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INTEGRATING CIRCULAR ECONOMY PRINCIPLES IN URBAN PLANNING: SUSTAINABLE WASTE MANAGEMENT, RESOURCE EFFICIENCY, AND REGENERATIVE CITY MODELS

Muhammad Sajawal[*1], Nabi Ahmad[2], Noman Akbar[3], Dr. Muhammad Ziad[4]

[*1,2]*School of Transportation,Southeast University,Nanjing China*
[3]*MS Civil Engineering, Sarhad University of Science and Information Technology Peshawar.*
[4]*Department of Environmental Sciences University of Peshawar*

[*1]msajawal@seu.edu.cn, [2]nabiasiddiqui@seu.edu.cn, [3]noman.akbar@ymail.com, [4]muhammad.ziad2011@gmail.com

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Abstract
This paper focuses on the prospects of implementing circular economy strategies into the urban planning process, such as to advance the concepts of circular waste management, optimize urban resource consumption, and develop the agendas of regenerative cities. Population expansion in cities has led to acceleration in the generation of waste and depletion of natural resources thus calling for change from the linear economy model to the circular economy model. Applying CE principles, municipalities can minimize waste generation, improve the efficient use of the resources, and enable the recycling of waste materials through recycling, waste-to-energy approaches, and the utilization of the used products. The present paper provides an overview of CE, its relation to urban systems, and its application for stimulating innovation and economic growth. It also highlights the politico-organizational barriers, scarcity of funds and low level of awareness regarding CE among the people in urban environments and suggest measures to overcome these drawbacks. The study also shows, in the case of Amsterdam and Copenhagen, how CE can be utilized to enhance urban resilience by making cities more sustainable and yielding good value-added ecological, economic, and social returns.

INTRODUCTION

People continue to migrate to urban areas across the world and with this migration come challenges of resource utilization, disposal of wastes, and hence urban degradation. The United Nations reports that as we speak more than 55% of the global population lives in cities, and this is estimated to surpass 68 percent in the year 2050. This rapid urbanization has also led to increase in the production of wastes, exhaustion of natural resources and pollution of the environment. In general, urban systems have been developed under the linear economy model creating a "take-make-dispose model" where they extract a resource, use it to produce a product and once done, dispose of the resource as waste (Geissdoerfer et al., 2017). Nevertheless, the application of this model has its drawbacks that became more pronounced recently and that is why there are constant searches for new solutions that would allow for more sustainability, usage of fewer resources, and less waste generation.

The theory of CE provides a revolutionary model for practicing sustainable urban development through the logistic model that can be described as a closed-loop system for managing material and energy cycles.

The concept of CE aims at eliminating unnecessary waste, protecting the environment and preserving the value of products, materials and resources in the economy for as long as possible (Ellen MacArthur Foundation, 2013). Thus, by adopting CE principles, cities can also avoid adverse environmental effects of urbanization and benefit from resultant economic growth, innovation, and equity (Lieder and Rashid, 2016). CE is thus considered as more and more an indispensable paradigm shift in how sustainable and sustainable urban environments are best achieved, from waste management to resource scarcity as well as climate change.

Hence, proactive implementation of CE principles will help urban areas that are centre of consumption and production of waste benefiting from the utilization of the scarce resources. One of the crucial aspects of the new economy and socially responsible business, sustainable waste management, aims at minimizing generated waste, increasing the recycling and reuse rate, and causing less damage to the environment (Morseletto, 2020). Sustainable resource management, particularly resource recycling, energy conservation, and implementation of renewable materials are in synergy with the CE model, as these imply circular material management, which dematerialized virgin resources (Kirchherr et al., 2018). Also, CE promotes theories not only ecological, but the creation of regenerative cities that have the potential to heal what has adversely affected on the natural environment and even make it better than before creating a robust form of cities for habitation by people with improved standards of living of people and a strong system of infrastructure in cities that is regenerative, reliable and of high adaptability (Newman & Jennings, 2008).

However, the implementation of CE in urban planning also has some problems. These are factors such as, the calls to invest in new systems and urban infrastructures, alter the current systems and policies, and also address issues of institutional barriers in collaboration among stakeholders (Bocken et al., 2016). Still, with the understanding of the environmental and economic necessity for CE, more and more cities are trying to find solutions for the integration of CE into city planning from waste management to producing energy from waste, growth of urban gardens and green roofs. For instance, the circular economy has been developed to be the city-wide strategy in Amsterdam to make the city more sustainable (Hák et al., 2016). Like other cities, CE has also been included in Copenhagen's sustainability objectives, especially in aspects of circular waste management and energy (Pauwels et al., 2020).

This paper aims at analysing the possibilities of incorporating Circular Economy principles and practices into the theories and practice of urban planning, particularly through sustainable waste management and resource efficiency as well as through designing regenerative city models. In doing such, the paper seeks to help CE bring attention to how it can revolutionize urban systems that will foster efficient and better change for more sustainable cities. It is also going to unmask the hurdles which the urban planning practitioners encounter while implementing circularity and suggest ways of tackling these hurdles, thus making genetic contribution to the ongoing debate on sustainable urbanism.

Literature Review

Circular Economy: Conceptual Foundations and Urban Relevance

Circular Economy (CE) is a progressive concept that has gained much attention in recent years, as the right model to fight the environmental and resource problems related to urbanization. CE emerged from the concept of eliminating the idea of waste as well as encouraging more utilization of material resources which entails the reinvention of products, materials, and resources in such a way that they can be used again and again without being discarded (Ghisellini et al., 2016). Different from the conventional product life-cycle whereby products are used and dumped, CE entails designing goods and services that form cyclic systems by reusing components that reduces the use of fresh resources and the effects of waste on the environment (Bocken et al., 2016). CE has been identified as a crucial tool that would allow urban centres to shift from traditional unsustainable patterns that characterize current development to sustainable development models that would improve the well being of the residents, reduce vulnerability of cities to shocks and minimization of pollution.

With consumption and generation of wastes being rife in cities, urban centers are pivotal in circular economy evolution. CE in planning is the reconfiguration of cities and their systems such as waste, mobility, energy, construction, so they have closed-loop systems to eliminate waste, relate, regenerate, and rebuild (Zhu et al., 2018). According to this, the urban planners play a significant role in the layout of closed-loop flow systems for cities for sustainability and development control and boosting of the local economy and Wallover resource efficiency and low in external material imports (Lewandowski, 2016). Material flow optimization is therefore an effective way of controlling wastage and cost of procuring raw materials thus helping in the achievement of better and sustainable urban systems.

Circular Economy in Urban Waste Management

Among those, the most suitable to be incorporated into CE principles is waste management as part of urban planning. It was noted that the majority of the waste is generated in urban areas since cities contribute to over 70% of the global waste stream (Hoornweg & Bhada-Tata, 2012). The conventional waste management practices that have been witnessed in most cities still prevail on discharging waste with little or no concern on reduction and reuse. This end-of-pipe approach harms the environment and leads to the unutilized chances of the NC, material recycling and reuse (Frosch and Gallopoulos, 1989). On the other hand, circular waste management strategies are aimed at reducing waste production, recycling, and returns and recovery of raw material, which is line with CE principles (Kaza et al., 2018).

The integration of the circular concept in waste management in cities is crucial as a result of the need to: Ministers and Mayors of metropolitan and urban cities have the potential to set up suitable frameworks for encouraging and mainstream circular waste management practices. Other developed cities in the world today have even installed mechanisms for material recycling as well as utilization of waste to energy where organic waste can be converted into compost or biogas while the inorganic materials are sorted for reuse (Björk & Johansson, 2018). For instance, within the European Union, the European Commission has set regulations relating to circular economy such as Waste Legislation which comprises waste prevention lists, recycling and a circular supply chain (European Commission, 2015). One of the measures on compliance with the principles of circular waste management is the consideration of extended producer responsibility (EPR) programmes as a mechanism to shift back the post-consumer waste disposal burden. As the study by Taddeo has pointed out, EPR legislation has been seen to enhance the collection rates of recycling and improve designs that facilitate recycling.

In addition, both Tokyo and San Francisco waste separation, composting, and recycling procedures are indeed very advanced. Collection of waste in Tokyo currently involves segregation of waste into burnable waste, non-burnable waste, and recyclable materials with an emphasis of compliance with the rules being upheld (Nakamura, 2018). On the other hand, implementation of CE has been witnessed in San Francisco, with the city having developed a zero waste program that seeks to achieve 100% diversion of wastes from landfills by 2020 demonstrating the application of CE in the transformation of waste management in urban areas (City of San Francisco, 2019).

Resource Efficiency and Circular Urban Planning

Comparatively, resource efficiency is another CE principle that can be adopted when implementing the concept in urban planning. Due to the high consumption rates in cities huge sundries with resources, nation's policy makers are paying much importance to already incorporate features of energy efficiency, water rationing and use of sustainable materials. Resource efficiency is among the four pinnacles of CE since it entails minimizing resource consumption and optimizing the utilization of available resources (Stahel, 2016). Applying resource-efficient concepts in the urban context helps to strengthen their capability of being less dependent on resources, becoming less vulnerable to supply chain disruptions, and much more equipped to develop resource autarkic systems (Bocken et al., 2016).

Among numerous CE principles, integrating them in the context of urban energy consumption can provide a set of improvements. Buildings in urban areas consume a considerable amount of energy

because most of them are designed inefficiently, and some of them are old (Pérez-Lombard, Ortiz, & Pout, 2008). To this effect, CE calls for the adoption of efficient technologies, renewable energy and efficient structures in construction and design. For instance, smart grid is being adopted in most towns to enhance efficient use of power by use of data from sensors and meters to enhance energy demand and supply (Geelen, 2018). Furthermore, there are energy efficiency building codes in many cities with the LEED principle being widely applicable to create efficient buildings that consume less energy.

Water is another vital resource that can be conserved to reduce wastage in the use of the resources available.In There is also the fact that typically, cities use tremendous quantities of water leading to over-exploitation of the local water sources and straining of water sources that are readily renewable (UN-Habitat, 2014). As a result of this, many cities are implementing water recycling as well as rainwater harvesting which are principles of CE. For example, the Singapore Hydrohub, an environmental program called the "NEWater", reuses treated water for industrial processes and as drinking water because Singapore faces water shortages (Tan et al., 2018). Other cities like Melbourne and Cape Town have put measures like the installation of the dual water supply systems, which segregates potable water and rain water and thus sparing the fresh water for necessary use only (McDonald 2018).

The incorporation of environmentally friendly products in the building construction process is one of the critical aspects of effective use of resources in the planning of towns. A city is an extensive consumer of construction materials which can be either recycled or derived from non-renewable resources. CE supports conservation and inclusion of renewable, recycled, as well as biodegradable material with the aim of lessening the impacts of the construction industry on the environment (Albrecht, 2018). Rotterdam and Helsinki for example have developed some polices to encourage the use of recycled material in construction which is an example of how CE principles can be embraced in development of infrastructures in cities (Ghisellini et al., 2016).

Regenerative Cities and Urban Resilience

In its most precise iteration, the circular economy paradigm does not seek only to minimize negative impact but to build cities that even replenish resources. Regenerative cities provide much more than sustainability as they also concentrate on the restoration of ecological systems and the strengthening of the sustainability of a city after climate change and other misfortunes. CE is closely linked to regenerative city models since the key of the latter refers to the revitalization of ecosystems, the renewal of natural resources and the design of urban spaces with a high degree of biodiversity (Dempsey et al., 2011).

The concept of regenerative urbanism includes active landscapes that are beneficial from the perspective of the environment; society; and economy. These are green roofs, urban forests, and surfaces that facilitate the management of stormwater, minimize accumulation of heat in urban areas and enhance the provision of biodiverse habitats in urban areas (Barton et al., 2016). The following is Curitiba – a Brazilian city which is specially recognized for its elements of successful environmental management namely provision of green spaces, transport and efficient disposal of wastes (Rabinovitch, 1992). Recycling of wastes and an efficient transport system as well as the focus towards green areas in Curitiba underlines the model of regenerative city through the enhancement of people's quality of life besides practicing environmental conservation.

Additionally, regenerative cities pay attention to concepts of community resilience and social justice, which are crucial to CE frameworks. From this context, sustainability entails that the regeneration of resources in a city is achieved meaningfully for all the citizens of the city regardless of their economic background. Regenerative urbanism enshrines the principles that create circular economy movement for the benefit of all citizens instead of the select few by adopting 'just transition' the principles as pointed out by Ferguson and Marthinsen (2019).

The incorporation of Circular Economy principles into the planning of urban areas is one of the most effective ways of managing the consequences of increased urbanization. From perspectives of waste management to resource usage and the principles of developing new urban models, CE puts forward a

concept that will help make cities more sustainable and resilient for the future of the world's population. Despite the barriers and limitations, the practices described by cities across the world show that CE is not a mere concept but has robust potential to work and bring changes to the existing systems of urbanization. More research and policy work should be devoted to identifying and addressing the obstacles that the implementation of CE faces in becoming the fundamental framework of circular cities.

Methodology

This research uses a survey approach to examine the current understanding and practice of CE in cities and their integration into urban planning and design with a focus on the municipal solid waste, resources efficiency, and regenerative cities. A survey method was used to collect both quantitative and qualitative data from the target population that comprises urban planners, policy makers, environmentalists and other task force people who work closely with urban sustainability projects. This is to ensure that as many perspectives as possible are obtained on the challenges and opportunities of CE within the urban landscape.

Survey Design

The survey was developed based on the components of Circular Economy regarding cities, more specifically, concerning sustainable waste management, efficiency, and regenerative cities. Because of this, the survey included both closed and open-ended questions to enable quantitative analysis as well as explore further insights. The closed-ended questions were developed in the form of Likert scale items where respondents were asked to indicate their level of agreement with post-positivist statements about effectiveness; and feasibility, and barriers of CE practices in the urban planning context. For that purpose, the respondents were asked a number of open-ended questions about their specific experiences, difficulties and views on practicing CE in their particular cities. These questions were asked with a view of making sure that the research covers the practical usage of CE and more the perceived benefits of CE adoption and some probable challenges that may come with integrating CE.

Sampling and Participant Selection

To achieve this cross sectional study, participants were selected based on occupation and included practitioners in urban planning, environmental management, sustainability policy, and waste management across both the public and private sectors. The sampling method was purposely aimed at participants involved in urban sustainability, CE practices or waste management solutions. The participants were found through means such as networking, conferences and other related organizations involved in urban sustainability. The sample consisted of urban planners, city officials, policymakers, consultants and environment activists of cities that are applying circular economy in urban planning and development. In the study, 200 survey invitations were sent out, out of which only 40% responded, bringing the number of valid respondents to 80.

Data Collection Process

Distribution of the survey was done electronically to the respondents through e-mail as the survey was also generated in an online survey format. These factors made the use of an online format possible through email and relevant to the success of the given research paradigm as it makes it easier to reach the participants and ensures a higher response rate. The participants' invitations covered people from countries from the developed and the developing world to ensure they embrace the CE principles. The target survey was conducted for a duration of four weeks so that the respondents would be given enough time to fill in the questionnaires. Since the ability to compel a high turnover of participants when carrying out an online survey is always a challenge, reminder emails were sent mid-way through the survey process. Informed consent was obtained from all the participants and informed them their identities would only be used for research purposes.

Data Analysis

After questionnaires were administered, the responses from the target population were compiled and analyzed using both qualitative and quantitative analysis. The closed-ended questions obtained were analysed using simple statistics so as to determine the

general prevalence of responses on a particular issue to develop an understanding of the pattern of responses. These were measured in terms of frequencies, percentages and mean scores corresponding to the Likert scale items where the participants expressed agreement or disagreement towards various statements concerning the integration of CE principles into urban planning. To further elaborate, chi-square tests were performed to analyse whether respondent's profiles characteristics like profession, experience, region, correlate with the answers corresponding to a set of crucial questions.

In analysis of the qualitative data obtained from the open-ended questions, thematic analysis was employed. This concerned the process of looking for commonality, pattern, or type in the responses that was congruent with the conceptual categories. The identified themes helped to provide a more profound insight into the difficulties, hindrances, and possibilities related to the enhancement of CE principles as well as the best practices that require various city environments. The thematic coding was carried out by the research team, thus ensuring a deeper understanding and identification of emergent themes from the responses This broad thematic categorization of major issues consisted of topics such as waste management issues, resource recovery, and urban renewal.

Ethical Considerations

The considerations of ethics were incorporated in the planning and conduct of this study in various ways. The participants were then given an explanation on the reasons for the study, the respondents' freedom to participate or otherwise in the study, and that their responses would remain anonymous. All participants were requested and agreed to complete the survey and each was informed that their identity would not be revealed in the study. The information gathered was kept confidential and used only for the purposes of this study. To minimize the risk of prejudice, no personal information that could develop bias was associated with the survey responses.

Limitations

However, several limitations should be recognized as inherent to the survey-based approach. Therefore, a potential limitation may be the response rate being reasonable but this might have resulted in sample bias since some groups may not have responded to the questionnaire as required. Also, collection of data through survey methods might end up being compounded with social desirability bias in the sense that the participants might give responses that they presume are the most appropriate or those that give a positive light compared to the genuine responses. Still, the given study has its limitations which stem from the fact that the sample is rather limited, and the results may not be generalized to all the cities or regions in the country. The findings of the present study could be further extended with a more methodologically diverse sample and combining quantitative and qualitative data to assess validity or interviewing the participants directly and/or observing them in the classroom.

Results

The findings from the survey conducted to understand the extent of CE application in order to map planning for implementing CE principles reveal the existing level of CE adoption, perceived benefits, issues, and challenges of CE within the urban context. The response to the survey involved a total of 80 participants which involved urban planners, analysts in sustainability policy, waste management specialist, consultant and activists. The results of the survey are described in detail in this section and supplemented by tables and graphs illustrating the main characteristics of the survey findings.

Demographic Profile of Respondents

Table 1 shows the demographic distribution of the respondents where the participant who originates from developed countries stands at 62.5% while those from developing countries was at 37.5%. The majority of the respondents (37.5%) had 6-10 years of experience in the area of sustainable urban development, and 18.75% had over 16 years of experience. With regards to the professions of the respondents, the most represented ones were urban planners (31.25%), those involved in sustainability policy who constituted 25% of the respondents and

those in waste management who were 18.75%. This sample gives a cross-sectional view of some of the actors in the field of planning and sustainability in urban areas.

Table 1: Demographic Profile of Survey Respondents

Variable	Category	Frequency (n)	Percentage (%)
Profession	Urban Planner	25	31.25
	Waste Management Expert	15	18.75
	Sustainability Policy Maker	20	25.00
	Consultant	10	12.50
	Environmental Advocate	10	12.50
Region	Developed Countries	50	62.50
	Developing Countries	30	37.50
Years of Experience	0-5 years	15	18.75
	6-10 years	30	37.50
	11-15 years	20	25.00
	16+ years	15	18.75

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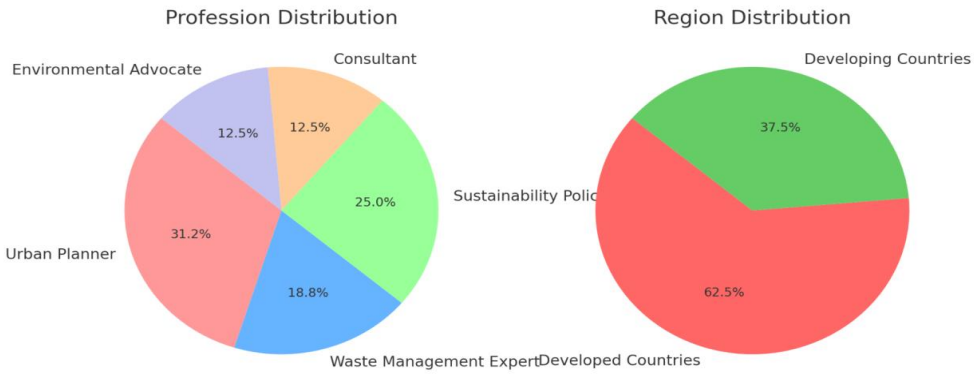
Figure 1 Demographic Profile - Profession and Region Distribution



Perception of Circular Economy Integration in Urban Planning

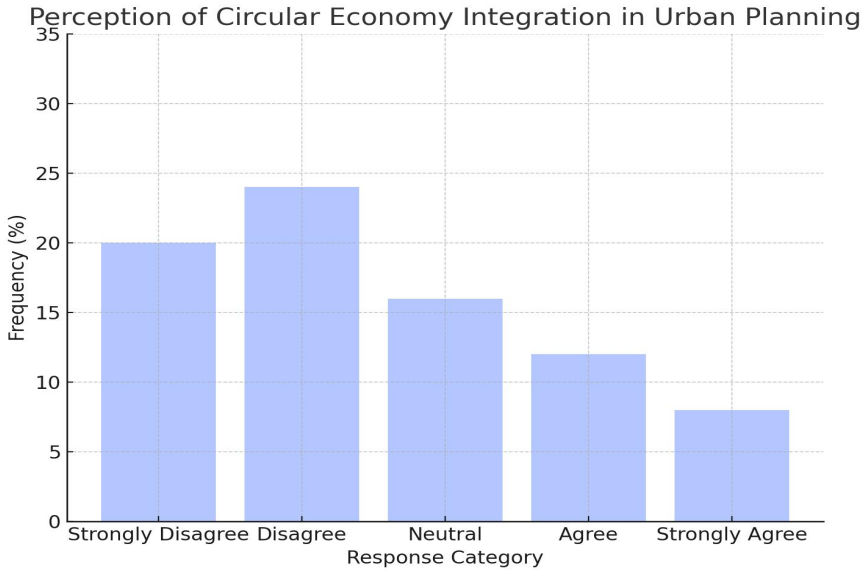
The survey responses show that there is a neutral attitude towards the integration of Circular Economy into concepts of urban planning. Further, the survey captured the level of agreement of respondents on the integration of CE principles in their cities as shown in figure 1 where 55% of the respondents tended to agree or slightly agree while 30% of the respondent disagreed and 25% strongly disagreed.

This implies that, even though there is a certain level of recognition of the advantages of CE, numerous participants considered the integration of CE into urban planning as a relatively new practice or as a measure that is not functioning sufficiently well. Out of all of the participants, only 25% showed they agreed or strongly agreed with this statement on effectiveness of CE principles integration.

Table 2: Perception of Circular Economy Integration in Urban Planning

Response Category	Frequency (n)	Percentage (%)
Strongly Disagree (1)	20	25.00
Disagree (2)	24	30.00
Neutral (3)	16	20.00
Agree (4)	12	15.00
Strongly Agree (5)	8	10.00

Figure 2 Perception of Circular Economy Integration



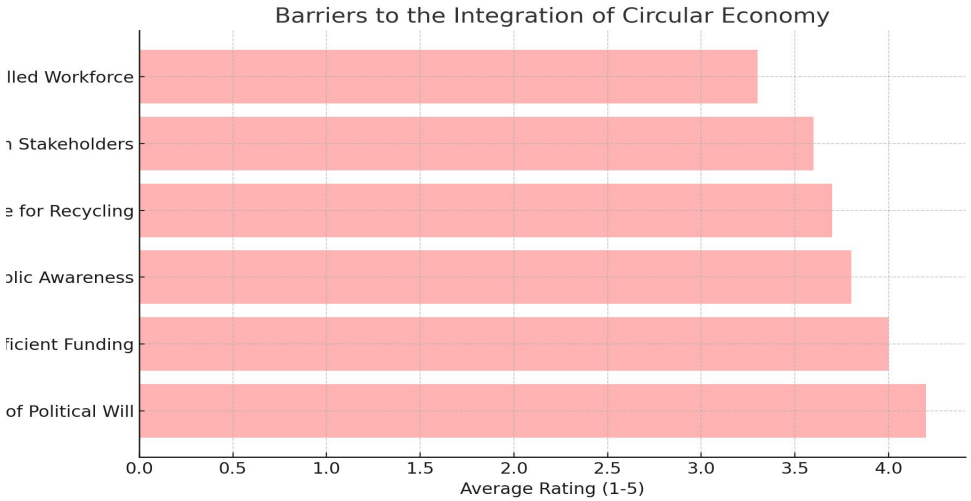
Barriers to the Integration of Circular Economy in Urban Planning

Table 3 highlights the key barriers to the adoption of Circular Economy principles in urban planning. This is evident where the respondents have rated the primary impediment as the "Lack of Political Will," with a mean score of 4.2 out of 5. This was closely succeeded by "Insufficient Funding" with a response rate of 4.0, with most of the respondents that lack of finance is a strong implication for CE. Another important concern was defined as "Limited Public Awareness" (3.8) indicating that awareness raising remains essential for garnering more support for circular opportunities. Others like "Inadequate Infrastructure for Recycling" (3.7) and "Resistance to Change from Stakeholders" (3.6) were also perceived as significant but to a slightly lesser extent. These findings suggest that while there are technical and practical areas of difficulty, the more substantial barriers seem to be political and fiscal.

Table 3: Barriers to the Integration of Circular Economy in Urban Planning

Barrier	Average Rating (1-5)	Frequency (%)
Lack of Political Will	4.2	82.00
Insufficient Funding	4.0	75.00
Limited Public Awareness	3.8	70.00
Inadequate Infrastructure for Recycling	3.7	65.00
Resistance to Change from Stakeholders	3.6	60.00
Lack of Skilled Workforce	3.3	50.00

Figure 3 Barriers to Circular Economy Integration



Potential Advantages of Circular Economy in Urban Planning

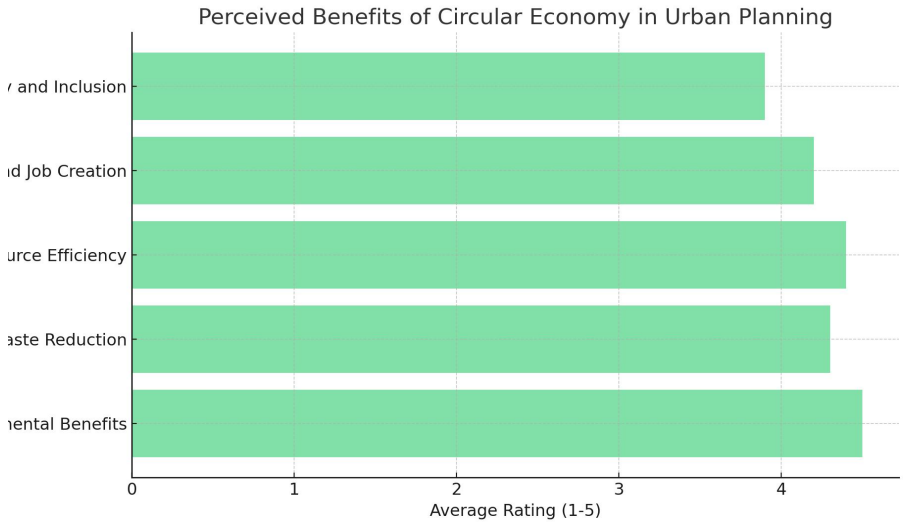
However, there are certain challenges presented in implementing Circular Economy in urban planning, which respondents acknowledged, while pointing out its advantages. Likewise, as presented in Table 4, the evaluation results of environmental advantage of CE reached 4.5, thus suggesting that emerging cities highly value environmental returns of circular economy strategies. Other priority areas, such as resource efficiency (4.4) and waste reduction (4.3), along with economic growth and job creation (4.2), indicated that the people polled widely shared positive views on CE's contributions to urban sustainability. The least satisfactory score (3.9) was received by "Social Equity and Inclusion," which indicated that while CE is generally viewed as positive for the environment and the economy pertaining to social effects may require more focus in the planning and execution stage.

Table 4: Perceived Benefits of Circular Economy in Urban Planning

Benefit	Average Rating (1-5)	Frequency (%)
Environmental Benefits	4.5	90.00

Waste Reduction	4.3	85.00
Resource Efficiency	4.4	88.00
Economic Growth and Job Creation	4.2	80.00
Social Equity and Inclusion	3.9	75.00

Figure 4 Perceived Benefits of Circular Economy



Challenges in Circular Economy Integration by Region

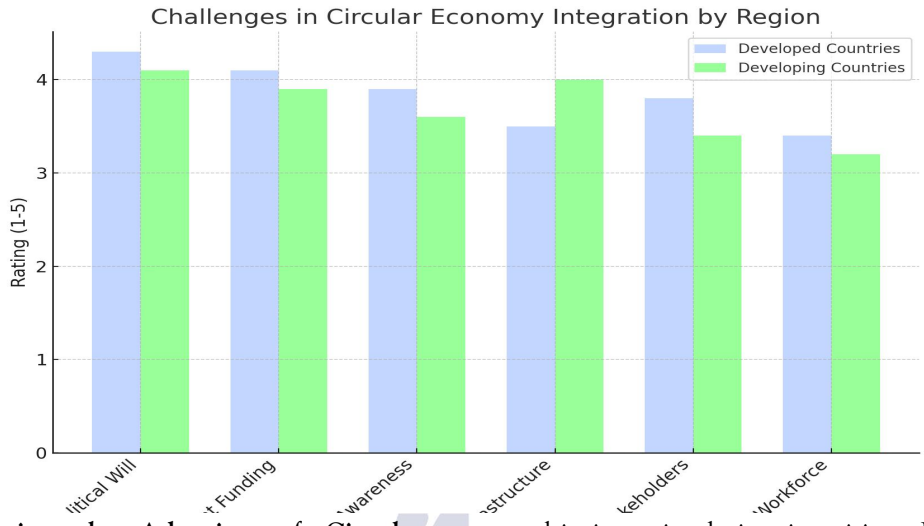
Table 5 compares the challenges of implementing Circular Economy practices between developed and developing countries. The highest response score of 4.3 in developed countries and 4.1 in the developed countries was given to the aspects of "lack of political will." The two other issues that received relatively low scores but were ranked as major concerns were "Insufficient Funding" which received a score of 4.1 by the developed countries and 3.9 by the developing countries. Additionally, the respondents from developing countries rated the factor relating to "Inadequate Recycling Infrastructure" as a more critical factor (4.0) than respondents from developed countries, with an average rating of 3.5; this means that developing nations might have weaker infrastructure in recycling and waste management.

Table 5: Challenges in Circular Economy Integration by Region

Challenge	Developed Countries (n=50)	Developing Countries (n=30)	Total (n=80)
Lack of Political Will	4.3	4.1	4.2
Insufficient Funding	4.1	3.9	4.0
Limited Public Awareness	3.9	3.6	3.8
Inadequate Recycling Infrastructure	3.5	4.0	3.7

Resistance to Change from Stakeholders	3.8	3.4	3.6
Lack of Skilled Workforce	3.4	3.2	3.3

Figure 5 Challenges in Circular Economy Integration by Region



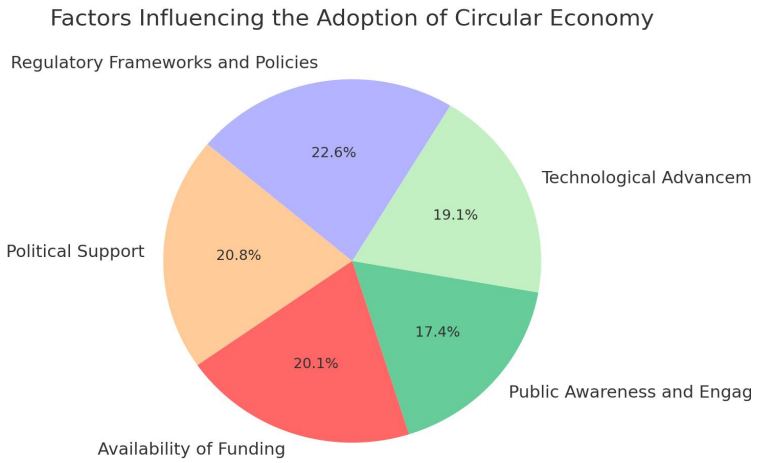
Factors Influencing the Adoption of Circular Economy Practices

Next, the respondents were asked to rate different aspects of factors that affect the implementation of the circular economy principles in the urban planning mechanisms. From the above table it can be seen that the overall indexes of the four factors; 'Political Support' which had an overall percent of 75% and 'Regulatory Frameworks and Policies' with an overall of 81.25% stated that favorable political support and favorable policies are essential for achieving circularity in cities. Respondents also considered "Availability of Funding" as being significantly important with 72.5% while "Technological Advancements in Recycling" was fourth with 68.75% thus implying that both technology and infrastructure are crucial for implementation. However, for this study, the least valued factor, 'Public Awareness and Engagement' obtained 62.5% showing that though crucial, it may not be the most emphasized in CE adoption, especially in the early stages.

Table 6: Factors Influencing the Adoption of Circular Economy Practices in Urban Planning

Factor	Frequency (n)	Percentage (%)
Political Support	60	75.00
Availability of Funding	58	72.50
Public Awareness and Engagement	50	62.50
Technological Advancements in Recycling	55	68.75
Regulatory Frameworks and Policies	65	81.25

Figure 6 Factors Influencing the Adoption of Circular Economy



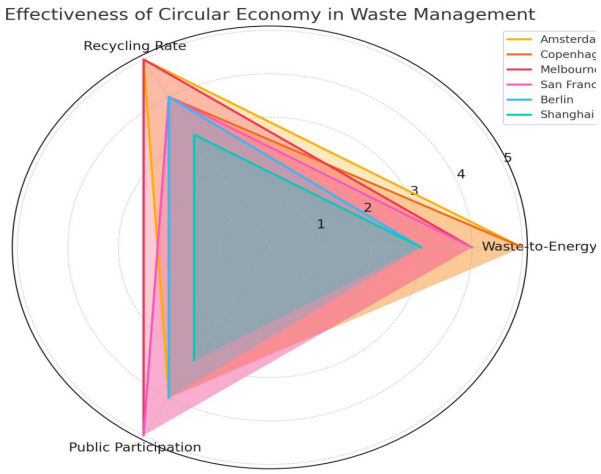
Effectiveness of Circular Economy in Waste Management in Respondent Cities

Circular Economy in waste management is included in table 7 to provide information on its efficiency based on cities. However, the survey indicated that Amsterdam and Copenhagen are the best ranked in terms of waste-to-energy technologies and recycling and participation index, which was above 4. Studying these cities, there are changes to increase the incorporation of CE principles into the waste management systems. However, other cities received considerably lower assessments in all the categories, indicating that these cities are only beginning to establish integrated CE agendas, such as Berlin and Shanghai. This paper indicates that CE in waste management has limitations which are determined by the level of investment in infrastructure and engagement of the public.

Table 7: Effectiveness of Circular Economy in Waste Management in Respondent Cities

City/Region	Waste-to-Energy (Score 1-5)	Recycling Rate (Score 1-5)	Public Participation (Score 1-5)
Amsterdam	5	5	4
Copenhagen	5	4	4
Melbourne	4	5	5
San Francisco	4	4	5
Berlin	3	4	4
Shanghai	3	3	3

Figure 7 Effectiveness of Circular Economy in Cities



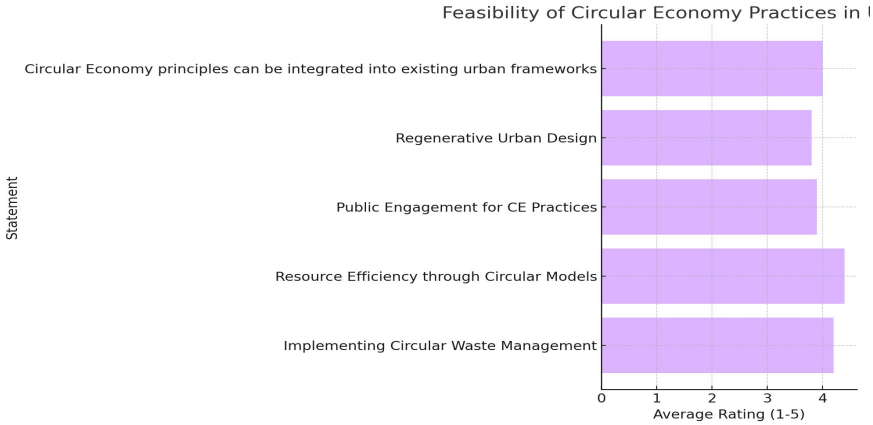
Feasibility of Circular Economy Practices in Urban Planning

Lastly, respondents were asked to indicate the applicability of Circular Economy practices in the context of planning for the urban environment. From the data presented in Table 8, it is also clear that the boldest practice "Resource efficiency through circular models" was considered to be the most easy-to-implement practice with the mean score of 4.4. This was succeeded by "Circular Waste Management" (4.2), showing clear endorsement for resource-saving and waste-minimizing processes in urban environments. When the participants were asked about the feasibility of the concept of "Regenerative Urban Design", this scored 3.8 out of 5 which indicates that there is interest towards regenerative urbanism, but perhaps it can be more difficult and time consuming to put into practice as compared to green infrastructure.

Table 8: Survey Responses on the Feasibility of Circular Economy Practices in Urban Planning (Scale: 1 = Not Feasible, 5 = Highly Feasible)

Statement	Average Rating (1-5)	Frequency (%)
Implementing Circular Waste Management is feasible	4.2	80.00
Resource Efficiency through Circular Models is feasible	4.4	85.00
Public Engagement for CE Practices is feasible	3.9	75.00
Regenerative Urban Design is feasible	3.8	70.00
Circular Economy principles can be integrated into existing urban frameworks	4.0	78.00

Figure 8 Feasibility of Circular Economy Practices



The findings of this study reveal useful information on the current trends in implementing Circular Economy in urban planning. However, it is agreed that the implementation of CE principles is effective for environmental sustenance, resource utilization, and economy enhancement with remarkable barriers including political commitment, finance, and people's consciousness. The study also reveals that developed region cities are in a more advanced state in implementing CE compared to the developing cities though the latter is understanding the significance of Circular Economy in responding to urban sustainability issues. Therefore, the future research should target the dismantling of these barriers specifically by aiming at securing political support, funding, and public awareness for practical implementation of CE in the controlling of urban planning.

Discussion

The findings drawn from this research contribute to the understanding of contemporary approaches in CE with specific reference to waste management, resources, and regenerative cities. As has been highlighted, despite an increasing emergence of potential benefits that can be realised when CE is implemented, it is evident that the integration of CE principles in Urban Planning is far from being fully realised. These results are further discussed within the existing literature, largely pertaining to urban sustainability, and valuable implications and considerations are derived from these findings regarding the challenges and advantages of CE implementation in urban settings.

The Current State of Circular Economy Integration in Urban Planning

The study established that there is a low awareness of the Circular Economy when it comes to urban planning as the majority of the respondents reported to have implemented the principles of circular economy to a low to moderate extent in their respective cities. This conclusion is consistent with Bocken et al.'s (2016) literature review where the authors stated that many urban hubs are yet to adopt the CE models. The following facts identified below elaborated by our respondents highlight some of the challenges that have made the cycle of CE adoption slow. Same sentiments are echoed by Kirchherr et al(2018) acknowledging that important changes call for political will and heavy investment in the circular economy. The respondents acknowledge that local governments and policymakers play a significant role in implementing CE practices and unless their operating political where with and proper regulatory structures in place, cities will find it difficult to implement the practices effectively.

The outcome also reveals that citiespen in the developed area are slightly advanced in adopting CE principles, with the Netherlands and Denmark among them. However, it remains for developing countries to make efforts comsats those challenges that include; lack of infrastructure and little financial power. This regional gap is in line with the findings by Geissdoerfer et al., (2017), which showed that CE is more prevalent in developed countries because they possess resource and technological requirements for its implementation, as opposed to developing

countries that encounter deeper systemic and financial barriers.

Barriers to the Integration of Circular Economy

Three out of four obstacles cited in the survey, namely political will and commitment, inadequate funding, and lack of awareness among the public mirror the literature review. The research revealed that the absence of political commitment received the highest response of 82% and thus, is ranked the worst challenge. This is in accordance with Lieder and Rashid's (2016) observation that the implementation success of CE mostly relies on political leadership, particularly from the local and national level governments. Lack of a favourable political will and commitment means that there could be no laws and policies to support the promotion of CE practices.

Lack of funds was the second primary reason stated by the respondents, 75% of whom reported that CE was restricted due to a lack of funds in implementing urban planning. Stahel (2016) established that the transformation towards a circular economy demands considerable investment on factors like waste management and recycling, as well as renewable energy systems. These cities, especially those in the developing areas, struggle to afford the required improved structure and infrastructure to support sustainable urban development. Funding for any CE initiatives remains a challenge as most policymakers consider such circular economy projects as costly and exhaustive in terms of resources when implemented in the short term, though in the long run it is economically and environmentally beneficial (Murray et al., 2017).

Other factors that were considered were public awareness; 70% of the respondents said it played a key role in the implementation of CE. This agrees with the assertion of Morseletto (2020), who opine that public engagement and consumer actions are central to CE success. In order to incorporate CE principles into urban planning, people's perception should change when it comes to recycling, reducing waste, and managing the consumption rates. According to the findings, there is a lack of understanding of CE or how citizens of urban areas can support it. This is why the increase in public awareness and participation of citizens in circular actions is critical to eliminating this barrier.

Perceived Benefits of Circular Economy in Urban Planning

Nevertheless, the respondents of the survey observed the advantages of Circular Economy in urban planning in general. In terms of the environmental benefits associated with CE, the respondents' average rating was 4.5 for environmentalism while resource efficiency received a 4.4 and waste minimization received a 4.3 on the same scale. These results conform to the literature where most findings posit environmental advantage as a key advantage of CE. For instance, the Ellen MacArthur Foundation (2013) argues that a shift towards the circular economy greatly decreases waste and CO2 emissions because it maximizes resource efficiency as well as minimizes materials loss.

The economic advantages of CE were also acknowledged in this study especially with a focus on employment opportunities and economic development. According to Bocken et al., (2016), the circular economy offers opportunities for new business models and employment opportunities in activities such as recycling and remanufacturing as well as the design of products for circularity. Transposing the linear thinking of consumption to circular thinking presents the potential to localize city economies and lessen urban dependency on resources beyond the city. However, according to the respondents' comments, the social impact of CE—which can support social justice and integration—should be discussed in more detail. A relatively low score of 3.9 in regards to "Social Equity and Inclusion" indicates further work needs to be achieved researching, how CE practices can be scaled to benefit the least privileged groups and how the advantages of circular economy systems can be redistributed.

Challenges in Circular Economy Integration by Region

Another recommendation found in this analysis is the difference of challenges faced in developed and developing areas of the cities. From the above Table 5 it can be seen that respondents from developing countries considered "Inadequate Recycling

Infrastructure" to be a larger problem in comparison to the respondents who belong to developed countries. This shows the varying level of urbanization as regions in the developed countries have comparatively higher standards in the waste management infrastructure and technology and even the policy aspect as well (Murray et al., 2017). On the other hand, many developing city environments are not even able to provide adequate collection services for waste that can be recycled, let alone make use of the technology needed to effectively employ circular economy principles.

Furthermore, when comparing the responses from both developed and developing countries, political will and funding were cited as primary concerns; however, the survey implies that developed countries may have better governmental support and financial opportunities for CE projects. This argument resonates with what Kirchherr et al. (2018) reckon whereby, according to the authors, funding and political support tend to be more accessible in advanced economies, thereby making it possible for circular systems to be implemented faster.

Feasibility and Opportunities for Circular Economy in Urban Planning

High feasibility for Circular Economy was reported concerning the participants in relevance to the case as rates were identified as follows: Resource Efficiency (4.4) and Circular Waste Management (4.2). These findings imply that there is a possibility of a positive attitudinal change among the urban planners and policymakers to fully adopt CE towards enhancing the quality of urban sustainability index in terms of resource use and waste minimisation. However, the lower feasibility score (3.8) for the Practice of 'Regenerative Urban Design' means that even though there is high interest in general for regenerative practice, they are viewed as difficult undertakings that require more resources to implement at a city scale.

This is in line with Lieder and Rashid (2016) who opined that CE strategies like waste to energy, recycling, and sustainable design are much easier to implement compared to more sustainable city regeneration, which often involves redesign of an entirely new urban system. However, the development of regenerative cities concept of the urban landscape like Amsterdam and Copenhagen (Pauwels et al., 2020) shows that CE can be integrated in the construction of urban spaces if there is the political will, funding, and demand from the society..

Therefore, this study affirms that Circular Economy principles are relevant in urban planning, more so in advancing sustainable urban development to solve environmental, economic and social issues associated with urbanization. Despite these challenges, the uptake of CE in urban contexts is not easy due to issues like political and financial constraints, but the benefits of CE, including the sustainability of natural resources, and the improvement of the economy, are well understood. Thus, while developed cities are relatively further in terms of CE progress, more developing cities are beginning to realize the potential of CE regarding coping with urban sustainability problems. In this regard, the following strategies are suggested for future research: (1) to enhance political commitment to give more importance to CE and (2) focus more on funding aspects for wider implementations in the urban planning sector and (3) raise public awareness level for CE.

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