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Drivers of Circular Food Economies in Mississippi, USA

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Abstract
Background of the Study: In the 21st century, adopting the principles of the circular economy to minimize waste and pollution has become prominent in several industries, including the food industry. The United Nation's sustainable development goal to reduce retail and consumer food waste by half by the year 2030 on a global level, has prompted many nations to deplore proactive measures to eliminate food waste. By eliminating food waste through a circular economy model, there are numerous benefits to be gained for businesses and the environments in which we live. This research will provide insights into how transitioning into a circular food economy will be beneficial for the state of Mississippi, the USA, and the world at large.
Purpose: The purpose of this paper is to explore the current level of awareness and advocated the benefits of transitioning to a circular food economy in Mississippi, USA.
Design/methodology/approach: A questionnaire survey of 120 construction professionals was used to assess the current level of awareness and advocated the benefits of transitioning to a circular food economy in Mississippi, USA. The questionnaire comprised three main sections each exploring different parts of the research question.
Findings: The key findings of the statistical analysis indicated that there is low awareness of the circular food economy. This study fills the gap in the existing knowledge by addressing concerns over circular food economies to improve confidence among practitioners.
Research limitations/implications: Although the data used in this paper was from educationally qualified individuals, the research is limited in some ways in that it does not cover all the professionals in the food industry. Nevertheless, all the professionals who responded to the questionnaire have an up-to-date level of awareness of the circular food economy.
Practical and Social implications: A noticeable proponent of the circular food economy is that it promotes the overall health of people by providing environmental and economic benefits.
Originality/value: This paper contributes with new outlooks aimed at assessing the current level of awareness, usage, and advocated benefits of the circular food economy and adds to the limited empirical studies on circular economy to governments, companies, and decision-makers.
Keywords: Awareness, Benefits, Circular, Economy, Food, Mississippi.
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1. Introduction

Over the years, the term circular economy has achieved and amassed a huge amount of recognition among individuals, companies, and governments since it was introduced by the EU and Chinese policymakers (Pesceet al, 2020) as a solution to reducing environmental degradation and pollution, decreasing poverty and discrimination, promoting economic growth, and identifying environmental effects (Wysokińska, 2016). Another motivating movement toward the application of circular economies is the UN's Sustainable Development Goals which consist of slashing food waste by the year 2030 (Ezeudu and Ezeudu, 2019).

Millar et al (2019) opined that for a circular economy to exist, all materials should be cycled at continuous high value as there is a fundamental and intrinsic inclination towards the dematerialization of products. In the long run, in a circular economy, all energy ought to be provided from renewable and sustainable forms like solar, wind, and geothermal, which is not exactly renewable, but can be considered a sustainable resource since the system is constructed for maximum energy productivity without conceding performance of the system (Lacy & Rutqvist, 2016).

Not long ago, several kinds of research centered on describing the circular economy as a concept, its correlation with sustainable development (Preston, 2012; Webster, 2013), and the enormous number of theories that describe it (Ghosh, 2019; Mathews & Tan, 2016). Despite their conflicting methods, these findings share a

comparable resolve which is that sustainability remains a driving force in the implementation of circular models. According to Oliver K., Stefan N., & Christine T., (2022) partnerships with biogas producers, livestock farmers, and feed companies just to mention a few would determine the implementation of circular economy business models (CEBMs) across the globe and internal processing of food products.

This paper focuses on food product waste in a circular economy as this will reduce waste and allow for more sustainable cities while reducing the effect of climate change. The world population is eight billion people and is projected to increase to as much as ten billion people by 2050 according to the World Health Organization (Wadley, 2020). This growth will affect the way food is grown, packaged, distributed, and manufactured as the global "take, make, and dispose of" everyday life puts immense pressure on raw materials and energy resources. It is worth mentioning that food waste is synonymous with increased income levels. This leads to large landfill sites, environmental deterioration, and food insecurity. Hence, the need to adopt a circular economy for food waste to address this and other sustainable development goals like climate action, responsible consumption, and sustainable cities (Charter, 2018; Dora, 2019).

A significant number of voices have been lent to proposing defining parameters for the scope and application of the concept which is considered relatively new in many economies around the world. In definitional and conceptualizing works like Geissdoerfer et al (2017), Korhonen et al (2018), and Prieto et al (2018) circular economy is operationalized, explained from different approaches, and delineated from similar concepts (e.g., sustainability) and proposed for multiple applications. Similar studies have examined circular economies within specific economies, countries, or regions. In a study that compared the efficiency of circular economies among the Visegrad Group countries (Poland, Slovakia, Hungary, and the Czech Republic) and the European Union (EU) countries, Lacko et al (2021) found that although Visegrad group countries recorded significant improvement in recycling and circular economies as they are not the most advanced.

Several studies advocated for better-structured waste collection and disposal practices to facilitate reuse and recycling. According to the Ellen Macarthur Foundation (2013) that if all countries could adopt Italy's policies whereby, they separated the collection of household food waste for biogas and compost production thereby generating additional income of revenue. Although a substantial amount of research presently exists in circular economics, none explicitly focuses on food product waste and examines its awareness levels, and benefits of embracing a circular food economy in Mississippi, USA.

2. Anticipated Benefits for Enhancing Circularity of Food Waste

The research report (Ilri, 2021) states that 20% of the world's food production is wasted, with 61% originating from households, 26% from food services like restaurants and fast foods, and 13% from retail like supermarkets. Thus, reducing food waste will have substantial health, corporate social, and economic gains in any society. This motivation is stated in UN Sustainable Development Goal that obliges nations to lower per capita world food waste at all cadres by 2030 (Canton, 2021).

The food Waste Index is a framework used to set benchmarks and measure the level of waste generation in countries. It is also used to monitor the level of food consumption, production, and socio-cultural habits of people. Households can also embrace healthier diets when using this index to track their lifestyle (Woodard, 2021). Another opportunity for enhancing food circularity is that food wastage and insecurity is affecting as close to 800 million people in 2020 (Camilleri, 2020). Hence, the need to create environmentally compliant food systems as it is estimated that food waste accounts for close to $1 trillion yearly (Ripple et al., 2021).

In a circular economy, all materials should be used such that they can be cycled for an indefinite period, just as they hypothetically can in nature (Stewart & Niero, 2018). Furthermore, methods and companies utilize suitable governance and management standards while ensuring that affected stakeholders are considered. Thus, simply put, the circular economy is a modern economic model for tackling human needs, avoiding waste, and reasonably allocating resources without destabilizing the operation of the planet and preserving the value of resources (Banks et al., 2018).

The Government of the Netherlands buys produce from local farmers at lower prices to incentivize the transition to sustainable practices. They also provide technical training, support, and equipment to all local municipalities and introduced a digital app that provides information and monitors farm-related activities thus encouraging the transition to regenerative farming practices (Woodard, 2021). The country also recently made it unlawful for supermarkets to thrash food that was not sold mandating them to donate it to charities through non-profits like WasteNoFood and Zero Percent. Achieving Sustainable Development Goals is a massive challenge and businesses should be well-prepared to benefit from the existing push and promote the circular economy movement for food waste. This can be achieved by transitioning to planetary health diets, venturing into regenerative agricultural practices, rewarding carbon removal on farms, and local sourcing which reduces (Ma et al., 2020).

Another opportunity is the possibility of using waste for producing other useable items. A good example is Starbucks using coffee grounds to make milk It is expedient to highlight the unexploited financial and ecological

advantages of the circular economy to agro-allied industries and farmers (Corrado & Sala, 2018). By adopting opportunities to use biofertilizers, protein feed, and waste streams, individuals and businesses can generate electricity using biodegradable waste and solar/wind panels (Preston, 2012). The circular economy model reduces food waste by constructing closed-loop systems. For example, a UK company called AgroCycle developed straws using rice bran fibers. Yume is another case study that creates marketing opportunities and potential for over five million tonnes of goods initially going to waste every year in Australia (Sherwood, 2020).

Food waste reduction can have clear benefits for the environment and communities by reducing, reusing, and recycling food waste thus allowing for innovative business models to materialize and monetary advantages that can be gained from what was lost. According to World Health Organization (WHO), there are all kinds of circular economy (CE) benefits that can result in significant health benefits just to mention a few, the reduction of the impacts of the negative environment such as direct and indirect health care systems benefits. However, some risks could lead to the effect of unattended health in cases like hazardous materials which require the need for national, regional, and local legislation to implement an appropriate plan that would eradicate the risks and strategies of the circular economy (CE).

3. Research Methodology

The study adopts a literature review to highlight the opportunities of transitioning to a circular food economy in Mississippi, USA. Furthermore, the study adopts a quantitative research approach using a structured questionnaire amongst professionals to investigate their perceptions regarding the circular food economy in Mississippi, USA. The sample employed in the survey was obtained from a databank of professionals in the food industry. A total of one hundred and twenty questionnaires were distributed electronically by email with 69 responses, a response rate of 57.5% which is satisfactory.

Random sampling was utilized in the survey; this is where each member of a population has a known and non-zero probability of being involved in the sample. It was utilized because of the low cost involved, faster data collection and since the data set is lesser, it is probable to guarantee similarity and to increase the correctness and quality of data. Closed-ended questionnaires were employed because they can be answered finitely by either "yes" or "no, in a few words or a specific short factual answer. The questionnaire comprised three main sections each exploring different parts of the research question.

The first section sought information on the respondents' profiles as shown in Tables 1 and 2. The second section investigated the current level of awareness of transitioning to a circular food economy in Mississippi, USA (see table 3). The third section ranked the anticipated opportunities of transitioning to a circular food economy in Mississippi, USA (see tables 4 to 6). The questionnaire responses were assigned numerical codes and the data was analyzed using descriptive statistics, Wilcoxon signed test, regression, and factor analysis.

Educational Qualification	Frequency	Percentage
Bachelor's	58	84.06
Masters	10	14.49
PhD	1	1.45
Total	69	100

Table 1: Educational qualifications of respondents

Years of Experience	Frequency	Percentage
1-10 years	40	57.97
11-20 years	15	21.74
21 years and above	14	20.29
Total	69	100

Table 2: Years of work experience

3.2 Analysis and Discussion of Results

Table 1 shows that 84.06% of the survey participants have completed at least undergraduate programs and 15.94% have additional postgraduate qualifications. This means that the outcomes obtained from the survey represent the opinion of a group of professionals with a good educational background to provide a significant contribution. The relevance of academic institutions cannot be over-emphasized as they promote the development of constructive initiatives in the food industry.

With regards to the years of experience, the results indicate that most respondents (57.97%) have at least 10 years of experience working in the food industry, 21.74% have industry experience ranging between 11 and 20 years, while 20.29% have at least 21 years or more (Table 2). As the experience of the respondents is quite respectable, opinions and views obtained through the survey can be regarded as important and reliable. The majority of respondents had reasonable experience in the food industry which further shows that respondents are

sufficiently experienced enough to provide credible data.

3.3 Test of Hypothesis to Investigate the Current Level of Awareness of the Circular Food Economy in Mississippi, USA

The Wilcoxon signed-rank test is a non-parametric statistical hypothesis test used either to test the location of a population based on a sample of data or to compare the locations of two populations using two matched samples as presented in table 3. Wilcoxon rank-sum test is used to compare two independent samples, while Wilcoxon signed-rank test is used to compare two related samples, matched samples, or to conduct a paired difference test of repeated measurements on a single sample to assess whether their population means ranks.

There is a low level of awareness of transitioning to a circular food economy in Mississippi, USA			
STRONGLY AGREE	65	AGREE	4
STRONGLY DISAGREE	0	DISAGREE	0

d=XAGREEMENT – XDISAGREEMENT	|d|	Rank of |d|	Signed – Rank of|d|
65	65	2	-2
4	4	1	-1

Table 3: Wilcoxon Signed Test

H0: M agreement = M disagreement
H1: M agreement < M disagreement
T = 2+1=3
E(t) = 1.5
V(t) = 1.25
Z = T – E(t) = 3 – 1.5 = 1.5 = 1.34
√V(t) √1.25 1.118
For a 1− tailed test at 5% i.e α = 0.05 z – critical value = 1.65
DECISION: Since Z does not fall in the critical region, H0: MAGREEMENT = MDISAGREEMENT is accepted and H1: MAGREEMENT < MDISAGREEMENT is rejected.
Hence, the hypothesis that the median of the population of AGREEMENT affirms there is a low level of awareness of transitioning to a circular food economy in Mississippi, USA.

3.4 Anticipated Opportunities for Circularity of Food Waste

The main objective of the research is to rank anticipated opportunities and benefits of the circularity of food waste. The summary statistics of the analyzed variables are presented in Table 4. The t-value column provided the individual significance of each independent variable in the regression equation and showed whether the variable was making a statistically significant contribution.

Table 4 presents the summary of the anticipated opportunities for the circularity of food waste. Only three of the attributes of the benefits made statistically unique contributions to the circularity of food waste at a 95% confidence level namely: reusing, and recycling food waste allows for innovative business models and monetary advantages, monitoring the level of food consumption, production, and socio-cultural habits of people, and reducing food waste will have substantial health, corporate social and economic gains in any society.

This result is similar to results by Banks et al., (2018) and Börger et al., (2019) who state that the most benefits of enhancing the circularity of food waste were recycling food waste, observing food consumption, and economic gains in any society. The box labeled ‘model summary’ (Table 5) gives the measure of how well the overall model fits, and how well the predictors can predict the dependent variable. The first measure in the table is called R. This is a measure of how well the predictors predict the outcome, but the square of R provides a more accurate measure. In this case, it is 0.224, so 22.4% of the variance in the dependent variable can be explained by the predictors. The final column gives the standard error of the estimate. This is a measure of how much R is predicted to vary from one sample to the next.

Table 6 shows the ANOVA results. The F-value is the Mean Square Regression (0.810) divided by the Mean Square Residual (0.485), yielding F=1.670. The p-value associated with this F value is very small (0.0000). These values are used to answer the question "Do the independent variables reliably predict the dependent variable?” The p-value is compared to the alpha level (typically 0.05) and, if smaller, one can conclude the independent variables reliably predict the dependent variable. It is glaring that the group of (independent) variables can be used to reliably predict the dependent variable. The overall significant value (0. 110) is less than the standardized significant value which reveals that the causes are generally acceptable.

In analyzing the anticipated opportunities for circularity of food waste, the standardized beta coefficients which provide the order of importance or relative contribution of the circularity of food waste attribute show that reducing environmental degradation and pollution makes the largest contribution, followed by the decreasing

poverty and discrimination and then the circular economy model reduces food waste by constructing closed loop systems. The multiple regressions equation that relates the circularity of food waste to the model attributes is given by the constant and the coefficients of the unstandardized beta as:

cofw = 4.270 + 0.37RED + 0.05DPA - 0.068CSH - 0.107HCE - 0.033TCM - 0.260RAR - 0.249MTL +0.013TCE - 0.116POU – 0.296SRFW(1.1)

The equation shows that reducing environmental degradation and pollution makes the largest contribution, followed by decreasing poverty and discrimination are positively correlated to the circularity of food waste.

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.270	1.393		3.065	.003
	Reducing environmental degradation and pollution	.379	.210	.363	1.805	.076
	Decreasing poverty and discrimination	.051	.154	.058	.331	.742
	Creating significant health benefits such as direct and indirect health care systems benefits.	-.068	.095	-.117	-.717	.476
	Households can embrace healthier diets when using an index to track their lifestyle	-.107	.193	-.095	-.556	.581
	The circular economy model reduces food waste by constructing closed-loop systems	-.033	.105	-.060	-.314	.755
	Reusing, and recycling food waste allows for innovative business models and monetary advantages	-.260	.128	-.359	-2.028	.047
	Monitoring the level of food consumption, production, and socio-cultural habits of people.	-.249	.096	-.376	-2.589	.012
	The circular economy model reduces food waste by constructing closed-loop systems	.013	.109	.019	.115	.909
	Possibility of using waste for producing other useable items	-.116	.097	-.191	-1.199	.235
	Reducing food waste will have substantial health, corporate social, and economic gains in any society.	-.296	.125	-.389	-2.376	.021
Source: Analysis of surveyed data, 2022. a. Dependent Variable: There is a low level of awareness of transitioning to a circular food economy in Mississippi, USA.						

Table 4: Anticipated opportunities for circularity of food waste

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.473a	.224	.090	.696	1.562

Table 5: Model Summary

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8.095	10	.810	1.670	.110a
	Residual	28.108	58	.485		
	Total	36.203	68			

Table 6: Anova

4. Recommendation and Conclusion

It would be advisable if a roadmap can be crafted in constructing a new path that would eradicate the socio-economic growth while other local businesses join forces with the consumers in the transition of CE. Adopting the CE utilizing the technical and behavioral effect could reduce the over-confidence in the manufacturing hub in the country, opportunities for job creation locally following their needs such as mobility, health, built environment, and consumables just to mention a few, and drifting out from the traditional pollution.

It would be great if the WHO is actively involved in the health and public health sectors and can help in transitioning and being the key stakeholders in the process of attaining the benefits of health and addressing the risks to the public. This initiative would help both public and occupational health to eradicate air and water

pollution, extraction of emissions, consumption, and manufacturing process. However, NGOs and other businesses are also not excluded in supporting the process of transitioning to address the risks to the public and the actions of CE to occupational health and the alternative of hazardous materials.

The main findings from the literature review are that governments, businesses, and individuals implementing circular economic models typically enjoy greater utilization of resources and monetary value, reduced waste, improved modernization, and better interactions with customers this paper will be very beneficial to industry practitioners and economic researchers with an interest in the circular economy. Potential future research directions will explore the level of awareness and benefits in other parts of the United States and North America as the research interest is very integral in all economies. Future research will also discuss the potential barriers to actualizing the already-mentioned drivers of circular economics.

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