IWMI
International Water Management Institute

Policy Brief

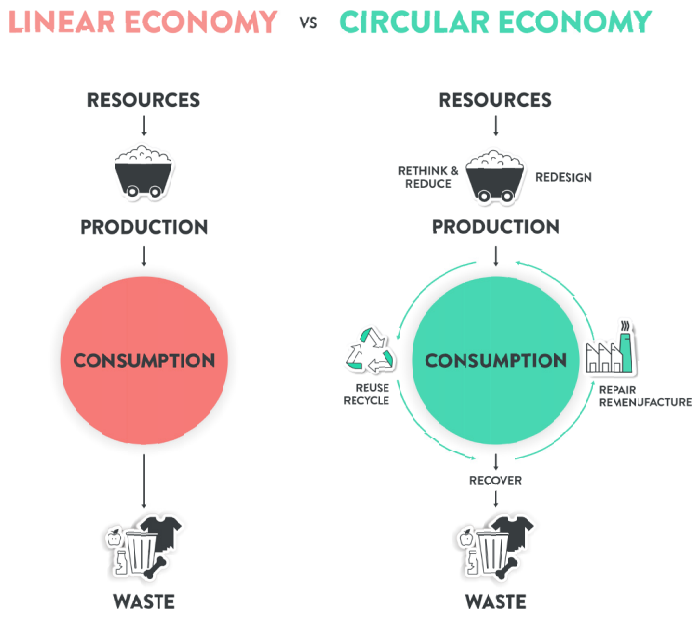
Regulations drive circular bioeconomy in emerging economies, but further action is required

Key messages

- Circular bioeconomy (CBE)[1] in the global south is strongly driven by climate change funding allocated to minimize greenhouse gas (GHG) emissions and to support green energy.
- However, funds are often limited to clean energy despite policies increasingly supporting circular systems, as the waste sector is usually perceived as less interesting financially.
- Waste-related regulations focused more on potential environmental and human health risks compared to viewing waste as a resource. Hence, regulations that support the polluter-pays-principle and promote waste as valuable materials in transition are key steps towards a paradigm shift.
- Creating a suitable ecosystem for private investments and operations, is another key step towards a paradigm shift, followed by the support of institutional capacities and infrastructures.
- A few countries, namely Singapore, Brazil, China, Japan, South Korea, Ghana and South Africa are at the forefront of promising regulatory frameworks that enable CBE implementation. These countries created regulatory ecosystems through statutory agencies to monitor solid and liquid waste management (collection and treatment systems); involve the private sector; financial mechanisms; and the legal recognition of reuse.

Context

The need to reduce GHGs from organic waste in landfills is a strong driver for CBE. Regulations incentivizing waste minimization are an important component of this transition including labeling waste as a 'resource' instead of a 'hazard' to banning organic waste from ending up in landfills. Climate change adaptation and related funding are probably a stronger and more tangible incentive for change than the original rationale of the circular economy (CE) of a more sustainable use of our resources than commonly practiced in a linear economy.



Comparison between linear economy and circular economy (*photo*: Whale Design/ Shutterstock).

[1] Circular bioeconomy (CBE) is a subset within the circular economy (CE) which targets minimizing organic waste from different sources, including sanitation, by recovering resources like biomass and crop nutrients, rejuvenating natural capital, and replacing non-renewable fossil-based energy.

Figure 1 outlines the transformation of waste-related regulations towards a CBE in the Global South which involves enforcing environmental safety and waste management regulations, formulation of policies and strategies for eventually promoting resource recovery from waste, and supporting private sector participation through the provision of subsidies, development of public-private partnerships and improving access to new markets as discussed further in the following sections.

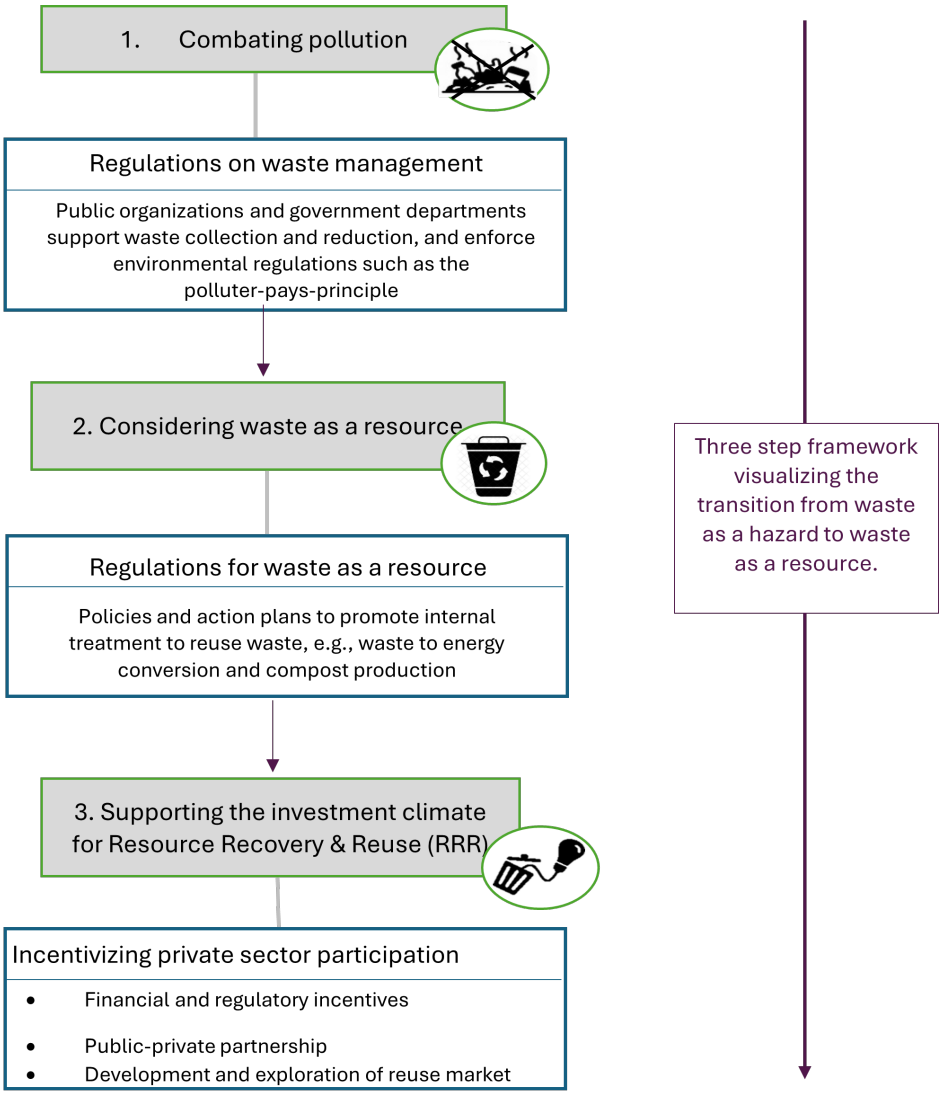


Figure 1. Transformative change of regulations towards a circular bioeconomy (CBE).
Source: Authors

The current status of CBE in emerging economies

CE (or CBE if organic waste is targeted) is still an emerging concept in many countries, despite increasing global dialogue, support (e.g., Green Growth), and related regulatory frameworks targeting sustainable energy, waste management and Resource Recovery and Reuse (RRR) principles. So far, the most prominent laws, policies, strategies, and action plans are those addressing the need for a low-carbon economy that promotes the use of renewable energy resources, particularly wind and solar energy. The more traditional transformation of organic waste to biogas or compost, which would be central to the CBE, receives a lower business interest.

However, there are differences in the CBE between countries. For example, India, Cambodia, Kenya, Rwanda and Colombia, are leading other countries within their respective regions by providing fiscal incentives and subsidies for renewable energy including waste-to-energy production and biogas production.

Similar to any transition, progress takes place step by step. Most countries still consider solid waste and wastewater as a burden, not an opportunity. Therefore, environmental regulations primarily target risk reduction, with environmental authorities or a 'Pollution Control Board' mandated to implement and safeguard the regulations. The regulatory frameworks are designed to address waste collection and reduction based on environmental and human health concerns, and limited to guidelines and standards to ensure the (risk free) quality of processes and products.

Without strict quality controls, RRR might even be disapproved. This applies in particular to wastewater reuse in agriculture

despite increasingly liberal World Health Organization (WHO) and Food and Agriculture Organization of the United Nations (FAO) guidelines promoting multiple barriers on the reuse pathway (WHO 2006; Drechsel et al. 2023).

Some countries such as India, the Philippines, Vietnam and Colombia are, for example, promulgating the implementation of the polluter-pays-principle to address water pollution (Box 1), or charging households a waste collection fee. By imposing additional costs based on environmental impact, the polluter-pays-principle[2] encourages resource-efficient practices, discourages pollution, and stimulates the exploration of internal treatment and reuse options.

Box 1. Imposition of penalties against violation of environmental laws

In India, the National Green Tribunal (NGT) under the Supreme Court imposed fines of approximately INR 2,218 billion (USD 26.42 billion) to six states, namely Maharashtra, Telangana, West Bengal, Rajasthan, Karnataka and Punjab for discharging untreated liquid waste and unprocessed legacy waste based on the 'Polluter-Pays-Principle'. Also, in the Philippines the Pollution Adjudication Board (PAB) of the Department of Environment and Natural Resources (DENR) fined a total of PHP 43 million (USD 0.76 million) to 219 business establishments in Boracay for discharging of water pollutants and untreated wastewater exceeding the effluent standards. Similar cases have been reported in Sri Lanka, Rwanda, Ethiopia, and Peru as well (Reuters 2013; Wijedasa 2019; Amare 2019: Kayiranga 2021).

An important second step is accepting waste as 'materials or resources in transition'. With this, the 3R principles of 'reduce', 'reuse' and 'recycle' are linked to promoting a more waste-conscious consumer and industry behavior supported by positive or negative incentives, including penalties.

In 2010, Ghana took this step and identified waste in its National Environmental Sanitation Strategy and Action Plan (NESSAP)[3], as "materials in transition" (MINT), demonstrating that waste has the potential to reduce costs for waste management and/or can be of value to other sectors. The NESSAP highlighted waste segregation, reuse, recycling, and similar practices as effective strategies to manage waste, reduce environmental impacts, create green jobs, and lower waste management costs.

Enforcement of regulations

While policy reforms supporting the 3R principles are required, their implementation can face fundamental challenges that must be addressed. The actual enforcement of regulations, especially those based on negative incentives, fails in many countries due to various reasons ranging from low capacities to lack of data, or poor coordination across departments and agencies. In a recent IWMI study, emerging economies[4] with different gross domestic product (GDP) per capita groups[5] were analyzed within their respective regions[6]. GDP per capita is often treated as a proxy parameter for investment opportunities. The countries were selected from different economic groups to compare investment attractiveness with environmental stringency and enforcement (Figure 2).

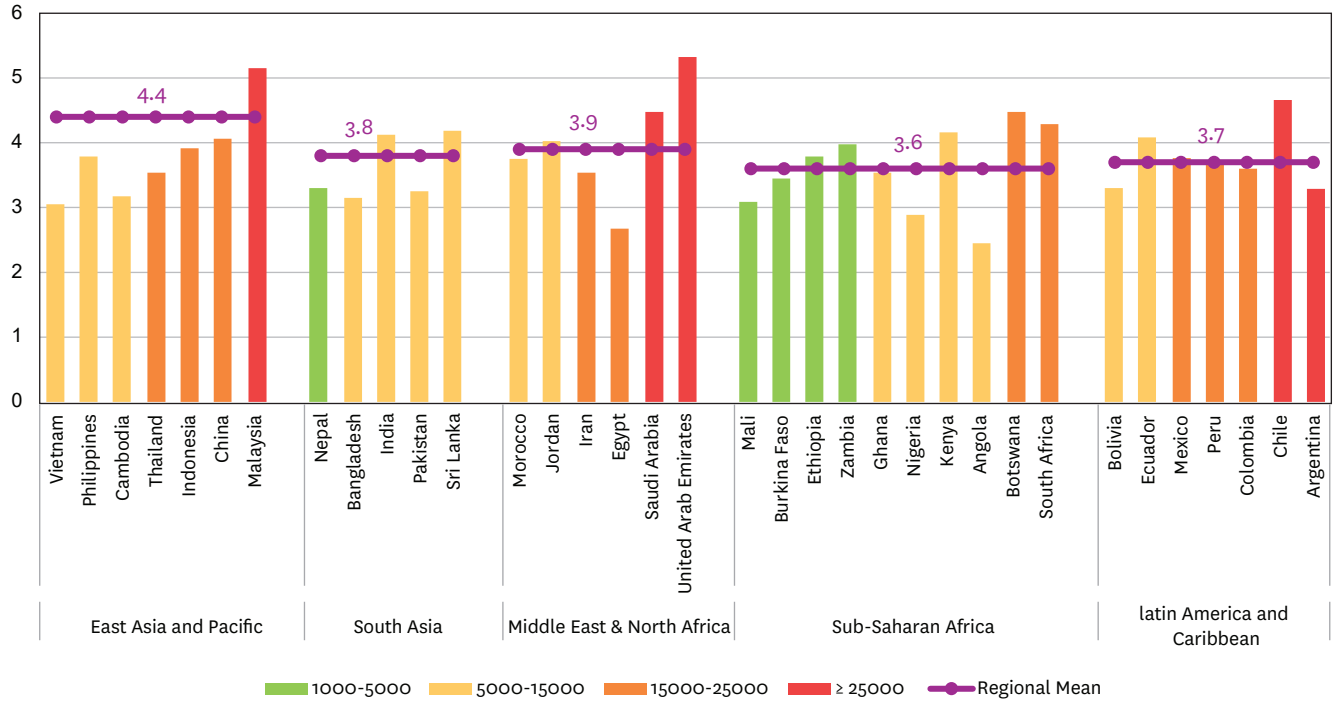


Figure 2. Stringency and enforcement of environmental regulations across the countries selected for this study.

Source: Taron et al 2024; Calderwood and Soshkin 2019. Data obtained from WEF 2013, 2015, 2017.

[2] The 'polluter pays' principle is the commonly accepted practice that those who produce [water] pollution should bear the costs of managing it to prevent damage to human health or the environment.

[3] https://www.ircwash.org/sites/default/files/MLGRD-2010-National.pdf

[4] The emerging economies across different regions were selected based on the GDP per capita at current prices provided by IMF (https://www.imf.org/en/Publications/WEO/weo-database/2023/April/groups-and-aggregates#oem).

[5] The representative countries were selected based on their economic performance – GDP per capita at current prices as an indicator for investment attractiveness. The IMF classifies five strata for GDP per capita – (i) USD 25,000 and more, (ii) USD 15-25,000; (iii) USD 5-15,000; (iv) USD 1-5,000 and (v) under USD 1,000 (https://www.imf.org/external/datamapper/PPPPC@WEO/OEMDC/ADVEC/WEOWORLD).

[6] Regions classified as per the World Bank.

The World Economic Forum (WEF) provides average scores collected from qualitative data (from Executive Opinion Surveys) asking respondents to assess the stringency and enforcement of environmental regulations between 1-7 (1 being low, to 7 being the best score). This classification usually considers the stringency of environmental pollution standards, sophistication of regulatory structures, quality of the environmental information available, the extent of subsidization of natural resources, the strictness of enforcement and the quality of environmental institutions (Koziuk et al. 2019). To analyze the stringency and enforcement of environmental regulations, an average 'country score' was calculated from different rounds of WEF data (WEF 2013, 2015, 2017; Calderwood and Soshkin 2019). These 'country scores' are then compared to regional averages[7] obtained for all countries within the regions classified under the World Bank (Figure 2).

The emerging economies across the regions indicate that countries with higher GDP per capita are more stringent and enforce environmental laws. These countries are better placed in terms of waste management and waste resource recovery, as the primary input for the CE is waste. However, except for East Asia and the Pacific, it is notable that a low correlation exists between implementing environmental standards and GDP per capita. Even some low-income countries in Africa are found to have stringent laws with higher enforceability. Most countries of the middle-income group (USD 5,000-10,000 GDP per capita) perform as per regional averages. Considering the region, Latin American countries are better positioned with their environmental regulations and implementation.

The effective execution of environmental regulations along with the development and implementation of CE roadmaps, policies and strategies can lead to the evolution of CBE initiatives. Figure 3 provides a global picture of the maturity levels of existing CE regulations which can foster the development of CBE. Most emerging economies with higher incomes (hence investment opportunities) are observed to attain a mature state in CE transitioning. Similarly, Latin American countries as a region are observed to be at a higher maturity level in terms of regulations fostering CE transition.

For instance, the government of Chile has created a CE unit within the Ministry of Environment which enabled the development and implementation of a CE road map and a program to finance innovative circular opportunities through achieving interagency collaboration with the state economic development agency and the Sustainability and Climate Change Agency of Chile.

As for Vietnam, the United Nations Development Programme (UNDP) promotes the growth of a CE by advising the government of Vietnam to initiate and execute CBE activities. This has led to the development of CE strategies for different sectors as well (the government issued Decision 687 on CE development which revised the environmental laws governing waste management).[8]

When it comes to the transition of CBE from theory to practice from a global perspective, the legislation of most emerging economies is still in initial or progressive stages. A key step is the promotion of public-private partnerships or business models in general (Otoo and Drechsel, 2018) for transitioning waste from a burden to waste as a resource.

While in Sri Lanka, for example, more than 120 compost stations were created (as highlighted in Box 2), their main purpose was waste volume reduction, not necessarily the creation of compost for sale. Stations are managed by public health

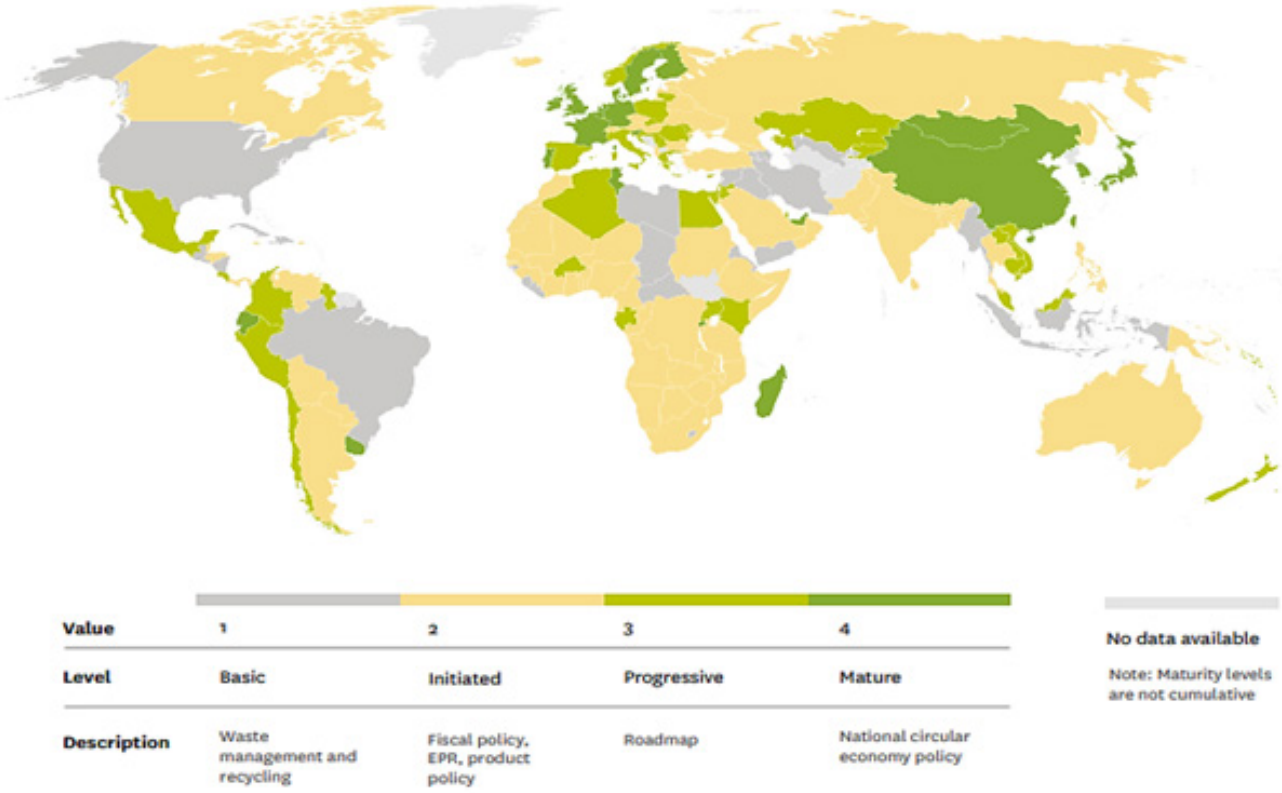


Figure 3. Maturity assessment of circular economy (CE) legislation rated on a scale of 1 to 4.
Source: Weick and Ray (2022).

[7] The regional averages were estimated from scores of developed, emerging, and low-income countries.
[8] https://vietnamcirculareconomy.vn/?lang=en

inspectors, not entrepreneurs knowledgeable of compost markets, farmers' quality demands, or compost marketing. Compost sales remained low, however, without an impact on staff salaries. As staff can't be changed, alternative options are needed, such as a business model where compost stations have a contract with a central public or private sector entity which will absorb and pay all produced compost while specialized on selling it. Such a model can be a win-win for all parties involved.

Other challenges

While embracing CBE policies is an important first step, improper execution and monitoring constitute a barrier to development. More than 50% of waste-to-energy plants in India, for example, are inoperative due to poor waste segregation within the waste collection system.

Many existing regulations are inadequate to provide guidelines and action plans for implementation. For instance, all the countries shown in Figure 3 have a well-developed regulatory framework for sustainable waste management. However, solid waste treatment (SWT) efficiency is low with a percentage less than or equal to 40% except for Colombia, Rwanda and Cambodia showing a higher SWT efficiency, and Egypt and Peru showing a higher wastewater treatment (WWT) efficiency.

The low waste management efficiency is due to the incapability of administrations to execute laws, lack of monitoring, limited involvement of the private sector and lack of public awareness of proper waste segregation practices that allow authorities to engage in RRR. Therefore, a holistic regulatory framework involving the collaboration of various sectors is necessary for solid progress in CBE. The Sri Lankan compost station (Box 2) illustrates a common gap where regulations started promoting a CBE while the incentive systems to link the waste and agricultural sectors are still missing.

A few countries, namely Singapore, Brazil, China, Japan, South Korea and South Africa are setting the standard for favorable regulations on CBE (Box 3). For instance, the regulatory framework of Singapore focuses on establishing several statutory agencies to ensure the implementation of policies and promote the synergy of government with nongovernmental organizations (NGOs), civil society groups, private organizations and community groups to elevate the transition of the RRR approach from theory to practice. In Brazil, the development of legislation related to sanitation and incentive programs for renewable energy sources has paved the way for a transition towards a successful waste-to-energy future.

On the other hand, the regulations on wastewater treatment and reuse in South Africa are diverse with various aspects such as accommodating the legal and cost requirements of effluent discharge monitoring, combining legal rights with access to quality water, and involving the development of certification programs (e.g., green drop certification program) to provide the stakeholders of the water industry with adequate performance-based information to improve wastewater treatment facilities. The governments of China and South Korea are focusing principally on the development of mandatory waste sorting policies, as the segregation of waste is the primary step in promoting RRR approaches such as biogas and compost production from waste. As for Japan, the specific legislation governing the waste management system and the stringent landfill policy has led to a successful waste-to-energy sector.

Box 2. Gaps between intention and execution.

The 10-year waste management program named 'Pilisaru' initiated by Central Environment Authority of Sri Lanka for achieving the goal of 'Waste Free Sri Lanka by 2018' managed to establish about 120 compost stations. However, it was inefficient due to limited institutional commitment, insufficient guidelines for waste segregation, lack of monitoring of composting processes and performance, poor compost quality, and deficiencies in understanding and/or establishing reliable compost markets (Roy et al 2021).

Recommendations

Stringency and enforcement of environmental regulations by imposing penalties play a key role in promoting e.g., the 'polluter-pays-principle'. This is an important step in the value chain to minimize harmful waste and initiate CBE solutions at the latter part of the value chain. The development of specific policies and strategies specifically targeting RRR approaches such as materials in transition or waste-to-energy production and composting is required to promote CBE initiatives. Establishing national regulatory agencies and improving synergy between NGOs, civil society groups, private organizations and community groups can enable the transition of the CBE approach from theory to practice.

Legal frameworks need to focus on providing financial support in terms of incentives, rebates, green bonds, tax exemptions and subsidies to promote sector growth, as small and medium-scale industries are playing a significant role in the progress of RRR.

Where public sector-based structure cannot be changed, innovative partnerships and business models help to link waste and the agricultural sector, for instance, to close the resource loops.

While focusing on improving stringency and enforcement of environmental regulations is pertinent, governments of emerging economies should develop policy frameworks and strategies that target the involvement of private investments and operations. Stringent regulations in waste management do not necessarily provide innovative solutions for implementing sustainable waste management practices, instead, it makes private sector efforts to improve waste management futile. An ecosystem allowing public-private partnerships for waste management and resource recovery is imperative to promote CBE. For example, Innovation Hubs can be used by governments by incorporating public agencies, technology providers, private funders, operators and donors to promote the sector (CGIAR 2023).

Emerging economies should formulate regulations encouraging the actual use of recovered products, instead of new ones, to create a reliable market for the products. Thus, existing incentives need to promote the reuse of reclaimed water, biogas or compost recovered from organic waste e.g. via taxes on new products or twinning new and recovered resources as described in Box 3.

Box 3. Promising regulations of benchmark countries promoting CBE.

The Singapore's Public Utilities Board (PUB), together with the National Environmental Agency (NEA) ensure strict enforcement of regulations for effluent discharge by imposing penalties for water pollution, which is fundamental for implementing a safe water reuse program like NEWater, a reclaimed water product for portable and non-portable uses (GWF 2018). To address public perceptions, the reclaimed water is inserted as a smaller percentage into freshwater. Such twinning was also promoted time back in India where industrial fertilizer could only be sold together with municipal waste compost for integrated soil fertility management.

The Department of Forests, Fisheries and Environment of South Africa initiated the National Organic Waste Composting Strategy to ensure that organic waste is diverted from landfills to produce compost, and to guide the development of legislation, norms, and standards including South African Certification Standards for compost (DoEA 2013).

A policy called PROINFA (Programme of Incentives for Alternative Energy Sources) was established by the Brazilian government aiming to promote electrical energy production using biomass sources such as sugarcane bagasse, rice hull, timber waste and landfill biogas, by setting short-term and long-term targets for bioenergy production. The program however closed in 2011 (IEA 2015).

The Chinese central government provided over CNY 24 billion as biogas subsidies in rural areas from 2000 to 2017 which increased the number of household biogas digesters from 10 million in 2000, to 40 million in 2017 (Oos and Martin 2014).

The regulations in Japan emphasize the development of a long-term waste management plan by municipalities to treat and recycle their own waste, which facilitates the progress of waste-to-energy production within the municipalities since transporting waste over longer distances is prohibited (Ministry of Environment 2012).

In 2005, South Korea banned landfilling of food waste and established a universal system of curbside food waste pickup. Nearly all food waste there is now turned into biogas, compost, and animal feed. The government developed a mandatory composting scheme in 2013, requiring residents to use biodegradable bags for disposing food waste (Broon 2019). The scheme ensures the use of food waste (collected in the biodegradable bag) to produce biogas and fertilizer (compost). The bag charges serve 60% of the costs for running the scheme, which increased the amount of food waste recycled from 2% in 1995 to 95% today. The South Korean government has improved composting to a greater extent by making public participation easy, accessible and affordable.

The Ministry of Environment of Rwanda together with the Ministry of Infrastructure and the Global Green Growth Institute (GGGI) launched the 'Waste to Resources' project in the City of Kigali to valorize organic waste and to improve various CBE initiatives in the waste sector such as the transformation of waste to energy (GGGI 2021).

The Government of Colombia has developed an initiative called the 'National Circular Economy Strategy' to address environmental issues and promote long-term economic growth by implementing CBE activities including several waste management initiatives such as waste-to-energy production and composting (GIZ 2023).

The Ministry of the Environment of Peru together with the United Nations Environmental Programme (UNEP) created the project 'Organic Waste Management in Peru: Accelerating Progress Towards a Circular and Carbon-Neutral Waste Sector' to promote policy reforms for improving waste tariff collection schemes, facilitating the implementation of source separation and streamlining the permitting processes. The project also aims to develop a long-term national organic waste strategy to ensure the implementation of organic waste treatment and landfill gas capture projects (HCH 2021).

The promotion of a circular bioeconomy requires regulations, finances, market development and private participation. (*photo*: chayanuphol/shutterstock).

References

Amare, A. 2019. Corporate environmental responsibility in Ethiopia: a case study of the Akaki River Basin. *Ecosystem Health and Sustainability* 5(1): 57-66. https://doi.org/10.1080/20964129.2019.1573107

Calderwood, L.U.; Soshkin, M. 2019. *The travel & tourism competitiveness report 2019: Travel and tourism at a tipping point*. Geneva, Switzerland: World Economic Forum. 129p. Available at https://www.weforum.org/publications/the-travel-tourism-competitiveness-report-2019/ (accessed on May 29, 2024).

CGIAR. 2023. *Introducing circular bio-economy Innovation Hub in Ghana: Co-ownership for sustainable impact facilitation*. CGIAR Website. Available at https://www.cgiar.org/news-events/news/introducing-circular-bio-economy-innovation-hub-in-ghana-co-ownership-for-sustainable-impact-facilitation/ (accessed on June 3, 2024).

Broon, D. 2019. *South Korea once recycled 2% of its food waste. Now it recycles 95%*. World Economic Forum Website. Available at https://www.weforum.org/agenda/2019/04/south-korea-recycling-food-waste/ (accessed on February 10, 2024).

DoEA (Department of Environmental Affairs). 2013. *The national organic waste composting strategy*. Final Strategy Report. Pretoria, South Africa: Department of Environmental Affairs. Available at https://sawic.environment.gov.za/documents/3635.PDF (accessed on February 10, 2024).

Drechsel, P.; Marjani Zadeh, S.; Pedrero, F.(Eds). 2023. *Water quality in agriculture: Risks and risk mitigation*. Rome, Italy: Food and Agriculture Organization of the United Nations (FAO); Rome, Italy: International Water Management Institute (IWMI). 192p. https://doi.org/10.4060/cc7340en

EFL (Environmental Foundation Limited). 2017. *Status of waste management in Sri Lanka*. Environmental Foundation Limited Website. Available at: https://efl.lk/status-waste-management-sri-lanka/ (accessed on December 15, 2023).

GIZ. 2023. *Circular economy in Columbia: Opportunities for reusable packaging systems and women's participation*. Bonn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Available at https://www.giz.de/de/downloads/giz2024-en-colombia-circular-economy.pdf (accessed on February 10, 2024).

GGGI (Global Green Growth Institute). 2021. *Rwanda launches new Project "Waste to Resources: Improving Municipal Solid Waste (MSW) and Hazardous Waste Management in Rwanda"*. Global Green Growth Institute Website. Available at https://gggi.org/rwanda-launches-new-project-waste-to-resources-improving-municipal-solid-waste-msw-and-hazardous-waste-management-in-rwanda/ (accessed on February 10, 2024).

GWF (Global Water Forum). 2018. *NeWater in Singapore*. Global Water Forum Website. Available at https://www.globalwaterforum.org/2018/01/15/newater-in-singapore/ (accessed on February 10, 2024).

HCH (Holland Circular Hotspot). 2021. *Waste management country report*: Peru. Rotterdam, The Netherlands: Holland Circular Hotspot. Available at https://hollandcircularhotspot.nl/wp-content/uploads/2021/04/Report_Waste_Management_Peru_20210322.pdf (accessed on February 10, 2024).

IEA (International Energy Agency). 2015. *Programme of incentives for alternative electricity sources - Programa de Incentivo a Fontes Alternativas de Energia Elétrica – PROINFA*. Paris, France: International Energy Agency. Available at https://www.iea.org/policies/4019-programme-of-incentives-for-alternative-electricity-sources-programa-de-incentivo-a-fontes-alternativas-de-energia-eletrica-proinfa (accessed on February 10, 2024).

Kayiranga, J. Must know: Penalties and fines against environmental offences in Rwanda. *Top Africa News*, 2021. Available at https://www.topafricanews.com/2021/11/25/must-know-penalties-and-fines-against-environmental-offences-in-rwanda/ (accessed on August 27, 2024).

Koziuk, V.; Hayda, Y.; Dluhopolskyi, O.; Klapkiv, Y. 2019. Stringency of environmental regulations vs. global competitiveness: Empirical analysis. *Economics and Sociology* 12(4): 278-298. https://doi.org/10.14254/2071-789X.2019/12-4/17

Ministry of Environment. 2012. *Solid waste management and recycling technology of Japan: Toward a sustainable society*. Tokyo, Japan: Ministry of Environment. Available at https://www.env.go.jp/content/900453393.pdf (accessed on February 10, 2024).

Oos, M.; Martin, F. 2014. China's biomass energy development – A perception change from waste to resource. *Rural 21*, April 2014. Available at https://www.rural21.com/fileadmin/downloads/2014/en-04/rural2014_04-S38-40.pdf (accessed on February 10, 2024).

Reuters. 2013. Peru tries to close legal loophole for pollution fines. *Reuters*, May 8, 2013. Available at https://www.reuters.com/article/business/environment/peru-tries-to-close-legal-loophole-for-pollution-fines-idUSBRE9470U3/ (accessed on August 28, 2024).

Roy, E.D.; Esham, M.; Jayathilake, N.; Otoo, M.; Koliba, C.; Wijethunga, I.B.; Fein-Cole, M.J. 2021. Compost quality and markets are pivotal for sustainability in circular food-nutrient systems: A case study of Sri Lanka. *Frontier Sustainable Food Systems* 5:748391. https://doi.org/10.3389/fsufs.2021.748391

Taron, A.; Sathiskumar, A.; Malviya, T.; Bodach, S.; Muthuswamy, S.; Gebrezgabher, S. 2024. *Assessing the investment climate to promote a circular bioeconomy: A comparison of 15 countries in the Global South*. Colombo, Sri Lanka: International Water Management Institute (IWMI). 89p. (Resource Recovery and Reuse Series 24). https://doi.org/10.5337/2024.218

Weick, M.; Ray, N. 2022. *Regulatory landscape of the circular economy*. London, United Kingdom: Ernst & Young Global Limited. 7p. Available at https://www.ey.com/en_us/insights/chemicals/circular-economy-navigating-the-evolving-global-policy-landscape (accessed on May 28, 2024).

WEF (World Economic Forum). 2013. *The travel & tourism competitiveness report 2013: Reducing barriers to economic growth and job creation*. Geneva, Switzerland: World Economic Forum. 517p. Available at https://www.weforum.org/publications/travel-and-tourism-competitiveness-report-2013/ (accessed on May 28, 2024).

WEF. 2015. *The travel & tourism competitiveness report 2015: Growth through shocks*. Geneva, Switzerland: World Economic Forum. 519p. Available at https://www.weforum.org/publications/travel-and-tourism-competitiveness-report-2015/ (accessed on May 28, 2024).

WEF. 2017. *The travel & tourism competitiveness report 2017: Paving the way for a more sustainable and inclusive future*. Geneva, Switzerland: World Economic Forum. 387p. Available at https://www.weforum.org/publications/the-travel-tourism-competitiveness-report-2017/ (accessed on May 28, 2024).

WHO (World Health Organization); Food and Agriculture Organization of the United Nations (FAO); United Nations Environment Programme (UNEP). 2006. *Guidelines for the safe use of wastewater, excreta and greywater*. Volume IV. Paris, France: World Health Organization (WHO). 204p. Available at https://www.who.int/publications/i/item/9241546859 (accessed on September 17, 2024).

Wijedasa, N. 2019. SC in landmark judgment applies "Polluter Pays" principle of environmental law. *The Sunday Times*, April 7, 2019. Available at https://www.sundaytimes.lk/190407/news/sc-in-landmark-judgment-applies-polluter-pays-principle-of-environmental-law-344028.html (accessed on August 27, 2024).

Authors

This Policy Brief was prepared by Abinaya Sathiskumar (Research Consultant, International Water Management Institute [IWMI], Colombo, Sri Lanka), Avinandan Taron (Researcher - Investment and Institutional Analyst for RRR Business Development, IWMI, Colombo, Sri Lanka), Pay Drechsel (Senior Fellow–Advisor – Research Quality Assurance, IWMI, Colombo, Sri Lanka), and Solomie Gebrezgabher (Senior Researcher – IWMI, Accra, Ghana).

Citation

Sathiskumar, A.; Taron, A.; Drechsel, P.; Gebrezgabher, S. 2024. *Regulations drive circular bioeconomy in emerging economies, but further action is required*. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Initiative on Resilient Cities; CGIAR Initiative on Nature-Positive Solutions. 8p.

Project

The CGIAR Initiative on Resilient Cities generates evidence, technologies and capacities that help improve urban food systems and secure equitable job and business opportunities, healthy diets for all, human and environment health, and a reduced carbon footprint.

The CGIAR Initiative on Nature-Positive Solutions aims to re-imagine, co-create and implement nature-positive solutions-based agri-food systems that equitably support food and livelihoods while ensuring that agriculture is a net positive contributor to biodiversity and nature.

Acknowledgments

This study was commissioned by the International Water Management Institute (IWMI) and carried out with support from the CGIAR Initiative on Resilient Cities (https://www.cgiar.org/initiative/resilient-cities/) and the CGIAR Initiative on Nature-Positive Solutions (https://www.cgiar.org/initiative/nature-positive-solutions/). We would like to thank all funders who supported these initiatives through their contributions to the CGIAR Trust Fund (https://www.cgiar.org/funders/).

Disclaimer

This publication has been created with care. Responsibility for opinions expressed and any possible errors lies with the authors and not the partner institutions involved. The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by IWMI, CGIAR, our partner institutions and donors.

Contacts

Avinandan Taron, International Water Management Institute (IWMI), Colombo, Sri Lanka (a.taron@cgiar.org)

IWMI
International Water Management Institute
CGIAR
IWMI is a CGIAR Research Center

The International Water Management Institute (IWMI) is an international, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 15 countries and a global network of scientists operating in more than 55 countries.

International Water Management Institute (IWMI)

Headquarters
127 Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka

Mailing address:
P. O. Box 2075, Colombo, Sri Lanka
Tel: +94 11 2880000
Fax: +94 11 2786854
Email: iwmi@cgiar.org
www.iwmi.org