



Comparative Analysis of Waste Management Laws and Practices: Lessons for Nigeria from California, United States of America, and India*

Abstract

This study presents a comparative analysis of waste management laws and practices in California United States of America, and India, identifying actionable lessons for Nigeria. California, Extended Producer Responsibility promotes sustainable waste management. India, on the other hand, has introduced tax incentives, and subsidies. The research methodology adopted is doctrinal, focusing on analyzing existing data, literature, laws, regulations, and practices related to waste management in the State of California, the Republic of India, and Nigeria highlighting areas where Nigeria can improve its waste management framework. This paper finds that the legal and policy review reveals an excessive overlap and duplication of regulations and laws on waste management and environmental protection in Nigeria. Despite international agreements and local legislations, Nigeria fails to enforce these laws effectively, leading to ongoing threats to the environment. The paper also find that Nigerian government has not introduce fiscal incentives, such as tax Holidays for waste management companies, subsidies, and exemptions on import duties for recycling equipment and technologies leading to limited private sector involvement. Recommendations include adopting robust legal frameworks, incentivizing private sector participation, tax incentives and subsidies, adequate funding, enforcing Extended Producer Responsibility (EPR) policies, and enhancing community engagement through education and awareness campaigns.

Keywords: Comparative analysis; Waste management laws; Environmental protection; Fiscal incentives; Tax holidays; Recycling equipment

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1. Introduction

Waste management is one of the most pressing environmental challenges in today's world, particularly in rapidly developing countries like Nigeria. The situation is further compounded by limited resources, inadequate infrastructure, and weak governance in many developing nations, where waste management often consumes a disproportionate share of municipal budgets. For example, waste management authorities in low- and middle-income countries allocate between 3% and 15% of their city budgets to waste management, with approximately 90% of this expenditure directed solely toward waste collection.¹ Despite these significant investments, the effectiveness of waste management systems remains poor, leading to widespread environmental pollution and public health risks.

This paper aims to explore lessons that can be learned from the waste management practices of California, United States of America, and India—three regions that face their own unique challenges yet have adopted innovative approaches to tackle waste. By examining these practices, Nigeria can adapt and integrate strategies to develop a more sustainable and efficient waste management system. California, United States.

California has invested in waste-to-energy technologies, utilizing landfill gas for energy production and exploring advanced methods like anaerobic digestion to convert organic waste into biogas, which can be used as a renewable energy source.²

For Nigeria, adopting elements of California's comprehensive waste diversion policies could significantly reduce the volume of waste sent to landfills, decrease pollution, and generate energy from waste.

Although India is considered a developing country, much like Nigeria, it has made significant strides in waste management that Nigeria can learn from. Despite facing similar challenges such as rapid population growth, urbanization, and limited resources, India has implemented innovative and effective waste management practices that could provide valuable lessons for Nigeria.³ For instance, India has successfully promoted the segregation of waste at the source, a practice that helps in the efficient recycling and composting of materials.⁴ These initiatives, which are both environmentally sustainable

¹R. Singh, A. Yadav, *Informal waste pickers in India: 'A review of their contribution to waste management and challenges faced'*. *Journal of Resources, Conservation and Recycling*, (2016) 106, 181-190

²California Integrated Waste Management Act of 1989, *Cal. Pub. Res. Code §§ 40000-49620* (1989).

³R. Singh, A. Yadav, *Informal waste pickers in India: 'A review of their contribution to waste management and challenges faced'*. *Journal of Resources, Conservation and Recycling*, (2016) 106, 181-190

⁴S. M. Bharat, Government of India. *Swachh Bharat Mission: Guidelines for Implementation 2024*

and economically beneficial, could be adapted to Nigeria's context, where waste-to-energy technologies could help address the country's energy challenges.⁵

Despite the differences in waste management infrastructure and resources between California, India, and Nigeria, several lessons can be drawn from their respective experiences that could benefit Nigeria's waste management system: Developing a Comprehensive Waste Management Policy: California's regulatory framework, which encompasses everything from source reduction to recycling and waste-to-energy, provides a solid foundation for a national policy.

Nigeria should create an enabling environment for private companies to invest in waste management services, with a focus on innovation and sustainability.⁶

2. Comparative Analysis of Laws and Practices

2.1. State of California

Background of Waste Management Americans began recognizing the public health threat posed by improper chemical disposal in the 1970s. Multiple high-profile incidents led to public outcry – Love Canal in New York, A.L. Taylor (Valley of the Drums) in Kentucky, and multiple fires on the Cuyahoga River in Ohio. These incidents – caused by uncontrolled and improper management of hazardous materials and wastes – highlighted the need for specific waste management standards to be protective of public health and the environment. The United States Congress passed the Resource Conservation and Recovery Act (RCRA) in 1976 to address the increasing problems the nation faced from the growing volume of municipal and industrial waste. RCRA was an amendment to the Solid Waste Disposal Act of 1965, which was the first statute that specifically focused on improving solid waste disposal methods.

The California Integrated Waste Management Act of 1989, also known as Assembly Bill 939 (AB 939), as amended (Section 40000 et seq. of the California Public Resources Code (PRC)), established a foundational legislative framework aimed at addressing the growing challenge of waste management in California. One of the critical components of AB 939 is the requirement for each county to develop and implement a Countywide Siting Element.⁷

⁵ A. K. Sharma, & S. P. Sharma, *Waste-to-energy technologies in India: Policies and prospects*. *Journal of Environmental Science and Pollution Research*, (2018). 25(22), 21898-21910.

⁶ S. Pratt, S., *Waste Management Systems in the United States: Insights for Developing Countries*. *Journal of Waste Management & Research*, (2016) 34(6), 495–504.

⁷ Los Angeles County Countywide Integrated Waste Management Plan Annual Report 2020 Annual Report, October 2021 <https://dpw.lacounty.gov/epd/swims/News/swims-more-links.aspx?id=4> accessed January 20, 2025

The Resource Conservation and Recovery Act (RCRA)⁸ Subtitle C addresses waste management by establishing specific requirements for three categories of hazardous waste handlers Treatment, Storage, and Disposal Facilities (TSDFs) (U.S. EPA, 2021).⁹ For TSDFs, these requirements set technical standards for their design and safe operation to prevent the release of hazardous waste into the environment. Additionally, RCRA imposes restrictions on land disposal practices, ensuring that wastes are treated before disposal to reduce the mobility and/or toxicity of hazardous constituents in landfills (U.S. EPA, 2021).

The U.S. Environmental Protection Agency (EPA) delegates the primary responsibility for implementing the RCRA hazardous waste program to individual states. However, the EPA retains authority to administer the RCRA program in all states through its 10 regional offices (U.S. EPA, 2021). A state may seek authorization from the EPA to implement its own waste program, provided the state's program is at least as stringent as RCRA.

California is one of the 48 states authorized by the EPA to implement the RCRA program (California Department of Toxic Substances Control, 2020). California enacted its own Hazardous Waste Control Act (HWCA) in 1972, predating the federal RCRA. The state's waste program is more stringent and broader in scope than RCRA, regulating more wastes than the federal EPA and imposing additional regulatory requirements for managing those wastes. California has determined that these additional regulatory requirements are necessary to protect public health and the environment (California Department of Toxic Substances Control, 2020). Furthermore, California has adopted a policy of managing its hazardous waste within state borders rather than relying on out-of-state facilities.

2.2. Waste Management Hierarchy in California

The State of California employs a comprehensive and structured approach to waste management, centered on the concept of a "waste management hierarchy."¹⁰ This hierarchy prioritizes strategies based on their environmental impact, aiming to reduce the volume of waste and the harmful effects it has on the environment.¹¹ The basic structure of this hierarchy is as follows:

⁸Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901–6992k. Public Law 94-580, 90 Stat. 2795. Retrieved from <https://www.epa.gov/rcra/resource-conservation-and-recovery-act>. Accessed January 12, 2025

⁹ U.S. Environmental Protection Agency. (2021). Treatment, Storage, and Disposal Facilities (TSDFs). Retrieved from <https://www.epa.gov/hwpermitting/treatment-storage-and-disposal-facilities>. Accessed January 22, 2025

¹⁰California Department of Resources Recycling and Recovery (CalRecycle) (2020). *California Waste Management Hierarchy*. Retrieved from <https://www.calrecycle.ca.gov> accessed December 19, 2024.

¹¹ G. Tchobanoglous, & F. Kreith, (2002). *Handbook of Solid Waste Management*. (McGraw-Hill Education.

- i. *Source Reduction (Highest Priority)*: The most preferred method of waste management is source reduction. This involves minimizing waste generation at its source through strategies such as designing products with less material, using fewer toxic substances, and optimizing manufacturing processes. By reducing the amount of waste produced, the need for subsequent waste handling and disposal is greatly diminished, making it the most effective approach to managing waste sustainably.¹²
- ii. *Recycling*: The next priority in the hierarchy is recycling, which involves the collection and processing of used materials to create new products. Treatment is vital for managing wastes that cannot be easily recycled or reduced at the source but still require careful handling to mitigate their harmful effects.¹³
- iii. *Land Disposal (Lowest Priority)*: Finally, land disposal is considered the least preferable option and is only utilized when other methods are not feasible. By following this hierarchy, California aims to reduce the environmental impact of waste management, promote sustainability, and encourage a circular economy where resources are reused, recycled, and disposed of in the most environmentally responsible manner possible.¹⁴

Waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment¹⁵.

Wastes are considered hazardous if they exhibit any of the four characteristics of a hazardous waste as defined in 22 CCR sections 66261.21 through 66261.24 –ignitability, corrosivity, reactivity, and toxicity. Ignitable wastes can create fires under certain conditions, undergo spontaneous combustion, or have a flash point of less than 60°C (140°F). Used solvents are an example of ignitable waste.¹⁶

A waste may be corrosive if it is able to corrode metal containers, such as storage tanks, drums, and barrels. The characteristic of corrosivity is defined in 22 CCR section 66261.22. Reactive wastes are unstable under normal conditions.¹⁷

¹² A. L. Booth, & D. Wetherell, “*Waste Management and the Environment: A Global Perspective*”. *Environmental Science & Technology*, (2004). 38(21), 5320–5329.

¹³ Kinnaman, T. C. (2009). The Economic Impact of Recycling and Waste Reduction in the United States. *Journal of Environmental Economics and Management*, 58(1), 109–120.

¹⁴ United Nations Environment Programme (UNEP) (2019). *Global Waste Management Outlook*. United Nations Environment Programme, Nairobi

¹⁵ Geyer, R., & Lindner, J. (2010). Waste Management and Waste Minimization Strategies in California: A Policy Perspective. *Environmental Policy & Governance*, 20(6), 383–395.

¹⁶ Title 22 of the California Code of Regulations (CCR)

¹⁷ Normal conditions refer to standard set of conditions established at standard temperature and pressure (STP). The most used standards are those of the International Union of Pure and Applied Chemistry (IUPAC) and the

2.3. The California Code of Regulations (CCR), Title 27.

The California Code of Regulations (CCR), Title 27, establishes comprehensive guidelines for the management and protection of California's environment, specifically in relation to solid waste disposal and treatment practices. Title 27 addresses the legal framework for the management of solid waste, including detailed standards for the design, operation, and permitting of waste management facilities.

Solid waste division 2 of Title 27 focuses specifically on the management of solid waste. It outlines the technical and regulatory requirements for solid waste treatment, storage, processing, and disposal.

Subdivision 1¹⁸ consolidates the regulations for the treatment, storage, processing, and disposal of solid waste. It offers a unified approach to managing waste, ensuring that all facilities involved in these activities are subject to the same set of standards, regardless of the nature of the waste being processed or disposed of. This subdivision provides a standardized framework for the siting, construction, and operation of waste management units and facilities across California.

Chapter 3¹⁹ sets forth the criteria that apply to all waste management units, facilities, and disposal sites in California. These criteria ensure that facilities are built and operated in ways that minimize environmental harm and protect human health. Chapter 3 outlines the requirements for site location, facility design, and the operations of solid waste management units. The regulations are structured to address potential risks of contamination, leachate formation, and other environmental impacts associated with waste disposal.

2.4. Listed Waste pursuant to California Code of Regulations (Cal. Code Regs.), title 22 (tit. 22), § 66261.3.

Hazardous waste is classified as either being subject to RCRA, found in 40 Code of Federal Regulations (CFR), or subject to HSC and Cal. Code Regs., tit. 22. In California, there are five types of wastes organized into five lists – F-list, K-list, P-list, U-list, and M-list. The F-list identifies wastes from many common manufacturing and industrial processes, such as solvents that have been used for cleaning or degreasing. Since the processes producing these wastes occur in many different industry sectors, F-listed wastes are referred to as wastes from non-specific sources. Non-specific means they do not come from one specific industry or one specific industrial or manufacturing process.

National Institute of Standards and Technology (NIST). NIST defines STP as absolute pressure of 1 atm (101.325 kPa, 14.696 psi) and 20 degrees Celsius (293.15 degrees Kelvin, 68 degrees Fahrenheit)

¹⁸[27 CA Code of Regs 2.1](#)

¹⁹[27 CA Code of Regs 2.1](#)

The F-list appears in the hazardous waste regulations in 22 CCR section 66261.31. The K-list includes certain wastes from specific industries, such as petroleum refining or pesticide manufacturing. Examples of source-specific wastes include certain sludges and wastewaters from treatment and production processes in these specific industries. The K-list appears in the hazardous waste regulations in 22 CCR section 66261.32.

2.5. Waste Treated on Site and Recycled On or Off Site

Health and Safety Code § 25135(b)(1)(G)(i)(ii) requires an estimate of the types and volumes of hazardous waste that are treated on site and recycled on or off site. The California Environmental Reporting System (CERS) contains information about specific facilities that treat hazardous waste on site and facilities that recycle on or off site. Among the processes used to treat or recycle waste include are the distillation of solvents, neutralization of acidic or basic wastewaters, separation of oily materials for return to refinery processes, and treatment of cyanide wastewaters at plating facilities.²⁰

Any retrograde material that has not been used, distributed, or reclaimable through treatment by the original manufacturer or owner by the later of the following dates: a. One year after the date when the material became a retrograde material b. One year after the material has been returned to the original manufacturer.²¹

2.6. Waste Treated on Site

Title 12 of the United States Environmental Protection Agency (EPA) regulations allows generators to treat their waste on site in tanks or containers without a permit if they meet certain requirements. However, California requires any person who treats hazardous waste to obtain a hazardous waste facility permit or other grant of authorization.²²

California has a comprehensive five-tier permitting program for managing hazardous waste facilities, designed to align the permitting requirements with the complexity of the facility's operations and the extent of any treatment performed. These tiers allow for flexibility while ensuring compliance with state and federal environmental laws.

The five tiers are as follows:

i. Full Resource Conservation and Recovery Act (RCRA) Permit

This is the most comprehensive permit required for facilities that handle hazardous waste under the federal RCRA program. It applies to facilities with complex operations

²⁰ M. Williams, Hazardous Waste Management Report: (*Implementation of California Health and Safety Code Section 25135* (2024))

²¹ Cal. Code Regs., tit. 22, § 66260.10

²² Cal. Code Regs., tit. 22, § 66260.10

and significant environmental impact risks, such as large treatment, storage, and disposal facilities²³.

ii. Standardized Permit Tier

This tier applies to facilities that manage specific types of hazardous waste and meet standardized operational and environmental protection criteria. Facilities under this tier typically have less complex operations than those requiring a full RCRA permit.²⁴

iii. Permit by Rule (PBR) Tier²⁵

Facilities in this category do not require an individual permit but must comply with specific regulatory standards set by rule. This tier is typically for facilities performing limited treatment activities that pose minimal environmental risk, such as neutralizing hazardous waste onsite²⁶.

iv. Conditional Authorization Tier

This tier is for facilities that meet specific conditions set by the California Department of Toxic Substances Control (DTSC). Conditional authorization applies to facilities performing particular treatment processes that are low-risk and well-regulated.²⁷

v. Conditional Exemption Tier

This is the least restrictive permitting tier and includes four subcategories for facilities that handle very low-risk activities. Facilities under this tier must comply with simplified regulatory requirements and are typically exempt from more stringent permitting processes.²⁸

The five-tier system ensures that hazardous waste management in California is tailored to the potential risks and operational complexities of each facility, promoting environmental safety while allowing for efficient regulation.

2.7. Zero Waste California program

The Zero Waste California program is a state initiative aimed at redefining the state's approach to waste management²⁹. It embodies a transformative vision of waste, prioritizing sustainability, resource conservation, and environmental responsibility. The core philosophy of Zero Waste California is grounded in the belief that wasting resources

²³ Resource Conservation and Recovery Act (RCRA) Permit, 42 U.S.C. § 6901 et seq. (1976).

²⁴ Section 25201.6 of the California Health and Safety Code (HSC)

²⁵ Permit by Rule (PBR) Tier, California Code of Regulations, Title 22, Section 67450.2 (2001).

²⁶ Cal. Code Regs., tit. 22, § 67450.1 through § 67450.13

²⁷ Section 25200.3 of the California Health and Safety Code

²⁸ Section 5201.5 of the California Health and Safety Code

²⁹ The Zero Waste California program is part of the Strategic Waste Plan adopted by CIWMB (now CalRecycle)

is fundamentally inefficient and that maximizing the utility of natural resources is essential for both environmental protection and economic prosperity. At its heart, the Zero Waste approach emphasizes the importance of designing products and systems that minimize waste generation across their entire lifecycle. This involves ensuring that products are designed for environmental sustainability—with the capacity to be reused, repaired, or recycled, rather than discarded after a single use. The program advocates for a circular economy, where materials flow in continuous loops, reducing the need for virgin resources and minimizing the environmental harm caused by waste disposal.³⁰

Key components of the Zero Waste California program include: Maximizing Recycling and Reuse Efforts: Zero Waste California builds on existing recycling and waste diversion practices, ensuring that materials are kept in use for as long as possible. It focuses not only on increasing recycling rates but also on reducing consumption and extending product life cycles through innovative reuse strategies. By maximizing material recovery, the program reduces the volume of waste that ends up in landfills and incinerators, thus decreasing the environmental impact of waste disposal.³¹

2.8. *Research and Development of Sustainable Technologies:*

Another critical aspect of the program is supporting the innovation and development of new technologies that can enhance waste diversion, recycling, and resource recovery. By investing in research and technological advancements, Zero Waste California aims to improve the efficiency and effectiveness of waste management systems while exploring new ways to recover value from waste.

Zero Waste California also places a strong emphasis on public education and engagement, helping Californians understand the importance of waste reduction, recycling, and sustainable consumption. Through outreach initiatives, educational campaigns, and partnerships with community organizations, the program empowers individuals and businesses to make environmentally conscious decisions and adopt zero-waste practices in their daily lives.

³⁰ California Department of Resources Recycling and Recovery (CalRecycle). (n.d.). *Zero Waste California program*. Retrieved from <https://www.calrecycle.ca.gov/> accessed January 10, 2024

³¹ U.S. Environmental Protection Agency (EPA). *Sustainable materials management: (Non-hazardous materials and waste management hierarchy (2020).)*. Retrieved from <https://www.epa.gov/smm> accessed January 22, 2025

2.9. California Budget for Waste Management

The California's Governor budget for 2022-2023 proposes a total of \$13 billion in expenditures from various sources—the General Fund, various special funds, bond funds, and federal funds—for programs administered for waste management³².

2.10. Impact of Zero Waste California

The success of Zero Waste California relies on collaboration between government agencies, industry stakeholders, and the general public. By aligning waste management practices with sustainability goals, the program works towards reducing the state's reliance on landfills and incineration, promoting a cleaner and healthier environment for future generations.

In addition to its environmental benefits, Zero Waste California has the potential to drive economic growth by creating new green jobs in sectors such as recycling, remanufacturing, and sustainable product design. The program also aims to reduce the economic costs associated with waste disposal, such as landfill fees and the environmental costs of extracting virgin resources. By embracing the principles of Zero Waste, California is positioning itself as a leader in the global movement towards sustainability, showcasing the potential for large-scale waste diversion and resource recovery.³³

3. India Waste Management Laws and Practices

India's environmental governance is rooted in the principles of sustainability and constitutional mandates for environmental protection.³⁴ India is the seventh-largest contributor to Solid Waste Generation (SWG) globally.³⁵ The current SWG rate in the country stands at approximately 0.34 kg per capita per day, and it is projected to rise significantly to 0.7 kg per capita per day by this 2025. By the year 2030, India is expected to generate an estimated 165 million tonnes of solid waste annually.³⁶

³² R. W. Davies, S.J. Cripps, *et al* 'Defining and Estimating Global Marine Fisheries Bycatch.' *Journal of Marine Policy* (2023) 33: 661-72. Also see <https://lao.ca.gov/reports/2016/3354/resources-analysis-021616.pdf> accessed January 2, 2025

³³ M. A. Olong, 'Human Rights, the Environment and Sustainable Development: Nigerian Women's Experiences' (2012) 5(1) *Journal of Politics and Law* 100, 108.

³⁴ Lebreton, L. C., Van Der Zwet, J., Damsteeg, J.-W., Slat, B., Andrady, A., &Reisser, J. (2017). "River plastic emissions to the world's oceans." *Nature Communications*, 8(1), 15611

³⁵ Municipal Solid Waste (Management & Handling) Rule, India. Ministry of Environment Forest and Climate Change-Govt. of India; 2024. Available from: https://cpcb.nic.in/uploads/MSW/SWM_2016.pdf.

³⁶ S. Kaza, L., Bhada-Tata, *et al.*, *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. World Bank Publications (2018). Vol.2334 p. 456-788

Over the decades, the country has established a robust legal framework to address the challenges posed by industrialization, urbanization, and environmental degradation. Among these, the Environment Protection Act, 1986, stands out as a cornerstone of India's environmental legislation. Enacted in response to the Bhopal Gas Tragedy (1984), this Act empowers the central government to take comprehensive measures for the protection and improvement of the environment. It complements a range of other environmental laws, including the Water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, and the Wildlife Protection Act, 1972, forming a cohesive legal structure. The Act's provisions aim to regulate environmental pollution, penalize violators, and ensure accountability at individual and corporate levels. By embodying principles like the Polluter-Pays Principle and enabling swift action in emergencies, the legislation highlights India's commitment to balancing economic growth with environmental sustainability.

3.1. Policy and Regulatory Framework in India

The Ministry of Environment and Forests (MoEF) and the pollution control boards: Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) together form the regulatory and administrative core of the sector.³⁷

3.2. Legislation

Under the Environmental Protection Act (EPA) 1986, MoEF has issued several notifications to tackle the problem of hazardous waste management. These include: Municipal Wastes (Management and Handling) Rules, 2000; Biomedical Waste (Management and Handling) Rules, 1998; Hazardous Wastes (Management and Handling) Amendment Rules, 2000; Environmental Protection Rules (1986) The Environmental Protection Rules, enacted under the Act³⁸, provide detailed directives for implementation.

Key provisions include standards for emissions and discharges (Section 3) which industries must comply with prescribed standards for emissions and discharge of pollutants. A one-year compliance period is generally provided, though it can be shortened by the Central or State.³⁹

3.3. Use of Hazardous Waste for the Purpose of Energy

The use of hazardous waste as a resource for energy recovery may similarly only be carried out by the units after obtaining approval from the Central Pollution Control

³⁷ . A. V. Bhambulkar, & I. P. Khedikar. 'Municipal solid waste (MSW) collection route for Laxmi Nagar by geographical information system'. *Int. J. Adv. Eng. Technol.* (2024);2:48-53. Available from: <https://www.technicaljournalsonline.com>.

³⁸ Environmental Protection Act (EPA) 1986, India

³⁹ S. 3, Environmental Protection Act (EPA) 1986

Board. Importing of Hazardous Waste for disposal is prohibited in India. The only purpose for which import may be allowed is for purpose of recycling, recovery and reuse.

3.4. Treatment, Storage and Disposal Facility for Hazardous Wastes

Any persons wishing to operate a ‘facility’, which is any establishment wherein the processes incidental to the handling, collection, reception, treatment, storage and recycling, recovery, reuse and disposal of hazardous wastes are carried out, must design and set up the Treatment, Storage and Disposal Facility in compliance with the technical guidelines issued by the Central Pollution Control Board.

3.5. The Polluter-Pays Principle

Section 9(3) incorporates the Polluter-Pays Principle, allowing authorities to recover expenses, including interest, incurred in addressing violations⁴⁰. This principle enforces strict penalties for ongoing offences: Imprisonment for up to five years. Fines up to ₹100,000 (about ₦1,887,200). An additional fine of ₹5,000 for every day the offence continues.

3.6. Lifting the Corporate Veil

The Act holds company officials accountable for environmental offences committed with their consent or connivance. Directors, managers, secretaries, or other officers may be individually prosecuted, emphasizing that corporate identity does not shield individuals from liability.

3.7. India’s Journey Towards Zero Waste and Sustainable Living Has Just Begun

India's journey towards zero waste and sustainable living is in its holistic stages, with efforts spanning from household waste segregation to recycling and composting.⁴¹

India emphasizes waste segregation at the source into dry, wet, and hazardous categories to reduce landfill dependency. The adoption of the 3R (Reduce, Reuse, Recycle) strategy has been central to minimizing waste generation.

In 2024, cities like Indore, Surat, and Navi Mumbai were celebrated as India's cleanest cities due to innovative waste management practices. Indore's success is built on a robust system involving door-to-door collection, waste segregation, composting, and public awareness campaigns. Surat has upgraded its sanitation and waste infrastructure, notably with underground bins equipped with sensors. Navi Mumbai's initiatives, such as "Zero

⁴⁰ S. 9 (3) of the Environment Protection Act of 1986

⁴¹ S. Kaza, L., Bhada-Tata, et al., What a Waste 2.0: ‘A Global Snapshot of Solid Waste Management to 2050’. *World Bank Publications* (2018) vol. 345 p. 448-456

Waste Slums," a "Dry Waste Passbook," and a "Septic Tank-Free City Plan," demonstrate effective urban waste management.⁴²

Bengaluru's "Hasiru Dala" (Green Force) initiative exemplifies community-driven SWM. Waste pickers, in collaboration with the Bruhat Bengaluru Mahanagara Palike (BBMP), segregate dry waste at the source and deliver it to designated Dry Waste Collection Centers. This model not only reduces landfill waste and promotes recycling but also provides livelihood opportunities and dignity to waste pickers.⁴³

Innovative waste management practices are reshaping urban sustainability across India. For instance: Indore's bio-methanation plant converts vegetable market waste into bio-CNG, fueling public transport and reducing the carbon footprint. Bhopal's smart bin sensors enable real-time waste collection tracking, enhancing efficiency. Mouda, Maharashtra, utilizes the Chase App for optimized waste collection through real-time worker tracking. Panaji, Goa, links user charges to property taxes, funding waste management with six organic waste converters and 70 recycling units. Rajkot's bio-methanation plants and "Reverse Vending Machines" encourage composting and recycling.

Lucknow's floral waste is converted into incense sticks in partnership with NGOs, empowering women and reducing waste. Efforts like these align with the Smart Cities Mission and Solid Waste Management (SWM) initiatives, which integrate technology and infrastructure to address urban waste challenges. However, issues such as urban sprawl and societal attitudes persist. Decentralized waste processing, citizen awareness, and accurate waste data are critical for sustainable progress.⁴⁴ India is also advancing towards a circular economy, driven by political commitment to the Sustainable Development Goals (SDGs).

3.8. Notable initiatives include

The Refuse Derived Fuel Used Cooking Oil Van (RUCO Van) by Council of Scientific and Industrial Research (CSIR)-Indian Institute of Petroleum (Dehra Dun), which collects used cooking oil and converts it into biofuel. Steel slag road technology by CSIR-Central Road Research Institute (CRRI), New Delhi, which repurposes steel slag waste for road construction. *Sampurn(e)arth*, an NGO in Mumbai, effectively manages segregated waste by converting wet waste into biogas, electricity, and fertilizer and

⁴² S. Survekshan. Annual Sanitation Survey Report. (Ministry of Housing and Urban Affairs, Government of India (2024).

⁴³ H. Dala. Empowering Waste Pickers for Sustainable Waste Management. *Journal of Waste Management* (2023). 345. Retrieved <https://hasirudala.in/> accessed January 28, 2025.

⁴⁴ Ministry of Housing and Urban Affairs (MOHUA). *Smart Cities Mission Progress Report*. (Government of India. (2024)

further recycling dry waste like e-waste, paper, and textiles. Despite being the seventh-largest solid waste generator globally, India is steadily making strides towards zero waste and sustainable living, with innovative solutions paving the way.⁴⁵

3.9. Fiscal Incentives Driving Waste Management Projects

India's efforts toward achieving zero waste are showing promising results, significantly driven by the government's decision to engage private companies/public sections in waste management at the source. By allowing private companies to sort and manage waste through innovative approaches, India has fostered a collaborative environment that leverages fiscal incentives to accelerate progress in waste processing and recycling initiatives.⁴⁶

The government has introduced a range of fiscal measures to encourage private sector participation, making waste management projects financially viable and attractive:

- i. *Tax Holiday:* Companies engaged in waste management projects benefit from a 10-year, 100% deduction of profits and gains, ensuring long-term financial sustainability and incentivizing investment in this sector (CPCB, 2022).
- ii. *Tax and Duties Relief:*
- iii. *Direct Taxes:* Waste project operators are eligible for 100% depreciation within the first year of project installation, providing immediate financial relief and encouraging rapid adoption of waste processing technologies.⁴⁷
- iv. *Excise Duty Exemptions or Reductions:* Companies can avail exemptions or reductions in excise duties for materials and equipment required in waste management and renewable energy (RE) projects⁴⁸.
- v. *Central Sales Tax and Customs Duty Concessions:* Concessions are provided on the import of materials, components, and equipment used in RE and waste management projects, reducing the financial burden on companies aiming to implement sustainable solutions.⁴⁹
- vi. *Duty-Free Import of Renewable Energy Equipment:* Equipment essential for renewable energy and waste-to-energy projects can be imported duty-free, further lowering project costs and encouraging advanced technology adoption.

⁴⁵ L.C. Lebreton, "River plastic emissions to the world's oceans." *Nature Communications*, (2017). 8(1), 15611

⁴⁶ Central Pollution Control Board (CPCB). (*Annual Report on Solid Waste Management in India* (2022).

⁴⁷ Press Information Bureau (PIB). (*Indian Government Initiatives for Waste Management and Renewable Energy*. (2023) <https://pib.gov.in/> accessed January 2, 2025

⁴⁹ Ministry of New and Renewable Energy (MNRE). (*Waste-to-Energy and Renewable Energy Integration Report*. (2022) <https://mnre.gov.in/en/> accessed December 29, 2024.

- vii. *Electricity Tax Exemptions:* To support waste-to-energy and recycling projects, the government offers exemptions from electricity taxes, reducing operational costs and promoting energy-efficient waste management practices.⁵⁰

These fiscal incentives have enabled private companies to innovate and expand their operations in areas such as Waste Segregation at Source. Private entities are actively involved in educating households and industries about proper waste segregation into dry, wet, and hazardous categories. This practice significantly reduces the volume of waste sent to landfills, making recycling and composting more efficient⁵¹.

- viii. *Waste-to-Energy Projects:* Incentives for renewable energy have driven the establishment of bio-methanation plants, which convert organic waste into bio-CNG and electricity.

- ix. *Recycling Infrastructure Expansion:* Tax benefits and duty exemptions have allowed companies to invest in advanced recycling technologies, enabling the reuse of materials like plastic, metal, and e-waste on a larger scale.⁵²

3.10. Plastic Recycling

Recycling of plastics in India is strictly regulated and must adhere to the specifications outlined by the Bureau of Indian Standards (BIS) under IS 1453: 1998, entitled “The Guidelines for Recycling of Plastics.”⁵³ These guidelines serve as the foundation for ensuring that plastic recycling is conducted in an environmentally responsible and standardized manner. Furthermore, manufacturers are required to comply with specific codification and marking standards to ensure transparency and traceability of their plastic products. Each bag or container made of plastic must be clearly marked to indicate whether it is made of virgin plastic, recycled plastic, or biodegradable plastic.⁵⁴

If a bag or container is made from recycled plastic, it must be labeled as “recycled” and include a clear indication of the percentage of recycled material used. Additionally, a code mark that conforms to the BIS specification ISI/ISO 17088: 2008, entitled “Specifications for Compostable Plastics,” must be affixed to such products. Similarly, carry bags or containers made from biodegradable plastics must also bear a code or mark in compliance with the same BIS specification and must be explicitly marked as either “compostable” or “biodegradable during composting.”⁵⁵

⁵⁰ United Nations Development Programme (UNDP) India. (Sustainable Development Goals and Waste Management Progress in India (2023)). <http://undp.org/india> accessed January 1, 2025

⁵¹ *ibid*

⁵² *ibid*

⁵³ Bureau of Indian Standards IS 14534: 1998, entitled “The Guidelines for Recycling of Plastics

⁵⁴ Bureau of Indian Standards IS 14534: 1998, Rule. 3

⁵⁵ Bureau of Indian Standards IS 14534: 1998, Rule. 8

The information provided on these marks must be clear and legible in English, Hindi, or the local language of the region. It should also include the name and address of the manufacturer, the registration number issued by the relevant State Pollution Control Board (SPCB) or Pollution Control Committee (PCC), and the size and thickness of the carry bag or container. In addition to labeling requirements, manufacturers of carry bags or containers made from either virgin or recycled plastics are mandated to register with the SPCB or PCC operating within their respective state or Union Territory.⁵⁶

4. Learning From India and Improving Waste Management in Nigeria

4.1. Lessons Learnt

India has faced similar challenges in waste management but has made significant strides through government interventions, private sector engagement, and community participation. Nigeria can adopt the following strategies observed in India:

1. Integrated Waste Management Framework

India has established a well-coordinated waste management framework that includes segregation at source, recycling, and waste-to-energy projects. The *Plastic Waste Management Rules, 2016*, for instance, mandate Extended Producer Responsibility (EPR), requiring manufacturers to take responsibility for the collection and recycling of their products. Nigeria can adopt a similar EPR framework to enhance accountability among producers of plastic and electronic products.

2. Innovative Recycling Practices

India has encouraged advanced recycling technologies to manage non-biodegradable waste:

- *Plastics*: Private companies and startups in India recycle plastics into building materials, roads, and other industrial products. For example, India has pioneered the use of plastic waste to construct roads, which are more durable and cost-effective.
- *E-Waste*: By fostering partnerships with private companies, India has developed e-waste recycling plants to safely extract valuable metals like gold, silver, and copper from discarded electronics.⁵⁷

⁵⁶ Bureau of Indian Standards, ISI/ISO 17088: 2008 - Specifications for Compostable Plastics.

⁵⁷ J. Anunobi. Hazardous Effects of Plastic Wastes on Land Biodiversity: A Review (*Seminar Paper in the Department of Science Laboratory Technology, Federal Polytechnic, Idah, Kogi State. 2023*)

- *Scrap Metals*: India's metal recycling industry has flourished due to incentives like duty-free imports of recycling equipment and subsidies for scrap metal processing plants.

3. *Community Participation and Awareness*

Public awareness campaigns and community involvement in waste segregation at the source have been game-changers in India. Programs such as *Swachh Bharat Abhiyan (Clean India Mission)* emphasize waste segregation, cleanliness, and behavioral change at the grassroots level. Nigeria can replicate such initiatives to educate communities on the importance of proper waste disposal and recycling.

4. *Fiscal Incentives for Waste Management*

India provides fiscal incentives to attract private sector investment and promote innovation in waste management:

- Tax holidays for companies operating in waste management projects.
- Duty-free import of equipment for recycling and renewable energy projects.
- Subsidies for waste-to-energy plants and recycling infrastructure.

Nigeria can adopt similar measures to encourage private sector participation and foster innovation in recycling technologies.

5. *California's Waste Management Framework and Its Lessons for Nigeria*

California's legislative and regulatory framework for waste management provides a model that Nigeria can draw from to address its own waste management challenges. The California Integrated Waste Management Act of 1989 (AB 939), codified in the California Public Resources Code, serves as a foundational policy aimed at sustainable waste management, emphasizing waste reduction, recycling, and environmentally sound disposal practices.

Key Aspects of California's Waste Management Framework Countywide Siting Elements and Waste Diversion under AB 939, each county is required to develop a Countywide Siting Element to manage waste. These siting elements ensure sufficient capacity for waste disposal while prioritizing sustainable practices. Nigeria can adopt a similar approach by mandating local governments to identify and secure sites that meet technical and environmental standards for waste management facilities.

The Resource Conservation and Recovery Act (RCRA) and California's Hazardous Waste Control Act (HWCA) establish stringent protocols for hazardous waste management. These include treatment, storage, and disposal requirements, ensuring that hazardous waste is treated to reduce toxicity and environmental risks. Nigeria could benefit from establishing a robust hazardous waste program, incorporating elements such

as: Treatment facilities for hazardous materials, site-specific guidelines for safe disposal, and capacity-building to enforce compliance with regulatory frameworks.

5.1. Waste Management Hierarchy

California employs a structured waste management hierarchy:

Reducing waste at its origin, a priority that aligns with Nigeria's need to address waste generation in urban areas. Promoting recycling industries to reclaim materials and reduce reliance on virgin resources. Stabilizing hazardous materials to minimize environmental harm. Used only as a last resort, with stringent requirements to prevent contamination. Nigeria can implement a similar hierarchy to systematize waste management efforts, prioritizing waste reduction and recycling over landfill use.

California's Title 27 of the California Code of Regulations (CCR) establishes a detailed regulatory framework for solid waste management, addressing facility design, siting, and operation. This ensures uniform compliance across the state. Nigeria could establish a regulatory system modeled on Title 27, incorporating Geological and hydrological site assessments for waste facilities; Standards for facility design and containment and Monitoring systems to prevent leachate and groundwater contamination.

5.2. Zero Waste California Program: A Vision for Nigeria

Encouraging public-private partnerships to foster innovation in waste management. Nigeria could implement a similar initiative, engaging stakeholders to shift toward a circular economy. This would reduce dependency on landfills, create jobs in the recycling and waste management sectors, and protect the environment.

5.3. Data-Driven Approaches to Waste Management

California leverages systems like the California Environmental Reporting System (CERS) to track hazardous waste generators and treatment activities. By gathering data, the state can identify trends, allocate resources, and enforce compliance. Nigeria could establish a centralized waste reporting system to provide real-time data on waste generation, treatment, and recycling efforts, enabling more effective policy interventions.

6. Nigeria's Path Forward

Fostering international partnerships for knowledge transfer and funding can accelerate progress. California's leadership in waste management serves as a guide for Nigeria to develop a sustainable system that not only mitigates environmental risks but also creates economic opportunities through resource conservation and a circular economy.

California's \$13 billion budget for waste management in the 2022-2023 fiscal year provides an excellent model for Nigeria to address its waste management challenges.

Drawing inspiration from this comprehensive approach, Nigeria can adopt strategies to improve its waste management systems and environmental policies. The waste management budget is funded through a combination of the General Fund, special funds, bond funds, and federal funds, enabling a robust and sustainable financial framework. Nigeria can diversify its funding by leveraging federal and state budgets, public-private partnerships, international grants, and green bonds. Collaboration with organizations like the World Bank, UNDP, and UNEP can provide additional funding and technical expertise.

Investment in infrastructure and grants for recycling and waste reduction programs are prioritized. Nigeria can develop recycling hubs and incentivize businesses to adopt sustainable waste management practices.

Nigeria can modernize its landfill management by adopting technologies for waste-to-energy conversion and implementing policies that promote waste diversion into recycling or reuse.

7. Conclusion and Recommendations

7.1. Conclusion

The State of California and India's success in addressing waste through legislative reforms, tax incentives, subsidies, public-private partnerships, and community involvement provides valuable lessons for Nigeria. By adopting a similar approach, Nigeria can enhance its waste management practices, mitigate environmental degradation, and contribute to global efforts to combat climate change. The integration of fiscal incentives, innovative recycling technologies, and public awareness campaigns will be pivotal in transforming Nigeria's waste management landscape.

7.2. Recommendations

To encourage private sector participation and investment in waste management, the government should implement targeted fiscal incentives, such as offering tax breaks and subsidies to companies involved in recycling, composting, and waste-to-energy projects, while also exempting essential recycling equipment and technologies from import duties to reduce operational costs and make these investments more financially viable for operators.

Introduce and enforce robust Extended Producer Responsibility (EPR) policies, specifically targeting plastics and electronic products, to hold manufacturers accountable for the entire lifecycle of their products, including post-consumer waste.