Vozmediano, D. De Meneghi, H. Sprong, A. Portillo, J.A. Oteo, L. Tomassone, A One Health evaluation of the surveillance systems on tick-borne diseases in The Netherlands, Spain and Italy, Vet. Sci. 9 (9) (2022) 504, doi: 10.3390/vetsci9090504.
[92] D.D.I. Wieland, J. Sircely, S. Tefera, ONE HEALTH POLICY CONTEXT OF ETHIOPIA, SOMALIA AND KENYA. https://cgspace.cgiar.org/server/api/core/bitstreams/82606776-3b06-4378-afce-61a14388b5c5/content, 2019 (accessed 1 December 2019).
[93] R.S.T.O.I. Epiz, One Health collaborations for zoonotic disease control in Ethiopia, Rev. Sci. Tech. Off. Int. Epiz 38 (1) (2019) 51–60, https://doi.org/10.20506/rst.38.1.2940.
[94] A.K. Ziraba, T.N. Haregu, B. Mberu, A review and framework for understanding the potential impact of poor solid waste management on health in developing countries, Arch. Publ. Health 74 (2016) 1–11, https://doi.org/10.1186/s13690-016-0166-4.
[95] Z. Gizaw, G.A. Biks, M. Yitayal, G.A. Alemayehu, K. Alemu, T. Awoke, et al., Sanitation predictors of childhood morbidities in Ethiopia: evidence from dabat health and demographic surveillance system, Environ. Health Prev. Med. 24 (2019) 1–8, https://doi.org/10.1186/s12199-019-0801-0.
[96] H. Singh, Y.T. Kamal, A.K. Mishra, M. Singh, S. Mohanto, S. Ghumra, et al., Harnessing the foundation of biomedical waste management for fostering public health: strategies and policies for a clean and safer environment, Discov. Appl. Sci. 6 (3) (2024) 1–31, https://doi.org/10.1007/s42452-024-05735-2.
[97] M.G. Gebremedhn, P.V. Raman, Socio economic and health status of street sweepers of Mekelle city, Ethiopia, Waste Manag. 103 (2020) 251–259, https://doi.org/10.1016/j.wasman.2019.12.024.
[98] H.S. Melaku, M.A. Tiruneh, Occupational health conditions and associated factors among municipal solid waste collectors in Addis Ababa, Ethiopia, Risk Manag. Healthc. Pol. (2020) 2415–2423, https://doi.org/10.2147/RMHP.S276790.
[99] FAO, Livelihoods and the Environment in Ethiopia, an Integrated Analysis, FAO, Rome, Italy, 2019. ISBN 978-92-5-131321-3, https://openknowledge.fao.org/server/api/core/bitstreams/6a1bba9a-2018-4e62-893b-e814e73503f0/content.
[100] W.A. Gebreyes, J.Dupouy-Camet, M.J. Newport, C.J. Oliveira, L.S. Schlesinger, Y.M. Saif, et al., The global One Health paradigm: challenges and opportunities for tackling infectious diseases at the human, animal, and environment interface in low-resource settings, PLoS Neglected Trop. Dis. 8 (11) (2014) e3257, doi: 10.1371/journal.pntd.0003257.
[101] N.A. Dafale, S. Srivastava, H.J. Purohit, Zoonosis: an emerging link to antibiotic resistance under "One Health approach.", Indian J. Microbiol. 60 (2020) 139–152, https://doi.org/10.1007/s12088-020-00860-z.
[102] S.T. Alemu, D. Ero, S.M. Mor, One health insights into pastoralists' perceptions on zoonotic diseases in Ethiopia: perspectives from South Omo Zone of SNNP Region, Pastoralism 13 (1) (2023) 13, https://doi.org/10.1186/s13570-023-00274-8.
[103] Y. Osman, T. Knight-Jones, S. Angombe, J. Becker, S.A. Bukachi, J. Chirenda, et al., Operationalizing a community-based One Health surveillance and response in Adadle district of Ethiopia, CABI One Health 2023, 2023, https://doi.org/10.1079/cabionehealth.2023.0014 ohcs202300014.
[104] S. Singh, P. Sharma, N. Pal, D.K. Sarma, R. Tiwari, M. Kumar, Holistic One Health surveillance framework: synergizing environmental, animal, and human determinants for enhanced infectious disease management, ACS Infect. Dis. 10 (3) (2024) 808–826, doi:10.1021/acsinfecdis.3c00625.
[105] M. Choudhary, D. Singh, M. Parihar, K.B. Choudhary, M. Nogia, S.K. Samal, et al., Impact of municipal solid waste on the environment, soil, and human health, in: in: V.S. Meena, A. Rakshit, M.D. Meena, M. Baslam, I.M.R. Fattah, S.S. Lam, et al. (Eds.), Waste Management for Sustainable and Restored Agricultural Soil, Elsevier, 2024, pp. 33–58, https://doi.org/10.1016/B978-0-443-18486-4.00011-7.
[106] A.Y. Osman, H.Mohamed, F.I. Mumin, H. Mahrous, A. Saidouni, S.A. Elmi, et al., Prioritization of zoonoses for multisectoral, One Health collaboration in Somalia, 2023, One Health 17 (2023) 100634, doi:10.1016/j.onehlt.2023.100634.
[107] A. Mohamed, Bovine tuberculosis at the human–livestock–wildlife interface and its control through One Health approach in the Ethiopian Somali Pastoralists: a review, One Health 9 (2020) 100113, https://doi.org/10.1016/j.onehlt.2019.100113.
[108] T.T. Mersha, B. Mekonnen Wolde, N.A. Shumuye, A.B. Hailu, A.H. Mohammed, et al., Prioritization of neglected tropical zoonotic diseases: a One Health perspective from Tigray region, Northern Ethiopia, PLoS One 16 (7) (2021) e0254071, https://doi.org/10.1371/journal.pone.0254071.
[109] W. Yadeta, A. Giro, M. Amajo, K. Jilo, et al., Recent understanding of the epidemiology of animal and human anthrax in Ethiopia with emphasis on diagnosis, control and prevention interventions-review, World J. Med. Sci. 17 (1) (2020) 1–9, https://doi.org/10.5829/idosi.wjms.2020.01.09.
[110] G. Alemayehu, G. Mamo, H. Desta, B. Alemu, B. Wieland, Knowledge, attitude, and practices to zoonotic disease risks from livestock birth products among smallholder communities in Ethiopia, One Health 12 (2021) 100223, https://doi.org/10.1016/j.onehlt.2021.100223.
[111] U. Tamiru, Z. Abera, Review on Carcass Disposal Procedures for Disease Prevention, 2020.
[112] M.K. Yunus, Environmental implications of abattoir waste in Ethiopia, Env Anal Eco stud. 6 (3) (2019), https://doi.org/10.31031/EAES.2019.06.000640, 648, 2019. 56.
[113] R. Tuckett, Greenhouse gases, in: Encyclopedia of Analytical Science, Elsevier, 2019, pp. 362–372.
[114] C. Dioxide, Overview of Greenhouse Gases. https://research.birmingham.ac.uk/en/publications/greenhouse-gases2017 (accessed 19 January 2017).
[115] Daniel Hoornweg, Perinaz Bhada-Tata, What a Waste : A Global Review of Solid Waste Management. Urban Development Series;knowledge Papers No. 15, © World Bank, Washington, DC, 2012. http://hdl.handle.net/10986/17388. License: CC BY 3.0 IGO.".
[116] A. Bassi, A.A. Mir, B. Kumar, M. Patel, A comprehensive study of various regressions and deep learning approaches for the prediction of friction factor in mobile bed channels, J. Hydroinf. 25 (6) (2023) 2500–2521, https://doi.org/10.2166/hydro.2023.246.
[117] A.A. Mir, J. Mushtaq, A.Q. Dar, M. Patel, A quantitative investigation of methane gas and solid waste management in mountainous Srinagar city-A case study, J. Mater. Cycles Waste Manag. 25 (1) (2023) 535–549, https://doi.org/10.1007/s10163-022-01516-4.
[118] M.A. Moghadam, R. Feizi, M.P. Fard, N.J.H. Fard, M. Omidinasab, M. Faraji, et al., Estimating greenhouse emissions from sanitary landfills using Land-GEM and IPCC model based on realistic scenarios of different urban areas: a case study of Iran, Journal of Environmental Health Science and Engineering 19 (1) (2021) 819–830, https://doi.org/10.1007/s40201-021-00649-2.
[119] J. Bogner, R. Pipatti, S. Hashimoto, C. Diaz, K. Marečková, L.F. Diaz, et al., Mitigation of global greenhouse gas emissions from waste: conclusions and strategies from the intergovernmental panel on climate change (IPCC) fourth assessment report. Working group III (mitigation), Waste Manag. Res. 26 (1) (2008) 11–32, https://doi.org/10.1177/0734242X07088433.
[120] T. Karak, R. Bhagat, P. Bhattacharyya, Municipal solid waste generation, composition, and management: the world scenario, Crit. Rev. Environ. Sci. Technol. 42 (15) (2012) 1509–1630, https://doi.org/10.1080/10643389.2011.569871.
[121] H. Endale, M. Mathewos, D. Abdeta, Potential causes of spread of antimicrobial resistance and preventive measures in One Health perspective-A review, Infect. Drug Resist. (2023) 7515–7545, https://doi.org/10.2147/IDR.S428837.
[122] T. Hammed, M. Sridhar, Green technology approaches to solid waste management in the developing economies, in: African Handbook of Climate Change Adaptation, Springer, 2021, pp. 1293–1312, https://doi.org/10.1007/978-3-030-45106-6_174.
[123] A.D. Seboka, G.A. Ewunie, J. Morken, L. Feng, M.S. Adaramola, Potentials and prospects of solid biowaste resources for biofuel production in Ethiopia: a systematic review of the evidence, Biomass Conversion and Biorefinery (2023) 1–32, https://doi.org/10.1007/s13399-023-04994-0.
[124] L. Jones, S. Owen, L.R. Kahle, Consequences of legislating packaging behavior: Germany's green dot program and its communications, in: Communicating Sustainability for the Green Economy, Routledge, 2015, pp. 201–216, https://doi.org/10.4324/9781315705491.
[125] J. Gutberlet, T. Bramryd, M. Johansson, Expansion of the waste-based commodity frontier: insights from Sweden and Brazil, Sustainability 12 (7) (2020) 2628, https://doi.org/10.3390/su12072628.
[126] N. Kundariya, S.S. Mohanty, S. Varjani, H.H. Ngo, J.W.C. Wong, M.J. Taherzadeh, et al., A review on integrated approaches for municipal solid waste for environmental and economical relevance: monitoring tools, technologies, and strategic innovations, Bioresour. Technol. 342 (2021) 125982, https://doi.org/10.1016/j.biortech.2021.125982.
[127] P.A. Solomon, D. Crumpler, J.B. Flanagan, R.K. Jayanty, E.E. Rickman, C.E. McDade, US national PM2. 5 chemical speciation monitoring networks—CSN and IMPROVE: description of networks, J. Air Waste Manag. Assoc. 64 (12) (2014) 1410–1438, https://doi.org/10.1080/10962247.2014.956904.
[128] A.V. Shekdar, Sustainable solid waste management: an integrated approach for Asian countries, Waste Manag. 29 (4) (2009) 1438–1448, https://doi.org/10.1016/j.wasman.2008.08.025.

[129] J.C. Lang, Zero landfill, zero waste: the greening of industry in Singapore, in: Greening Industries in Newly Industrializing Economies, Routledge, 2014, pp. 189–215, https://doi.org/10.4324/9781315810447.
[130] W.S. Yang, W.S. Yang, J.K. Park, S.W. Park, Y.C. Seo, Past, present and future of waste management in Korea, J. Mater. Cycles Waste Manag. 17 (2015) 207–217, https://doi.org/10.1007/s10163-014-0301-7.
[131] A. D'Amato, M. Mazzanti, F. Nicolli, M. Zoli, Illegal waste disposal: enforcement actions and decentralized environmental policy, Soc. Econ. Plann. Sci. 64 (2018) 56–65, https://doi.org/10.1016/j.seps.2017.12.006.
[132] R. Lybæk, Development, operation, and future prospects for implementing biogas plants: the case of Denmark, in: Use, Operation and Maintenance of Renewable Energy Systems: Experiences and Future Approaches, Springer, 2014, pp. 111–144, https://doi.org/10.1007/978-3-319-03224-5_4.
[133] V.F. Mario, G. Dijkstra, P. Scholten, D. Sucozhañay, The effectiveness of inter-municipal cooperation for integrated sustainable waste management: a case study in Ecuador, Waste Manag 150 (2022) 208–217, https://doi.org/10.1016/j.wasman.2022.07.008.
[134] J. Morlok, H. Schoenberger, D. Styles, J. Galvez-Martos, B. Zeschmar-Lahl, The impact of pay-as-you-throw schemes on municipal solid waste management: the exemplar case of the county of Aschaffenburg, Germany, Resources 6 (1) (2017) 8, https://doi.org/10.3390/resources6010008.
[135] M.V. Bueno-Delgado, J.L. Romero-Gázquez, P. Jiménez, P. Pavón-Mariño, Optimal path planning for selective waste collection in smart cities, Sensors 19 (9) (2019) 1973, https://doi.org/10.3390/s19091973.