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Original Article

Finding value in waste: Circular Economy Initiatives in NGOs in Brazil and Togo to reduce food wast

Encontrando valor no desperdício: Iniciativas de Economia Circular em ONGs no Brasil e Togo para redução de resíduos alimentares

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Abstract

Objective: Food waste can be repurposed through methods such as composting, reverse logistics, and anaerobic digestion using Circular Economy (CE) techniques. This study aims to analyze the application of Circular Economy by NGOs in Brazil (Ecozinha) and Togo (ENPRO) to address food waste.
Methodology: This research was a collaborative effort. Data was analyzed using the ReSOLVE framework through Document analysis and questionnaires. Four managers, two from each country, played a crucial role in completing the questionnaires (Google Forms), making them an integral part of this study.
Results: Both NGOs employ innovative regenerative approaches, converting waste into compost to enhance soil and food production. Ecozinha (Brazil) is an intermediary for proper waste disposal, while ENPRO (Togo) collects and transforms organic waste into value-added products. Ecozinha aids establishments in waste management, promoting the Circular Economy. ENPRO enhances sanitation by valuing waste. Both NGOs use composting to close the material cycle, sharing compost with farmers.
Theoretical implications: Applying a theoretical framework to an empirical case uncovers new avenues for research. Further exploration is recommended to create more resilient, fair, and adequate food systems.
Practical implications: By identifying opportunities and barriers and developing a framework illustrating collaborative relationships, this research provides valuable insights for producers, entrepreneurs, and government decision-making.
Originality: This study fills a significant gap in the literature. No studies have addressed the valorization and transformation of food waste by non-governmental organizations in developing countries, making this research a novel and significant contribution to the field.

Keywords: Circular economy; Food waste; Non-governmental organizations; Food security; Upcycling

Resumo

Objetivo: Os resíduos de alimentos podem ser reaproveitados por meio de métodos como compostagem, logística reversa e digestão anaeróbica, usando técnicas da Economia Circular (EC). Este estudo visa analisar a aplicação da economia circular por ONGs no Brasil (Ecozinha) e Togo (ENPRO) para lidar com o desperdício de alimentos.
Metodologia: Fazendo uso da estrutura *ReSOLVE* analisou-se dados elaborados de duas maneiras: Análise documental e aplicação de questionários. Quatro gestores responderam completamente os questionários (*Google Forms)*, sendo dois de cada país.
Resultados: Ambas as ONGs utilizam abordagens regenerativas, convertendo resíduos em adubos para melhorar o solo e a produção de alimentos. A Ecozinha (Brasil) atua como intermediária na destinação adequada de resíduos, enquanto a ENPRO (Togo) coleta e transforma resíduos orgânicos em produtos agregados. A Ecozinha auxilia estabelecimentos a gerenciar seus resíduos, promovendo a economia circular. A ENPRO, por sua vez, valoriza resíduos melhorando o saneamento básico. As duas ONGs analisadas adotam compostagem para fechar o ciclo de materiais, compartilhando compostos com agricultores.
Implicações teóricas: A aplicação de uma estrutura teórica em um caso empírico releva novas formas de análise. Adicionalmente, são sugeridas pesquisas posteriores para a criação de sistemas alimentares mais resilientes, justos e eficazes.
Implicações práticas: O levantamento de oportunidades, barreiras e a elaboração de um *framework* ilustrando a relação colaborativa contribuem para a tomada de decisão de produtores, empresários e governo.
Originalidade: Até o presente momento, não se encontram estudos que abordem a valorização e a transformação de resíduos alimentares por organizações não governamentais nos países em desenvolvimento.

Palavras-chave: Economia circular; Desperdício de alimentos; Organizações não governamentais; Segurança alimentar; Upcycling

INTRODUCTION

In recent years, there has been a significant increase in interest in food waste, including policymakers, non-governmental organizations (NGOs), and researchers. Concerns about food security and environmental impacts have increased attention (Schanes et al., 2018). Due to population and income growth, the demand for food is expected to increase, which raises concerns about arable land in developing nations, especially in sub-Saharan Africa and Latin America (FAO, 2019). Therefore, Campos et al. (2024) highlight that food security depends on how actors in the food supply chain behave in the face of food crises.

Food waste can be reused through methods such as composting, reverse logistics, and anaerobic digestion, using circular economy techniques (Silva & Capanema, 2019). Proper waste treatment is crucial to avoid contamination and environmental degradation (Silva et al., 2015). In addition, policymakers are interested in waste prevention and reduction programs aligned with the Sustainable Development Goals (SDGs), which also bring economic benefits (Cristobal et al., 2018).

The circular economy approach has gained importance on a global scale, notably in developing nations such as Brazil and Togo (Ghisellini et al., 2016; National Confederation of Industries, 2019; Dora et al., 2021). This approach has effectively reduced pollution and greenhouse gas emissions by converting waste into higher-value products (Bianchi & Cordella, 2023). According to Rosa et al. (2023), the circular economy contributes to achieving sustainable development goals. Cerqueira-Streit et al. (2024) pointed out, through a case study, the importance of the circular economy in supply chains in general for preventing and reducing waste.

Despite these advances, there are considerable gaps in research on the circular economy (Merli et al., 2018) both in the African context, as pointed out by Nijman-Ross et al. (2023), and in the Brazilian scenario (Guarnieri et al., 2023). Furthermore, to date, no studies have addressed the valorization and transformation of food waste by non-governmental organizations in developing countries, addressing this issue from the circular economy perspective and exploring the concept of upcycling as a driver of this approach.

In Brazil, NGOs such as “Favela Orgânica”, “Gastronomia Responsável”, “Banco de Alimentos”, among others, are actively involved in reducing waste and promoting the SDGs (Creus, 2018). In Togo, NGOs also play a fundamental role in working with environmental education, sanitation, malnutrition and hunger (Koledzi, 2011).

Given this context, the following research question is posed: What circular economy initiatives have NGOs in Brazil and Togo carried out to reduce the volume of food waste? Therefore, this study aims to analyze the application of the circular economy by NGOs in Brazil (Ecozinha) and Togo (ENPRO) to deal with food waste.

The paper is structured in five sections. The theoretical framework will then present the concept and principles of the circular economy and its relationship with food waste. The methodology section presents the techniques used for data collection and the documents analyzed. The part dedicated to the presentation and discussion of the results presents the actions of each NGO analyzed and discusses their theoretical and practical implications.

Finally, the framework illustrating the symbiotic chain of NGOs with the external environment is presented to stimulate future studies in the same area. In this way, the research contributes to food waste management aligned with the principles of the circular economy (EMF, 2015; Korhonen et al., 2018).

THEORETICAL BASIS

Circular Economy business models and practices

The Circular Economy (CE), an alternative to the current economic model, seeks to reduce the exploitation of natural resources, increase the reuse of discarded products and minimize environmental pollution (EMF, 2013). CE principles are increasingly indicated as a sustainable solution to achieve sustainable development goals. To this end, it is essential to create new circular models that assist professionals, decision-makers and policymakers in adopting practices and assessing the impacts of this approach (Saidani et al., 2019).

It is essential to understand that the shorter the product's life cycle, the lower its loss of value. Therefore, there is a sequence of priorities for the forms of recirculation: maintenance, reuse, remanufacturing and recycling, as the possibilities for recirculating matter and energy are countless (Kirchherr et al., 2023).

Lacy and Rutqvist (2016) present five circular business models: circular supply chain, recycling, product life extension, and product and service sharing platform. Circular models offer competitive advantages through cost reduction, revenue generation, and risk mitigation (Lacy & Rutqvist, 2016). Osterwalder et al. (2014) highlight

how Circular Economy business models can generate new business opportunities, growth, sustainability, and transformation of customer relationships.

Osterwalder and Pigneur (2010) discuss nine elements of a circular business model: customer segments, value propositions, relationship channels, revenues, resources, activities, partnerships, and costs. Guldmann and Huulgaard (2019) explore circular model innovation with leasing contracts and performance-based services.

Lacy and Rutqvist (2016) highlight that circular models operate symbiotically. At the same time, Ünal et al. (2019) propose a circular model for Italian multinational companies, integrating several dimensions, including information and communication technology. Geissdoerfer et al. (2020) define circular business models as those that cycle, extend, intensify, and dematerialize resources, innovating through conceptualizing and implementing circular models.

The CE requires new business models to reduce and create positive environmental impacts. Practical implementation begins with developing products, processes, and models that create a positive impact (Bocken et al., 2019).

In short, the Circular Economy model is based on consciously producing and consuming, sharing, reducing, reusing, remanufacturing, repairing, refurbishing, and recycling existing materials and products for as long as possible. Due to rapid population growth, climate change, and declining soil fertility and biodiversity, the circular economy has received significant attention from researchers and policymakers (Khan & Osinska, 2022; EMF, 2013).

In the context of developing countries, the use of the ReSOLVE model helps implement the circular economy. The theoretical framework encompasses actions such as regenerating, sharing, optimizing, cycling, virtualizing, and exchanging (EMF, 2015). Other studies have used this method to analyze different chains.

For example, Cerqueira-Streit et al (2023) used ReSOLVE to analyze the implementation of circularity practices in the packaging sector in Brazil. After interviewing fifty-three stakeholders from different areas, the authors found a low implementation

rate. Therefore, among other points, they criticize the industry's insistence on using materials even though they know that reuse, repurposing, or recycling are not viable at the end of the product's useful life. Although some technologies favor actions such as virtualization, exchange, or loop, the results indicate that Brazil is not a high-tech country in recycling or reverse logistics of packaging (Cerqueira-Streit et al., 2023).

Moraes et al. (2023) highlight the six actions contained in ReSOLVE to enable circular economy actions. The literature review guided by Kalmykova et al. (2018) understands that, despite other methods, ReSOLVE provides a comprehensive and integrated view of the externalities that make up the flow. Table 1 below briefly explains each of the principles.

TABLE 1: Circular economy principles according to ReSOLVE

Principle	Basic Idea	Benefits
Regenerate	Shift to the use of reusable and renewable materials and energy.	Recover, retain, and restore ecosystem health; Return recovered biological material to the biosphere.
Share	Share the use of assets such as cars, physical spaces, and lighting.	Reuse and utilize materials already used by others; extend their life through maintenance, durability, and upgrades.
Optimise	Improve product performance and efficiency.	Reduce waste in the production chain; leverage big data, automation, and remote production control
Loops	Remanufacturing of products and components.	Recycle materials; digest anaerobically; extract biochemicals from organic waste.
Virtualize	Offer a specific product through a service (Dematerialized).	Generate less waste; save raw materials
Exchange	Replace old materials with new ones that are renewable, recyclable, biodegradable, among others.	Apply new technologies; choose new products or services.

SOURCE: The authors based on EMF (2015)

In Brazil, the application of circular models needs more national guidelines despite policies and programs for sustainable development and circular practices (CNI, 2019). The PNRS - National Solid Waste Policy (Brazil, 2010) includes ideas for a Circular Economy. However, challenges persist in waste management (Guarnieri et al., 2020).

Studies such as that of Corsi et al. (2017) highlight the lack of research on the circular economy in Brazil, focusing on concepts, applications, and relationships with the PNRS.

The implementation of reverse logistics faces obstacles in Brazil, and the PNRS still needs to achieve satisfactory results regarding shared responsibility for the product life cycle or the elimination of landfills (Ferreira et al., 2017; Guarnieri et al., 2020). The adoption of the Circular Economy in the country is affected by financial, operational, structural, attitudinal, and technological barriers (Cerqueira-Streit et al, 2023).

Understanding CE in Brazil involves analyzing normative methods, evaluating the effectiveness of instruments, and creating guidelines for their application. Social and economic issues require further investigation in research on the circular economy in Brazil (Guarnieri et al., 2023). Ferreira et al. (2017) emphasize the potential of the circular economy to modernize waste policies and highlight its economic relevance.

Therefore, with the growth of issues related to compliance with the UN 2030 Agenda in Brazil, the National Circular Economy Policy (PNEC) was established through the symbolic vote of the Senate plenary approved in 2024 to encourage more conscious use of resources and giving priority to more durable, recyclable and renewable products (Brazil, 2024).

In sub-Saharan Africa, especially in Togo, the Circular Economy addresses social, economic, and environmental crises arising from poverty, hunger, and limited access to services (Boon & Anuga, 2020; Lawson, 2020). This new way of doing business can increase resource efficiency, agricultural productivity, and economic benefits, and it has roots in traditional circular practices such as reuse and tontines in African communities (Thiaw, 2017).

Despite persistent challenges in waste management and the neglect of environmental sustainability in developing countries, initiatives in nations such as Rwanda and South Africa are leading the way in promoting the Circular Economy, with the establishment of institutes and organizations such as the African Circular Economy Network (ACEN) seeking solutions and raising awareness (European Commission, 2019).

University students in countries such as South Africa seek to drive transformation through recycling and environmental education projects. Despite the difficulties, CE is

considered a fundamental element for sustainability and well-being in Sub-Saharan Africa (Nijman-Ross et al., 2023; Boon & Anuga, 2020).

Overall, in sub-Saharan Africa, the Circular Economy is seen as a pivotal opportunity to address the challenges of sustainable development in the region, despite the barriers that need to be overcome, such as lack of education and political will in waste management.

CIRCULAR ECONOMY OF FOOD WASTE

Circular processes can convert food waste into higher-value products (Ouro-Salim & Guarnieri, 2022). In developed nations, adopting circular models has resulted in several collaborative consumption initiatives, such as public refrigerators, food-sharing apps, industrial symbiosis, and food exchange programs (Falcone & Imbert, 2017; Ferrari, 2016). In the production sphere, alternative approaches include using innovative packaging to extend the shelf life of food (Gallagher & Mahajan, 2011; Galgano et al., 2015).

In developing countries, strategies to reduce food waste should include efficient supply chain management, packaging improvements, training, communication/ education, logistics optimization, and improved handling practices (Dora et al., 2021).

The inedible and unavoidable parts of food waste can be processed anaerobically to produce green resources, such as compost, biogas, or green electricity, maintaining a circular life cycle and adding value (Shurson, 2021). However, EMF (2013) and McDonough & Braungart (2002) highlight the importance of rethinking our relationship with natural resources and adopting approaches that minimize excessive extraction and disposal. In this context, upcycling, which converts food waste into higher-value products, aligns with the essence of the circular economy, maximizing the utility of resources.

Turner and Pearce (1990) and Stahel (2016) emphasize the need for a systemic and collaborative approach to environmental and economic challenges. It is worth highlighting the role of consumers in combating food waste by taking initiatives, from purchasing to disposal. There is evidence that educational awareness campaigns, combined with political interventions and adequate selective collection, prevent the increase in food waste rates (Diaz-Ruiz et al., 2019).

New business opportunities and solutions will also emerge with the increasing focus on food waste and the adoption of circular models. Table 2 highlights some examples of circular models applied to mitigate food waste at different stages of the food supply chain.

TABLE 2: Business models and circular initiatives

Agriculture	**Post-harvest**	**Processing**	**Distribution**	**Consumption**
Horticultural waste	**Transport and storage waste**	**Food manufacturing waste**	**Logistics**	**Food Waste**
- Unwanted crops - Harvest losses - Crop damage, natural disasters	- Crop damage, natural disasters - Spillage, spoilage, contamination	-Wineries, breweries - Canneries, food processing - Off-spec (e.g. confectionery) -Slaughterhouses, slaughter waste	- Losses during packaging and transportation - Supermarkets, wholesalers	- Households - Retailers - Restaurants - Large facilities and services (e.g. airports, hospitals)
Waste of animal origin				
-Large animals, pigs, poultry for products - By-catch; - Pasture losses				
Different treatments for food waste				
Mechanical	**Chemical**	**Thermal**	**Biological**	
Mechanical conversions	**Chemical conversions**	**Thermal conversions**	**Biological conversions**	
- Dehydration - Filtration (e.g., micro- and ultrafiltration) - Centrifugation	- Composition analysis - Standard solvent extraction - Other solventless extraction	- Gasification - Pyrolysis - Incineration - Hydrothermal liquefaction	- Anaerobic digestion - Fermentation - Composting - Vermiculture - Insect processing	
New features with added values				
Harvesting inputs	**Industrial products**	**High-value products**	**Animal feed**	**Human food**
Mass materials	**Energy**	**Food system products**	**Animal food**	**Human food**
-Compost -Fertilizer -Carbon	-Gas -Diesel and ethanol - Hydrogen - Electricity **Materials** - Fibers - Biocomposites	-Nutraceuticals - Starch and fibers - Other additives (dyes) **Non-food products** - Pharmacological agents - Polymers -Fibers	- Reprocessed waste - Redirected waste	-Fresh food **Reprocessed foods** - Broths - Fermented foods

Source: The authors

The collaboration between upcycling and circular economy principles in combating food waste promotes more sustainable and resilient food systems (De Oliveira Costa et al., 2022). Applying the lessons in the literature makes it possible to transform challenges into solutions, contributing to a more prosperous and balanced future.

METHODOLOGY

Using ReSOLVE, developed and published by EMF (2015), it was possible to analyze an organic food waste management model in two NGOs, one in Brazil and the other in Togo, identifying points of convergence and divergence about the principles of the circular economy.

First, data were collected by analyzing documents from the two NGOs, available on their websites. Document analysis involves transforming the content of a document to make it more accessible and referenceable, contributing to the creation of documentation services or databases.

The documents analyzed included external standards (government regulations) and internal standards (documents issued by NGOs). These documents were publicly accessible and did not require prior authorization. Information about the NGOs' mission, vision, objectives, purposes, and activities was collected from official websites.

Document analysis (archival data) also illustrated the practice of the work carried out by the organizations studied. According to Schreier (2012), this method converges with qualitative content analysis.

Data were then collected from questionnaires answered by the NGO managers. The managers' participation was voluntary, ensuring accessibility and adhering to the exploratory characteristics of the research. The questionnaires, containing six questions (objective and subjective), were prepared using Google Forms to capture their perceptions about food waste management from the perspective of the circular economy.

Data collection occurred between August 2022 and January 2023 in Brazil and Togo. Four managers completed the questionnaires in total, two from each NGO. Both the documentary analysis and the analysis of the collected data followed the methodology proposed by Bardin (1977), involving stages of pre-analysis, exploration, and data processing. The responses were categorized based on content, aggregating them by similarity for later comparison between the practices in Brazil and Togo.

In this way, the researchers sought to triangulate the data collection techniques. According to Opperman (2000), methodological triangulation represents the union of means to obtain data. In the social sciences, it shows its usefulness in reducing biases and making the perspective of the phenomenon more comprehensive.

PRESENTATION AND DISCUSSION OF RESULTS

Ecozinha Institute

Ecozinha is a non-profit organization located in the Federal District of Brazil. It was founded in 2017 by hotel, bar, and restaurant companies. Its mission is to promote a more sustainable community through responsible waste management.

The organization manages organic, recyclable, and reject waste from its members through reverse logistics, addressing challenges in reducing, separating, and properly disposing of waste. Members contribute monthly fees to support these activities. Around 50% of the waste members generate is organic, including food scraps, prunings, and cork stoppers. These materials are separated and sent to composting yards with partners such as “Projeto Compostar” and “Engaia Compostagem’.

Ecozinha also uses logistics technology provided by the company “Sólidos” to track and audit waste, ensuring that it is recycled or composted by accredited recyclers. Its environmental impact includes reducing more than 20,000 tons of greenhouse gases through the composting process (Ecozinha, 2023a).

ENPRO

Founded in 1999, ENPRO's mission encompasses environmental, social, technical, and economic aspects. The organization collects food waste and other municipal solid waste, processing it mainly through composting, generating more than 300 tons of compost annually.

In addition, it seeks to develop new activities that benefit the environment and society while seeking to achieve financial sustainability through diversification strategies and the sale of recyclable waste. Since its creation, the organization has evolved, gaining recognition from local authorities in waste management and establishing international partnerships, such as the Africompost project in collaboration with the French association Gevalor (ENPRO, 2023b).

CIRCULAR ECONOMY PRACTICES USED IN THE ORGANIZATIONS STUDIED

The circular economy strategies adopted by NGOs in both countries were examined using ReSOLVE. The questionnaire sent to the managers of Ecozinha and ENPRO allowed the collection of primary data to compare their organic food waste management practices (see Table 3). ReSOLVE encourages circularity in agri-food supply chains. With increasing demand to address climate change, emerging economies are adopting circular practices (Tu et al., 2020). In this context, the management of food waste by Ecozinha and ENPRO was analyzed in light of this model.

TABLE 3: Relationship between ReSOLVE and methods employed by NGOs

	ECOZINHA	ENPRO
Regenerate	Soil regeneration	Soil regeneration
	Production of fertilizers	Fertilizer production
Share	Compostar Project	Farmers
	Romero Melo Gardens	Workers
	Restaurants, bars and hotels	Restaurants, homes
	CH4 Bio	Gardeners
	Pura Vida	Waste recycling companies
	Farmers	
	Vital Environmental Solution	
Optimise	Sales of composts	Waste management and recovery
	Composting	Urban sanitation and environmental protection
	Recovery of organic waste	Organic waste recovery
	Removing waste from the garbage cycle and placing it in the food cycle	Composting practices
Loops	Turning garbage into an environmental liability	Práticas de compostagem
	Fostering the circular economy through food	Organic waste transformation and recovery
	Obtaining quality organic fertilizer	Obtaining 100% organic products
	Sequestration of GHG in the atmosphere	Reduction
	Composting	Reuse
	Reuse	Recycling
	Recycling	Recovery
	Rethinking	
Virtualize	Using social networks such as Instagram, Facebook, and the website to publicize the need for restaurants, hotels, and bars to join and their social, economic, and environmental impacts	Use of website and LinkedIn to disseminate information about initiatives and their social, economic and environmental impacts
Exchange	Environmental education for environmental preservation	Shared knowledge with other waste recovery companies
	Promotion of low carbon through food	Source of jobs
	Participation in restaurants, hotels, and bars	Sustainable development
	Exchange of knowledge with other waste recovery companies	Awareness campaign
		Healthy food consumption
		Community well-being
	Marketing of products	Reduction of pollution
		Environmental protection
		Fight against poverty

Source: The authors

Regenerate is the principle focused on environmentally friendly agricultural and animal materials, promoting soil regeneration. Both NGOs use regenerative approaches, transforming waste into fertilizers to improve soil and food production. Share emphasizes sharing organic waste and reducing the use of virgin materials and emissions. Ecozinha is an intermediary in properly disposing waste, while ENPRO collects and transforms organic waste into value-added products.

The Optimize principle seeks economic efficiency by optimizing waste management. Ecozinha helps establishments manage waste, promoting the circular economy and economic development. ENPRO values waste, improving basic sanitation, and promoting healthy eating.

When seeking to reuse existing materials, an organization practices the Loop. The two NGOs analyzed adopted composting to close the material cycle, sharing the compounds with farmers. Virtualize is reached digitally, promoting transparency and information exchange. Both use social networks to publicize practices and impacts. Implementing the Exchange principle requires innovation. It is observed that Ecozinha exchanges information, while ENPRO focuses on awareness and job creation.

BARRIERS TO ECOZINHA E ENPRO

The challenges faced by Ecozinha and ENPRO are in line with existing literature on economic, social, and environmental aspects of the circular economy (Homrich et al., 2018; Korhonen et al., 2018; Guarnieri et al., 2023). The literature tends to focus more on theoretical aspects, needing more direct connections between theory and practice, especially in developing countries (Dou et al., 2022).

The need for collaboration between multiple stakeholders to promote the circular economy is highlighted in the literature (Newsholme et al., 2022; Hellal & Koraï, 2023). Ecozinha and ENPRO face challenges in financing their expansion, a barrier also mentioned in other studies. The complexity of Circular Economy practices increases with scale, representing a challenge for developing countries (Ferronato et al., 2019).

Both organizations face difficulties gaining recognition from society and policymakers, similar to the barriers identified in previous studies (Alvares et al., 2022; Davies, 2019). The lack of financial support from local authorities is an observed challenge, creating potential barriers to the future development of the initiatives in both countries (Koppers, 2020). The need for appropriate technology for food waste collection and recovery represents a common barrier in developing countries (Yadav et al., 2022; Islam, 2017).

In summary, the obstacles Ecozinha and ENPRO face align with challenges documented in the literature on CE. In addition, there is a need for theoretical-practical integration, financial barriers, lack of recognition, and technological difficulties, such as those commonly found in developing countries (Dora et al., 2021).

THEORETICAL AND PRACTICAL IMPLICATIONS

NGOs and startups play a crucial role in realizing the concept of Circular Economy. A notable example is the surplus food collection from restaurants for distribution to needy people. In addition, these organizations collaborate with restaurants, transforming excess food into meals donated to charities (Närvänen et al., 2022; Koppers, 2020).

The application of lean and sustainable operations in NGOs can be seen as an exemplary model of CE. These models integrate social, economic, and environmental aspects, recognizing food waste reduction's multidisciplinary and complex nature (Kazancoglu et al., 2020).

NGOs often need to receive the recognition they deserve. The prevailing idea that social needs should be met exclusively by public institutions makes it difficult to support NGOs dedicated to preventing and reducing food waste. In this context, it is essential that actors in the food supply chain support NGOs, collaborating in the sustainable development of their activities in both countries.

This study contributes significantly to the literature on food waste prevention and reduction. Examining the impacts of ReSOLVE on NGOs strengthens the implementation of the circular economy in food supply chains (Oldfield et al., 2016).

This research also indicates that using ReSOLVE in food supply chains can guide the creation of public policies aimed at minimizing food waste and its valorization.

To implement effective strategies to prevent and reduce food waste, allocating resources to infrastructure, technology, and education for stakeholders in the food supply chain is essential. Awareness-raising also plays a crucial role; educational programs should emphasize waste minimization. By prioritizing food waste prevention and reduction through ReSOLVE, NGOs can optimize their waste management practices in supply chains.

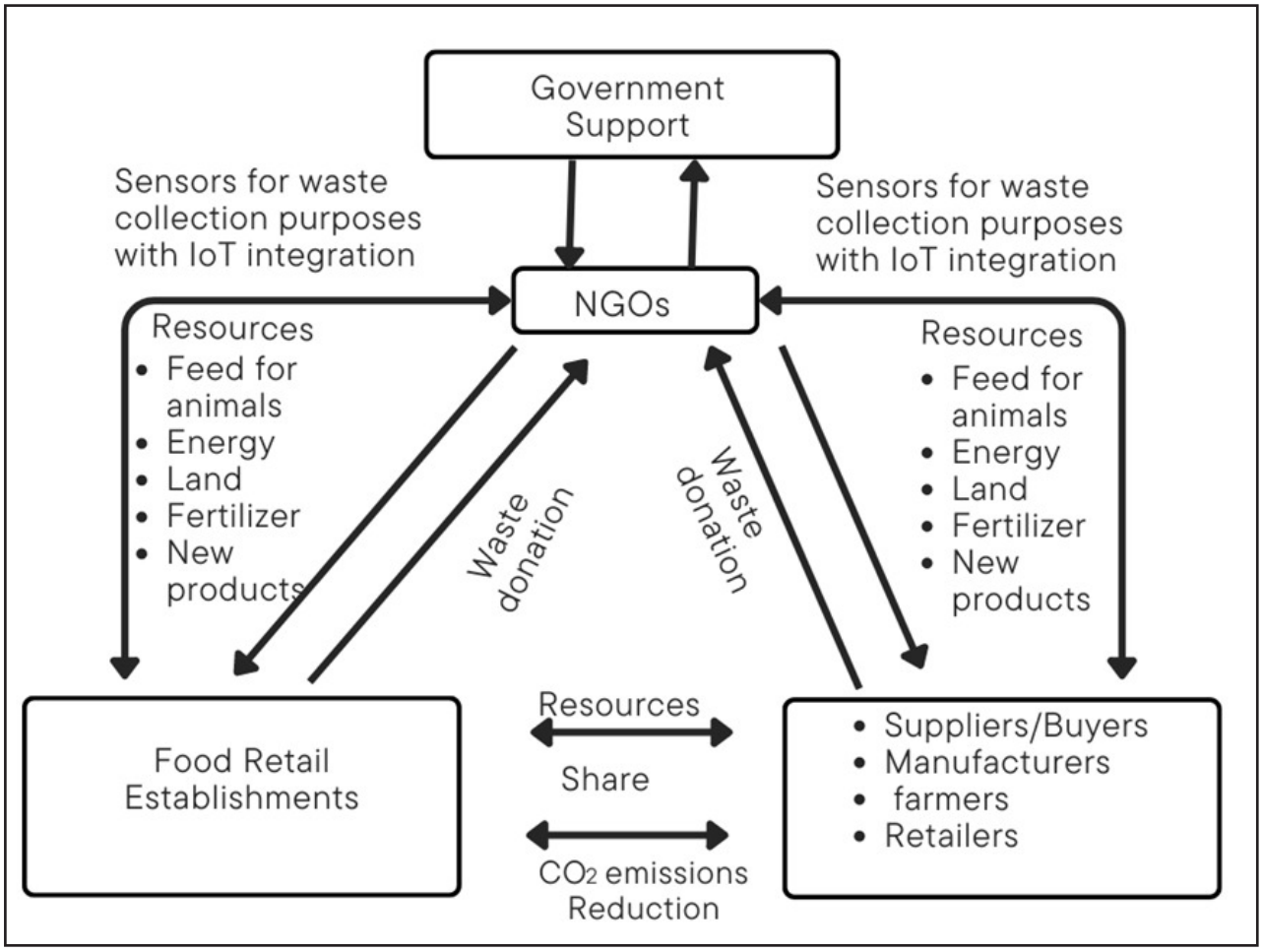
On the other hand, upcycling, a term resulting from the combination of "up" and "recycling", means generating new uses for raw materials or food parts that would otherwise be discarded at the beginning of the production chain (Borrello et al., 2016). Upcycling is an example of a win-win solution, as it helps reduce the environmental impact of food waste, generates revenue for the producer, and meets the consumer market's desire for differentiated and sustainable products (Borrello et al., 2016; Sharma et al., 2022). It is a model that food supply chain actors can adopt in developed and developing countries to reduce and value food loss and waste. Furthermore, recycled goods are likely cheaper than regular goods so that they may be in higher demand (Jamaludin et al., 2022).

Upcycling involves redirecting food that would otherwise be wasted to more valuable uses, benefiting the environment and society. This approach reinforces the economic value of discarded food, sparking interest among stakeholders in the circular economy. Food waste contributes significantly to greenhouse gas emissions, and upcycling efficiently redistributes excess food, improving global health, the environment, and economies (Tchonkouang et al., 2023).

Within the NGOs studied, collaboration between all actors in the food chain would yield positive results. Establishments such as restaurants, supermarkets, retailers, wholesalers, producers, farmers, and other sectors can form a symbiotic chain with NGOs specialized in transforming and valorizing food waste. This joint action would provide multifaceted benefits throughout the supply chain and society, as illustrated in Figure 1. To speed up the dissemination of information and

communication, integrating IoT (Internet of Things) sensors at all levels is necessary (Ouro-Salim et al., 2022; Hellal & Koraï, 2023).

FIGURE 1: Framework illustrating the symbiotic chain of NGOs with the external environment



Source: The authors

Effective communication strategies are essential for consumer acceptance of recycling and biotechnology in food quality. Highlighting the benefits of these approaches, presenting tasty and pesticide-free ingredients, and ensuring a transparent supply chain can boost acceptance. For example, presenting tomatoes with a longer shelf life as personally and socially beneficial led to greater acceptance of genetically modified tomatoes among participants in the United Kingdom and Switzerland (Sharma & Deutsch, 2023; Claudia et al., 2023).

However, NGOs face significant funding gaps in most developing countries, such as Brazil and Togo, as indicated in the literature. In this context, governments and international financial institutions should provide support (Kopers, 2020; Impoco, 2017; Lugo et al., 2023).

Moshtaghian et al. (2023) identified reluctance in Sweden towards consuming recycled food. The research applied logistic regressions to analyze the relationship between food choice factors and hesitation to consume recycled food. It was found that the importance of ethical concerns, health, and sensory appeal were associated with reluctance. However, only the importance of ethical concerns remained statistically significant after adjustments. This highlights the need for awareness-raising through environmental education to promote a culture of sustainable consumption and achieve the UN Sustainable Development Goal 12.3 by 2030 (Claudia et al., 2023). In developing countries, such as Brazil and Togo, awareness still needs to be improved (Guarnieri et al., 2023; Koledzi, 2011), which can complicate the efforts of NGOs. Therefore, NGOs supporting environmental preservation should be transparent about their approaches to treating, transforming, and recovering food waste.

Activist NGOs can improve food waste recovery by utilizing insects and their gut microbes, which naturally transfer nutrients from organic waste to higher animals. By selectively breeding insects on food waste and agricultural by-products, the resulting biomass can be transformed into protein-rich ingredients for animal and human nutrition (Rasool et al., 2023). This method surpasses composting and anaerobic digestion by optimizing nutrient utilization in biological waste and enriching agricultural soils, establishing a sustainable waste cycle. This approach reduces greenhouse gas emissions and environmental impacts associated with traditional waste management methods and reduces dependence on imported raw materials subject to price fluctuations. Recent European legislation supports this strategy, driving its adoption across the continent (Paisios et al., 2023; Taufek et al., 2023).

However, practical implementation on a pilot scale is essential to confirm local viability and cost details. This data is essential to support the adoption of the technology, especially in developing nations such as Brazil and Togo.

This strategy can help NGOs produce recycled food, promote insect-based products in relevant sectors, and encourage stakeholders to adopt the technology, overcoming challenges (Rasool et al., 2023) and promoting the circular economy throughout the production chain. In conclusion, these implications highlight the study's relevance for academia, policy formulation, and managers to apply food waste management practices.

FINAL REMARKS

This study analyzed the application of the circular economy to organic waste in two NGOs: Brazil (Ecozinha) and Togo (ENPRO). The four managers interviewed highlighted the importance of converting food waste into compost despite the limited evidence of circular practices per ReSOLVE. The convergence between upcycling and the circular economy emerges as a source of optimism for facing challenges such as food security, equity, and sustainability.

Comparing the findings with the literature, one can see the potential of the Circular Economy to establish more resilient, fair, and adequate food systems shaped by creativity, collaboration, and innovation. This approach reduces waste, reshapes the relationship with natural resources, and reimagines economic prosperity for a balanced and sustainable world.

The results indicate similar perceptions among stakeholders from different regions, which may apply to other developing countries. However, the study has limitations typical of empirical research. Only two NGOs in both countries were analyzed, and a limited number of respondents used questionnaires.

It is known that the application of questionnaires usually requires a more significant number of respondents, which is one of the limitations of this research. This fact motivated the researchers to triangulate the collection methods (document analysis and questionnaires) to reduce the possible biases of one or the other data collected.

In this sense, future studies can expand the quantity and quality of data collected, applying other techniques such as in-depth interviews to understand better the adaptation of ReSOLVE in the context of NGOs dealing with food waste in the supply chain. In addition, qualitative analysis may make it difficult to generalize the results to other developing countries.

Furthermore, this study is limited by being predominantly based on a single theoretical framework (ReSOLVE). To advance research on food waste reduction, it is suggested that future research assess the level of maturity and collaboration of relationships between NGOs and commercial establishments in light of the principles of the Circular Economy.

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3. Development of theoretical propositions (theoretical work)			√
4. Theoretical foundation / Literature review	√		√
5. Definition of methodological procedures	√		√
6. Data collection	√		
7. Statistical analysis	√		
8. Analysis and interpretation of data	√		
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10. Manuscript writing		√	
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