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A Multi-Criteria Decision Support Tool for Selecting Circular Economy Business Models

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Summary

Waste management has become a pivotal public health and environmental question, particularly in developing nations, due to rapid industrialization, population growth, and inadequate policy. To foster a long-term pattern of progress, global trends are encouraging governments, policymakers, and international organizations to explore pathways for transitioning from linear to circular economy business models. Resource Recovery and Reuse (RRR) offers viable pathways with multiple value propositions beyond environmental benefits. However, the decision-making processes involved in the shaping and selection of business models often require weighing costs and benefits and making trade-offs among alternatives and competing priorities. Some costs and benefits are clearly identifiable and can be numerically expressed, yet many others cannot be readily determined. This technical report presents the conceptual framework underlying a multi-criteria-based decision support tool tailored to enable decision-makers and practitioners to select appropriate and sustainable CE business models in the RRR context with positive social, economic, and environmental outcomes.

Report Outline

Towards a Circular Economy

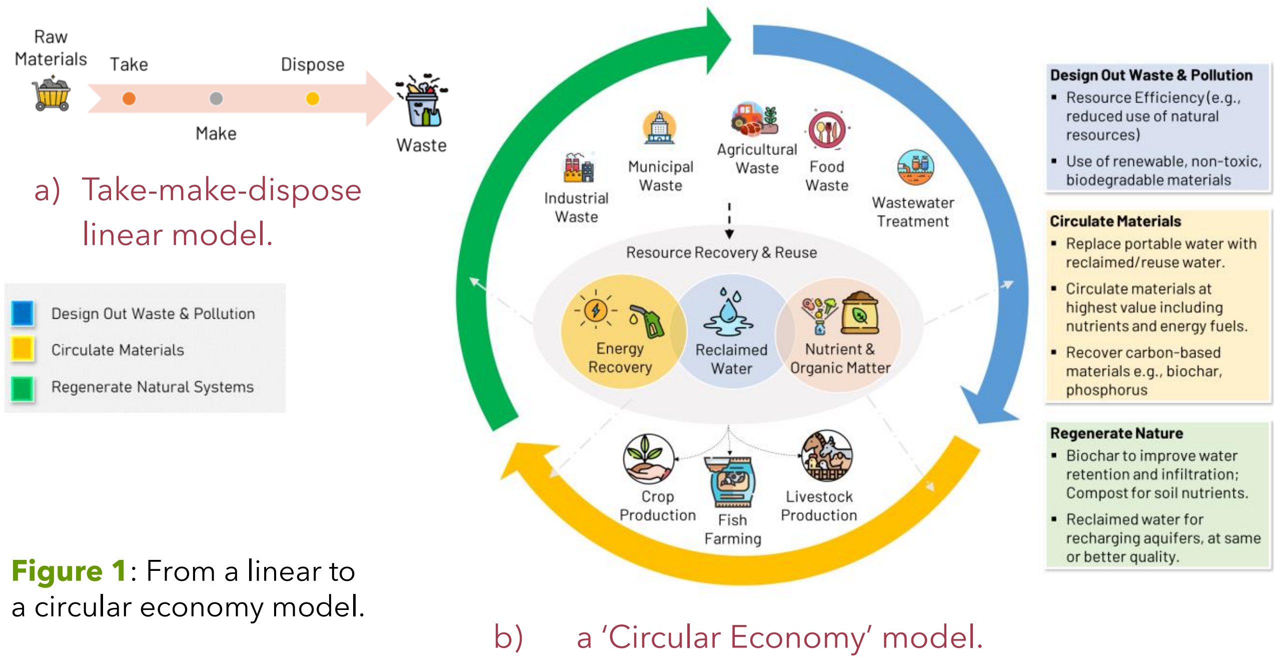
The aspiration of a 'Circular Economy' (CE) is to shift material flows toward zero waste and pollution, where resources are not consumed and discarded, but rather valued, and retained for as long as possible (MacArthur, 2013). The concept is gaining traction in developed and developing countries, due to the opportunities to decouple economic growth from the use of natural resources (WEF, 2018). It is high on the political agenda and widely discussed among companies, policymakers, NGOs, and other stakeholders as an approach to reducing resource consumption and environmental impacts.

CE offers an alternative to linear "take-make-waste" business models where resources are continuously extracted, and harm is created for the lives and livelihoods who depend on them. It promises to decrease resource consumption by closing, narrowing, and slowing material loops.

These outcomes are based on three CE principles: i) design out waste and pollution, ii) keep products and materials in use for as long as possible and circulate at their highest value and, iii) regenerate nature (MacArthur, 2013) – Figure 1.

One of the dimensions of CE involves capturing value (e.g., energy, water, animal feed, and nutrients) from waste streams that would otherwise be disposed into the environment through resource recovery and reuse (RRR) strategies and creating innovative business models that embed CE principles in their value propositions (Manninen *et al.* 2018). Such RRR strategies, when combined with innovative business models, can promote sustainable production and consumption behaviour.

Despite the countless benefits, implementing CE innovations in the waste management sector is not straightforward and decisions to transition are often laden with trade-offs and uncertainties. Some industries resist CE transitions due to cost concerns, and others do not fully grasp its benefits. For many decision-makers and practitioners, CE is viewed as an environmental agenda, and stakeholders' perspectives and priorities on waste management systems are often not considered. Enabling CE transition calls for holistic approaches to planning and implementation, and wide considerations must be given to the multidimensional nature of CE business models.



a) Take-make-dispose linear model.

b) a 'Circular Economy' model.

Figure 1: From a linear to a circular economy model.

Circular Economy Business Models

According to Otoo and Drechsel (2018), RRR business models within a CE framework can be classified in several ways. They can be classified by waste types, type of recovered resource, value proposition, partnership or financing mechanisms, and modes or scale of revenue generation. The choice of classification will depend on users' priorities and objectives. Table 1 highlights an example of the classification of RRR business models in the context of value-added products.

Table 1: RRR business models and their possible categorization (Otoo and Drechsel, 2018)

Product	Sector	Objective	Potential source
Water Reuse	Public; Public / Private Sector	Cost recovery	Wastewater for greening the desert
			Enabling private sector investments in large-scale wastewater treatment
	Public / Private Sector	Welfare / Profit Maximization	Leapfrogging the value chain through aquaculture
	Public / Informal; Public / Private Sector	Welfare Maximization	Cities as their own downstream users
			Inter-sectoral water exchange
			Corporate social responsibility as driver of change
			Wastewater as a commodity driving change
			Farmers' innovation capacity as driver of change
Nutrient and organic matter Recovery	Public and/or Private Sector	Cost recovery	Subsidy-free community-based composting
			Partially subsidized composting at district level
	Public and/or Private Sector	Welfare / Profit Maximization	Large-scale composting for revenue generation
			Compost production for sustainable sanitation service delivery
		Cost Savings	Nutrient recovery from own agro-industrial waste
			Phosphorus recovery from wastewater at scale
	Public and/or Informal Sector	Cost Savings	Outsourcing fecal sludge treatment to the farm
Energy Recovery	Public Sector	Cost recovery	Power from municipal solid waste
	Private Sector	Profit Maximization	Briquettes from agro- or municipal solid waste
			Bio-ethanol and chemical products from agro- and agro-industrial waste
		Profit Maximization / Cost Savings	Combined heat and power from agro-industrial waste for on- and off-site use
		Profit and Welfare Maximization	Power from agro-waste
			Combined heat and power from agro-industrial waste for on- and off-site use
		Cost Savings / Welfare Maximization	Biogas from fecal sludge and kitchen waste
			Power from manure

Multi-criteria Decision Analysis Approach

To effectively address waste management and recover resources, it is important to understand that there are various waste streams and approaches to harnessing value-added products (Figure 2). When conducting a study on the feasibility of implementing relevant value propositions and business models, it is critical to establish priorities based on the specific area, type of waste, and resources to be recovered. This prioritization is key to avoiding complicated feasibility studies and ensuring an efficient use of resources.

Furthermore, waste management and RRR businesses involve several decision-makers with different and often conflicting perceptions of what is acceptable in the context of sustainable development. Different interest groups attach disparate values to economic, social, and environmental objectives and rank priorities differently. For instance, for the private sector enterprise, keeping investment and operational costs at a minimum is important; however, for another organization, reducing environmental impacts is of higher importance than other objectives. If these differences are not considered, it can lead to a lack of support, resistance, or even rejection of CE innovations, and accompanying business models may not gain acceptance.

This report, therefore, proposes an approach for selecting CE business models based on multi-criteria decision analysis (MCDA) methods that enable the evaluation of alternatives, while explicitly considering the priorities of various decision-makers and stakeholders (Figure 3). MCDA tools are highly valuable for the holistic assessment of interconnected objectives and enable decision-makers to make informed choices based on their priorities (Smith *et al.* 2022).

In RRR/CE context, MCDA tools can help decision-makers identify which materials are recoverable and economically viable, which strategies align best with their goals and constraints, and solutions that can lead to cost savings, reduced environmental impact, and improved resource recovery. This simplifies the exploration of multiple possibilities, allowing decision-makers to assess the potential benefits, drawbacks, and risks associated with diverse strategies. By explicitly outlining the decision criteria, weights assigned to each criterion, and the rationale behind decisions, MCDA tools also enhance accountability and stakeholder understanding (Thokala *et al.* 2018).

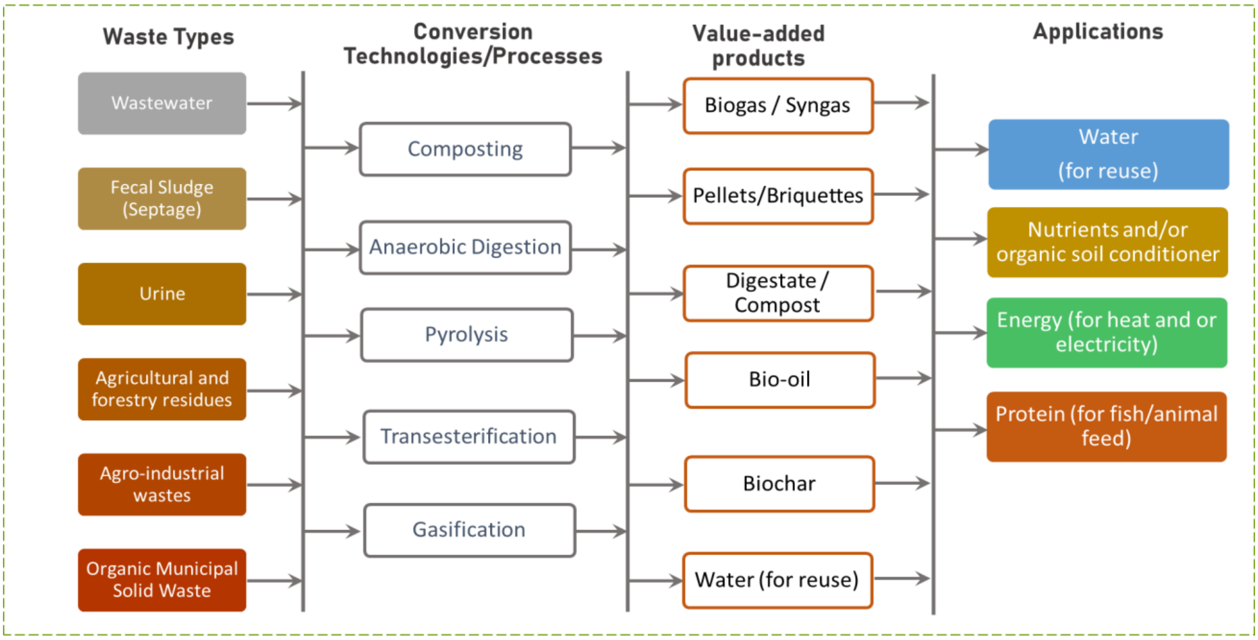


Figure 2: Diverse waste streams and resource recovery approaches

A broad selection of decision support tools (DSTs) has been developed for waste management, particularly for environmental assessment and a detailed overview is provided in de Souza Melaré *et al.* (2017) and Blikra Vea *et al.* (2018). There are also several waste mapping tools, some country-specific and others for regional assessment e.g., the Shit-Flow Diagram is designed for professionals and practitioners to characterize and compare at a high level various functional elements of a sanitation system from different perspectives (Panesar *et al.* 2018): REVAMP is created to visualize and estimate resources from urban waste streams (Mkude et al. 2021). While these tools provide a valuable framework for waste mapping and assessing the environmental sustainability of different waste streams, they do not capture the multi-dimensional nature of circular resource recovery and reuse objectives, e.g., economic viability, environmental impact reduction, social benefits, and technological feasibility. More importantly, these tools cannot be used for selecting business models in RRR context-specific conditions.

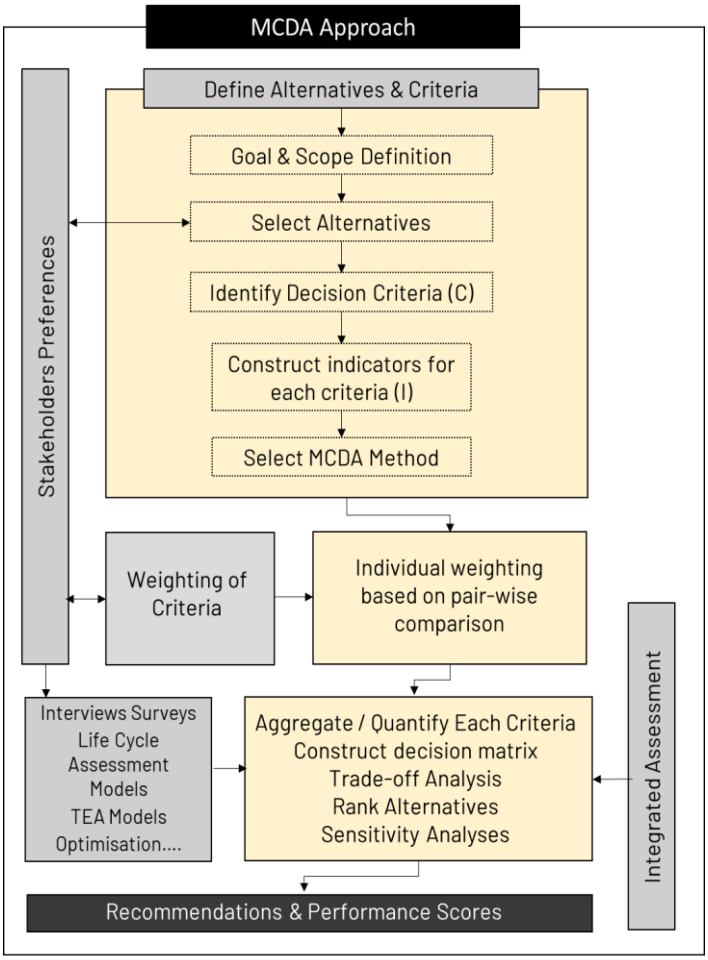


Figure 3: A typical workflow of MCDM methods.

Our work builds on the detailed methodological framework in Otoo *et al.* (2016) which suggests a stepwise assessment of the implementation potential of RRR business models in a developing country context (as shown in Figure 4). To begin with, a pre-feasibility assessment involving a baseline survey is proposed to identify the general possibilities and barriers of different waste-to-resource options and their connected business models. Following this, a comprehensive and in-depth evaluation of the RRR business model that offers the greatest chance of success within the local setting is proposed. In the end, the user executes the business model and delineates its business and strategy. Specifically, our work extends the pre-feasibility component of the stepwise assessment, enabling a quick narrowing of CE business model options.

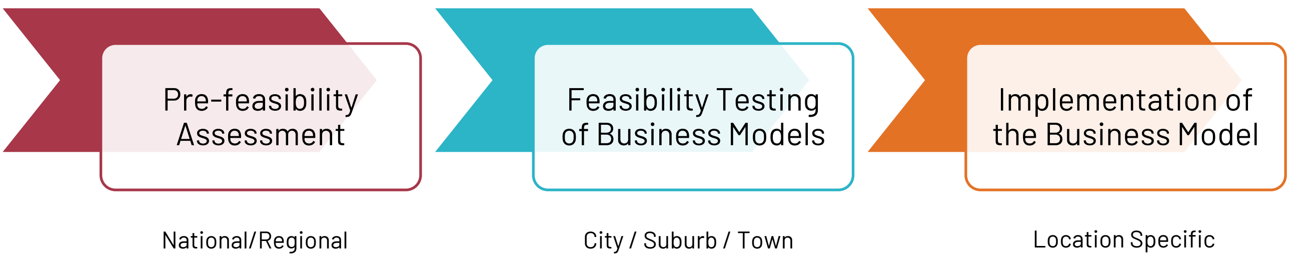


Figure 4: A stepwise assessment of the implementation potential of RRR business models (Otoo *et al.* 2016)

Conceptual Framework of the Decision Support Tool (DST)

The conceptual framework of the MCDA-based DST is highlighted in Figure 5 and consists of four key components: i) **user-defined inputs,** e.g., site of interest, waste options, and CE objective, which are used to estimate model parameters such as emission factors, cost factors, and requirements for land, water, and energy, ii) **model parameters** which are informed by user's inputs and choices with reference values derived from equations, databases or Geographical Information System (GIS) data sources, iii) **defined criteria and indicators** with context-specific weightings that are informed by analytical framework and processes and iv) **model outputs**, which outlines social, economic, and environmental outcomes and presents comparative performance of various CE business models. The MCDA uses an analytical hierarchy process (AHP) to rank users' priorities, thereby capturing site-specific and complex, interdependencies that may exist between various inputs, including social, economic, and environmental factor.

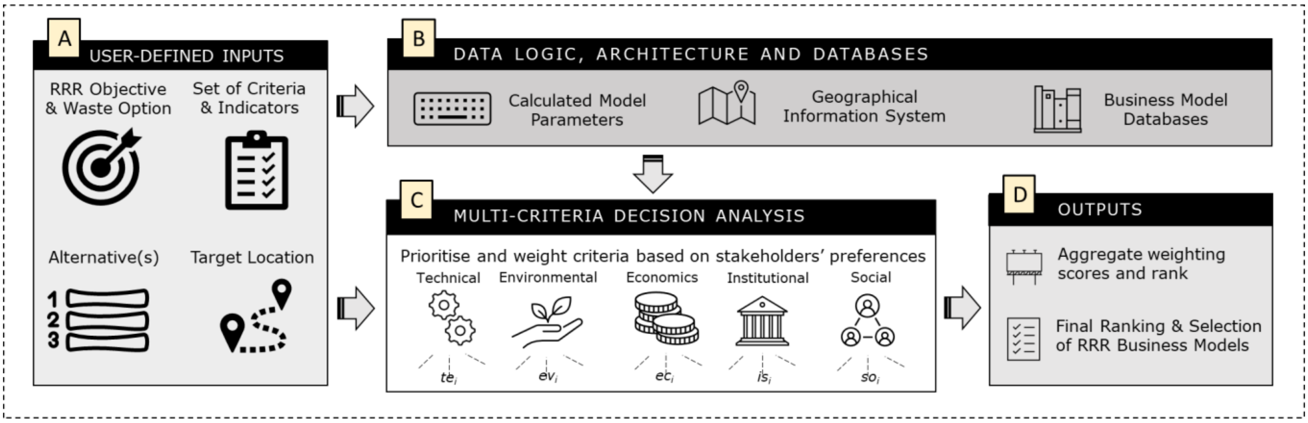


Figure 5: A simplified conceptual framework of the proposed multi-criteria decision support tool (DST) for selecting sustainable business models in resource recovery and reuse context.

A. User-Defined Inputs

The user-defined inputs include the following: i) the waste stream, selecting organic waste options such as domestic, market or food waste or agro-industrial waste: ii) the objective of the RRR business by selecting one of five options: cost recovery, profit maximization, welfare maximization, or cost savings. iii) value-added product of interest, selecting one of three options: nutrient, energy, or water reuse. In the case of multiple interests in value-added products and objectives, the user defines the preference as a fraction (between 0 and 1), provided their summaries are equal to 1. iv) criteria and indicators, considering various technical, environmental, social, economic, and regulatory conditions. v) site and country of interest to quantify and qualify wastes to determine if there is enough waste generated annually. The framework integrates stakeholders' preferences as well as allows the users to identify conflicting criteria and related indicators. Subsequently, they tailor business models to align with the target value-added products and overarching business goals. A simplified workflow is shown in Figure 6.

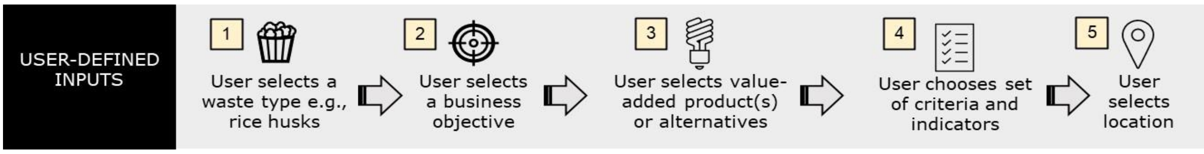


Figure 6: A simplified workflow of user-defined inputs.

B. Criteria and Indicator Selection

There are five criteria and eighteen indicators (as illustrated in Figure 7), which are informed by literature review, country scoping, and expert judgment. These include technical, environmental, financial, social, and institutional criteria.

The technical criteria cover aspects of resource mapping and assessment and technology feasibility. The resource mapping embeds GIS geographical data and functionality, enabling the user to assess multiple sites for their waste resource potential. Technology feasibility is captured for various waste streams through technical factors. These factors estimate the potential for recovery of energy, nutrients, animal feed, and water for reuse, enabling the user to ascertain the technical feasibility of RRR business in different local contexts.

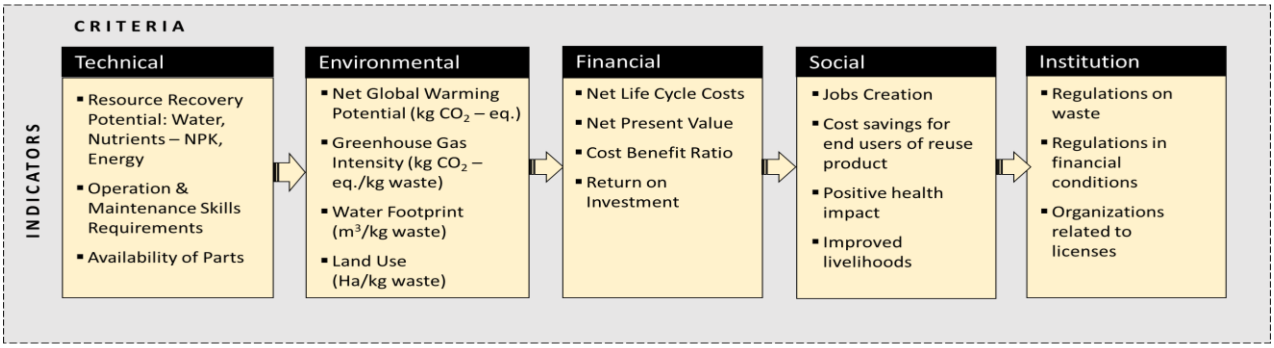


Figure 7: A summary of key criteria and indicators.

There are five quantitative technical indicators: energy recovery potential, nitrogen recovery potential, potassium recovery potential, phosphorus recovery potential, and water reuse potential. There are also other technical indicators, availability of parts, and manpower requirements, which have qualitative outputs. These criteria and indicators will be validated in a stakeholder workshop. During a stakeholder workshop, representatives from different stakeholder groups will have the opportunity to evaluate and validate the pre-defined criteria as well as recommend additional criteria to be used in the assessment of the different RRR business models. Note that a long list of criteria with possible interrelationships among them might be collected from literature and expert consultations. However, the number of decision criteria can be reduced to a representative list by applying different methods such as the Delphi, the least mean square (LMS), and the correlation coefficient (CF) method. The Delphi method is based on several rounds of discussions amongst a group of decision-makers to reach a consensus regarding a representative set of criteria to be used in the evaluation process (Rowe and Wright, 2001). The LMS method is used to eliminate the criteria with similar performance across the alternatives. In the CF method, if the correlation coefficient between two criteria is close to 1, they are closely related; therefore, one can be removed (Papadatos and Xifara, 2013).

C. Weight Assignment to Criteria and Indicators

There are different approaches for determining weights. In this analysis, we propose to use the AHP method to determine the weights of each criterion. The AHP is one of the MCDA tools that enable decision-makers to model a complex decision problem by breaking down the decision problem into a hierarchical structure comprising goals, criteria, sub-criteria, and alternatives (Saaty, 1980). It is an effective tool in dealing with complex decision-making by integrating the subjective and objective opinions of decision-makers as well as by integrating individual and group preferences and priorities (Ssebuggwawo and Hoppenbrouwers, 2009). The AHP is widely used due to its ease of use, flexibility, and ability to handle input from multiple decision-makers. The first step in AHP is breaking down a complex decision problem into a hierarchy of interrelated decision criteria and sub-criteria (indicators). Once these criteria and indicators are defined (Figure 7), individual decision maker's preferences with respect to a set of criteria are expressed through a pairwise comparison technique. In these pairwise comparisons, decision-makers are asked to assess the relative importance on a 9-point Saaty scale, ranging from equal importance (1) to absolute importance (9) (Saaty, 1980). Two types of pairwise comparisons are employed in AHP: the first compares pairs of criteria to ascertain decision-makers' priorities, while the second compares alternatives concerning the various criteria (Loken, 2007). Through pairwise comparisons of criteria, the AHP method enables the transformation of qualitative estimates provided by stakeholders into quantitative estimates.

D. GIS Approach

The GIS component plays a pivotal role in integrating geospatial data and analytics into the decision-making process. The process (as illustrated in Figure 8 involves the following: i) spatial data integration, ii) resource mapping, iii) site suitability analysis, iv) data visualization, and v) spatial decision support.

Figure 8: A simplified workflow of the GIS approach.

Spatial Data Integration

This process combines and harmonizes geographical data from various sources into a single, cohesive data set. It is fundamental and integral for urban planning and waste management and can meaningfully provide spatial relationships and inform the MCDA or decision-making processes.

Some of the key data sources may include i) *waste generation data,* which provides the annual amount of waste generated in specific geographic locations, typically in tons per annum. These data sources can be obtained from national databases, local municipal authorities, or directly using citizen scientists. ii) *waste composition data*, which involves the categorization of waste types according to composition or sources. Such data may be obtained from national or urban waste studies, literature, and field surveys. Other data sources may encompass waste generation sites, potential resource recovery locations, transportation networks, environmental conditions, regulatory zones, etc. With these data sources, decision-makers can gain a more comprehensive understanding of waste management systems and make informed decisions.

Resource Mapping

This process involves the spatial identification, analysis, and visualization of various organic waste streams across geographical areas, e.g., specific countries. The key steps in resource mapping will include Data Acquisition - obtaining relevant spatial data, e.g., georeferenced waste generation and waste composition data for target areas. Geospatial Analysis - using GIS techniques to process and visualize data and create thematic maps that show the distribution of waste resources (Figure 9). Resource Potential Assessment - calculating the quantity and quality of resources available, which may include energy potential, nutrient content, or water reuse potential, depending on the waste stream, and attributing this to spatial data sources. The dataset may be integrated with other environmental data for a comprehensive understanding of resource distribution and its impact.

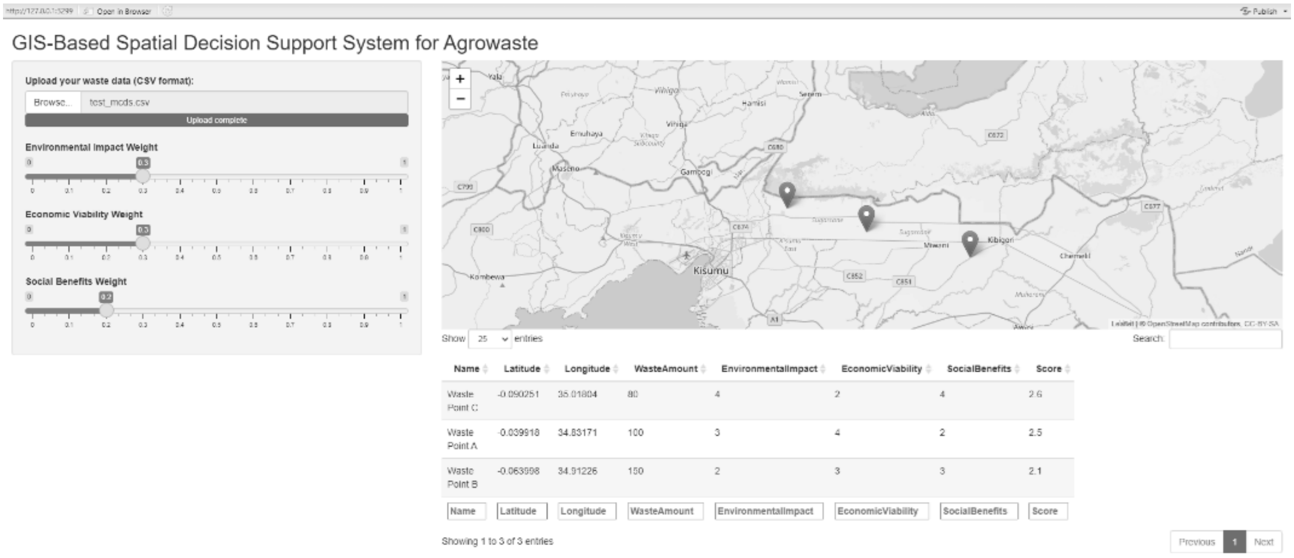


Figure 9: Sample GIS-based tool for spatial decision support system developed using R and Shiny tools.

Site Suitability Analysis

This process is useful for identifying the most suitable locations for RRR facilities. The feature is useful for decision-makers and urban planners who require insight into land use planning and appropriate sites for RRR business models. Some of the processes to be undertaken include a composition of various spatial data layers (vector and raster), including waste generation sites, potential recovery sites, transportation networks, and environmental constraints; conducting spatial analysis by employing multi-criteria decision criteria techniques to assign weights to different criteria influencing site suitability. This allows the model to take stakeholders' preferences, e.g., proximity to waste sources, transportation accessibility, and environmental sensitivity into account in weightings and to prioritize certain criteria over others based on their significance. This process also has the potential to combine and aggregate different data layers to create a composite site suitability map that highlights optimal sites for RRR operations. It also enables the calculation of scores, thereby providing a data-driven approach to site selection and planning.

Data Visualization

GIS offers advanced data visualization capabilities to enhance decision-maker understanding and exploration of spatial data. Key visualization techniques include thematic mapping to create maps that visually represent waste resource distribution, site suitability, and/or environmental impact. Charts and graphs can also be created within a GIS environment to display quantitative data and trends related to waste resources and business model criteria.

Spatial Decision Support

GIS serves as a robust spatial decision support system, enabling decision-makers to interactively explore and evaluate various RRR business models within a geospatial context. Key functionalities may include scenario modelling to enable users to define and simulate different scenarios and adjust criteria, weights, and parameters for spatial assessment; iterative decision-making and analysis where stakeholders are enabled to refine their choices based on spatial insights and feedback; spatial query, enabling users to perform spatial queries and analysis to answer specific questions related to site suitability, resource potential, and/or environmental impact; dashboards with interactive interphases for users to dynamically explore spatial data, adjust parameters, and visualize different scenarios. In summary, this GIS tool can facilitate spatial modelling and assessments, incorporate relevant environmental data and anthropogenic layers, and empower decision-makers to make informed choices regarding sustainable RRR business models. This can enable circular economy transition, promote RRR, and minimize adverse environmental impact. Furthermore, geospatial-based multi-criteria decisions can help to identify potential site locations and understand the potential risks and impacts of RRR activities, aiding in the selection of environmentally sustainable business models.

E. Model Parameters and Decision Matrix

Following the identification and allocation of weights to each of the criteria and indicators, performance scores are assigned to sets of indicators using user-defined inputs and data sets outlined in Table 2 for different model parameters. These include waste parameters that estimate quantities, qualities, and product yields for different waste streams; technology-related parameters that capture efficiency of conversion for various technologies and resource use efficiency; environmental parameters with emission factors for environmental performance analysis; and financial parameters for cost indication and feasibility assessment. Indicators such as investment cost, Benefit-Cost Ratio, reductions in GHG emissions achieved, and number of jobs created can be directly quantified or qualitatively scored as an ordinal indicator such as high/medium/low. The measurement method for each indicator is determined based on each criterion in question. For example, a cost-benefit analysis can be used for indicators related to economic criteria, and a life cycle analysis for environment-related indicators.

These measures each RRR business model's performance in terms of its contribution to the economic, environmental, and social objectives specified by the relevant stakeholder group. Thus, in this step, a decision matrix will be constructed, aggregating each RRR business model's overall performance in terms of the economic, social, and environmental sustainability criteria. Note that normalization of decision criteria or indicators might be needed for consistency purposes and comparison of different RRR business models.

Table 2: Overview of model parameters and assessment indicators

	Definitions & Use	Unit	Data Type	Potential source
Technical Model Parameters				
Waste Quantities	Amount of waste generated per annum and in target site(s).	tonne(s) per annum, also referred to as functional unit (FU)	Quantitative	GIS Model
Waste Qualities	Amount of biowaste in a given waste stream	% of biowaste	Quantitative	GIS Model
Waste Collection Efficiency	Percentage of waste collected for RRR processing	% of biowaste collected	Quantitative	GIS Model
Product Yield	Amount of usable product (e.g., biogas yield) per given waste and for specific technology routes. This parameter also captures technology conversion efficiency, e.g., energy efficiency for combined heat and power systems and mechanical efficiency for rotating equipment.	kg (solid) per FU L (liquid) per FU Nm^3 (gas) per FU	Quantitative	Model Equations, Literature
Resource Use	Resource use in operating the resource recovery facility, including water, energy, human resources, land use, fuel use	m^3 per FU (water) kWh per FU (electricity) kJ per FU (heat) person-months per FU (human resources) ha per FU (land) L per FU (fuel)	Quantitative	Model Equations, Literature

	Definitions & Use	Unit	Data Type	Potential source
Environmental Model Parameters				
Emission Factors	Amount of GHG per yield of product. This includes emissions to air, including carbon dioxide (CO_2), methane (CH_4), ammonia (NH_3), and nitrous oxide (N_2O); emissions to land and water, including nitrate, nitrite, and phosphates. All emissions are reported in CO_2 equivalent (eq.)	CO_2 - eq. per FU	Quantitative	IPCC Emission Factor Database, National GHG Inventories, IEA, Academic Literatures
Financial Model Parameters				
Cost and Revenue Factors	Associated costs per given technology route, including investment/capital costs, operational and maintenance costs (O&M), and potential revenues from selling products and services.	Cost Benefit Ratio (No Unit) Return on investment (%) Net Present Value (USD)	Quantitative	Model Equations, Databases and Academic Literature
Social Model Parameters				
Jobs Creation	Number of jobs created. This parameter captures direct and indirect employment opportunities and contributions to workforce growth and local economic development.	No. of jobs	Quantitative	Model Equations/ Academic Literature
Potential Health Benefits	Positive effects on human well-being due to improved waste management and resource recovery, including reduced morbidity rates and improved air quality metrics.	Disability Adjusted life years (DALYs)	Qualitative	Model Equations/ Academic Literature

	Definitions & Use	Unit	Data Type	Potential source
Improved Livelihoods	Additional revenue for waste generators or input suppliers, cost savings for end users of products and services	USD per FU	Quantitative	Model Equations/ Academic Literature
Institutional Model Parameters				
Waste Management Regulations	Legal guidelines and rules governing the management, disposal, and handling of waste materials to protect the environment and public health.	Binary	Qualitative	CBE Investment Climate Study
Financing Regulatory Framework	Regulatory measures and policies that influence financial markets, institutions, and conditions, impacting economic stability and performance.	Binary	Qualitative	CBE Investment Climate Study
Licensing Authorities	Institutions or bodies responsible for issuing permits, licenses, or certifications, often ensuring compliance with specific standards or regulations.	Binary	Qualitative	CBE Investment Climate Study

F. Business Model Generation

Following the determination of the RRR business model's overall performance in terms of the economic, social, and environmental sustainability criteria, the best alternative solution will be selected, and a suitable business model will be designed using a business model canvas (BMC), which specifies the target customers and markets, activities and operations and distribution strategy. The BMC is a qualitative tool that helps the decision maker frame the business model, and this helps in attaining a competitive advantage in market position and operations.

It consists of **four** core areas:

- **Value proposition** – describes the business's products and services offered to meet customers' needs.
- **Customer segment** – entities for whom the business creates value.
- **Operations** – elaborates the activities and tangible and intangible resources required for the business.
- **Financial aspects** – indicates the costs and revenue with profit or loss implications.

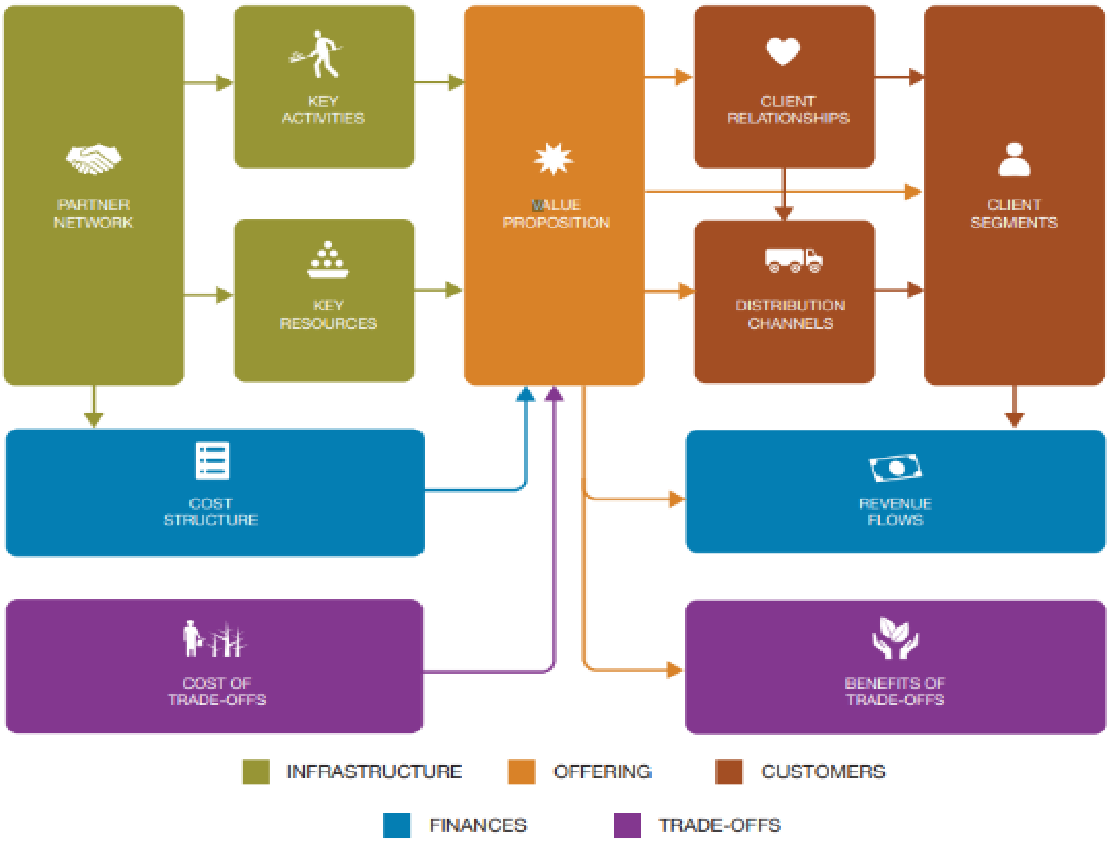


Figure 10: Components and interlinkages of the extended business model canvas (Osterwalder and Pigneur, 2010 as mentioned in Otoo and Drechsel, 2018)

These core areas can be extended to include social and environmental costs and benefits as shown in Figure 10.

To design the BMC, the decision maker needs to define the parameters related to market position and operational aspects. Market position is covered by value proposition, customer relationships, customer segments, channels, revenue streams, and social and environmental benefits. The operational aspects are covered under key partners, key activities, key resources, cost structure, and social and environmental costs.

Examples of parameters required in the BMC are listed in Table 3.

Table 3: Developing a Business Model Canvas

Parameters	Description	Examples
Positional aspects		
Customer segments	Include the consumers of the products and services specifying the target market segments	Households, business, public institutions, communities, farmers
Customer relationships	Type of relationships customers expect from the business	One-to-one service, contracts/licenses from local governments
Customer channels	Through which channels can the customers be reached	Retail outlet, brochures and media communications, municipality outlet
Value proposition	Specify the benefits derived from products and services for customer segments and problems solved for the different segments	Production of organic fertilizer for specific types of farmers, lower GHG emissions
Revenue streams	Elaborate the fees/prices for the products and explain the different revenue contribution to the total revenue	Sale of RRR products such as compost, energy in different forms
Social and environmental benefits	Mention the potential benefits to environment, health, and society	Job creation, potential positive health impacts, potential positive environmental impacts
Operational aspects		
Key partners	List the key partners (and/or suppliers) required for the business along with the key activities performed by them	Municipal corporations & local authorities, technology suppliers, financial partners, NGOs
Key activities	List the key activities that would lead to the value propositions, maintain customers, and generate revenue	Collection of organic fractions of municipal waste for composting, digesting food waste, and agro-waste for biogas generation
Key resources	The key resources required to complete activities for value addition and revenue generation	Appropriate technology and equipment, land, labor, finance, license/contracts
Cost structure	Identify the costs for different inputs to the production	Fixed investment costs, production, operation and maintenance costs, interest payments
Social and environmental costs	Indicate the potential environmental and health risks to society	Health risks for workers associated with compost production

Conclusion and Way Forward

This technical brief described the conceptual development of a decision support tool that can enable small and medium-sized enterprises (those involved or interested in CE), policymakers, and other decision-makers involved in the planning, implementation, and advocacy of CE initiatives to select sustainable CE business models with positive social, economic, and environmental outcomes.

The framework has incorporated a robust MCDA approach for the holistic assessment of CE approaches, business models, and interconnected objectives, enabling decision-makers to make informed choices and navigate pathways for cost savings, reduced environmental impact, and improved resource recovery. Based on key priorities and a comprehensive assessment of technical, environmental, financial, social, and institutional drivers, the tool can enable small and medium-sized enterprises to navigate the complexities of transitioning to a circular economy and provides data-driven insights on pathways to low carbon development and optimum resource efficiency. This will not only impact business strategies but also accelerate the implementation of CE innovations for waste management. The team is working forward to developing the decision support tool with a friendly graphical user interface and training manual to enable wide access, adoption, and engagement.

Expected Outputs

The tool will provide the following outputs:

i) rapid assessment of suitable locations for CE business models in a given context.

ii) a quick narrowing of options of CE business models for a given waste stream and technology options, while considering the priorities and interests of various stakeholders.

iii) a user-friendly interface, where users can modify inputs and test scenarios and an interactive data visualization dashboard for result analysis.

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