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A SYSTEMATIC LITERATURE REVIEW ON ZERO WASTE CONCEPT

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Abstract

The disposal of wastes without being evaluated in the recycling and recovery process causes serious resource losses in terms of both material and energy. While the population and living standards in the world increase, there is an inevitable increase in consumption, which increases the pressure on our natural resources and disrupts the balance of the world, and our limited resources cannot keep up with the increasing needs. Considering this situation, the importance of efficient use of natural resources becomes even more evident. For this reason, zero waste implementation studies have become widespread both individually and institutionally all over the world in recent years. The concept of zero waste has begun to take its place in scientific research. Researchers primarily used definitions and explanations and added current examples to their scientific studies in order to place the concept in repertoires and raise awareness. This scientific study emerged in order to analyse the content of the studies on the concept of "zero waste" in the literature. The study, which was carried out with the qualitative method, was analysed by content analysis, and the findings were presented in tables.

Keywords: zero waste concept, waste management, waste, systematic literature review, literature analyse

Introduction

Problem Statement

Rapidly increasing population, growing economy, urbanization and the rise in people's living standards have drastically accelerated solid waste production (Guerrero et al., 2013, Minghua et al., 2009). Solid waste has become one of the most important environmental problems all around the world. On the other hand, an enormous amount of natural resources is depleted along with the large solid waste generation everyday due to the high demand for new product (Menikpura et al., 2013; Plaganyi et al., 2013). In recent years, one approach that has been suggested as a means of addressing these concerns is that of the concept of Zero Waste (Bartl, 2011; Phillips et al., 2011).

The call for Zero Waste is a recent phenomenon-a reaction to an enormous rise in waste that set in about a hundred years ago and accelerated after World War II (Mauch, 2016). Dr. Paul Palmer first used Zero Waste in 1973, is the founder of the Zero Waste Institute in California, with an aim for recovering resources from chemicals (Palmer, 2004). According to Connett, who is the expert of Zero Waste Strategy, the main purpose is not to figure out

more sophisticated methods to destroy waste and vice versa, but to encourage the production of products and packaging materials that will never be destroyed (Connett, 2012).

According to International Alliance broad, the Zero Waste defined as a philosophy and visionary goal that emulates natural cycles, where all outputs are simply an input for another process that means designing and managing materials and products to conserve and recover all resources and not destroy or bury them and eliminate discharges to land, water or air that unproductively to natural systems or the economy (2012).

Disposable society represents a way of living that is not sustainable anymore, mainly in a context like our planet where resources are really scarce (Cuccia, 2018). Sustainability might be seen as the most important challenge mankind is going to face in this millennium; in fact, given the ongoing consumption rate, we ought to live at least in two planets assuming the European consumption model, whereas if we assumed the American one, we would need at least four planets (Moore and Rees, 2013).

Societies currently live in a linear economy where individuals take resources from the earth and then dump them in the ground. However, the Zero Waste strategy indicating waste has to move from a linear system to being more cyclical according to cradle approach for efficient material use (Elgizawy et al., 2016).

Waste is the symbol of the inefficiency of any modern society and representation of misallocated resources (Song, Li and Zeng, 2015). Globally, 120-130 billion tons of natural resources are consumed every year and produce around 3.4 to 4 billion tons of municipal solid waste (Chalmin and Gaillochet, 2009; Giljum et al., 2008). Any large amount of waste creates huge pressure for the authority to manage waste in a more sustainable manner (Cheng and Hu, 2010; Shekdar, 2009). Statistically, while 84% of the solid wastes generated globally are collected, only 15% are recycled, and the major part is taken to landfills (Zaman, 2016).

Aim of the Study

This study aimed to analyse and understand a number of selected articles about "Zero Waste" published between the years of 2015-2019. Within the framework of the general objective of this research paper, the following questions were tried to be answered.

1. What are the studies about the concept of "Zero Waste" published between the years of 2015-2019?

2. What are the methods and types of data analysis used in the studies?

3. What are the objectives and results of the studies?

Importance of the Study

Considering the pressing need for a holistic view on solid waste management, some researchers have provided scientific studies that encompass "Zero Waste", a broader approach when compared to that described in the "solid waste hierarchy" (Medeiros, Pietzsch and Ribeiro, 2017). Nevertheless, academia does not provide a clear view on the Zero Waste theme (Curran and Williams, 2012; Greyson, 2007; Zaman, 2016). The increasing solid waste problems in recent years and the lack of comprehensive information created an urgent need for a thorough view. Thus, this study evolved a systematic literature review about the "Zero Waste" concept.

Methodology

Design of the Study

In this study, a systematic literature review assigned with the content analysis. For the determination of certain words, themes, or concepts within some given qualitative data, content analysis is a very effective research tool. This method was chosen for it mitigates the possibility of errors and it enables replicability (Mulrow, 1994). This article is following the secondary data analysis procedure. In order to achieve the goals of this article, qualitative approach is followed where the investigator primarily uses post positivist claims for developing knowledge such as cause and effect thinking, reduction to specific variables and hypotheses and questions, use of measurement and observation and the test of theories (Creswell, 2003).

Sampling of the Study

The universe of this study consists of studies on zero waste indexed in Google Scholar, ERIC and EBSCO Host databases between 2015-2019. Purposive sampling method was used based on the inclusion criteria determined within the scope of the research. As a result of the search, 30 studies that met the inclusion criteria were reached. In order to determine the researches to be included in the study, a literature search was conducted in academic databases such as Google Scholar and Science Direct. The use of some keywords to carry out this scanning process in a purposeful way required. In this context, the title and summary sections of the researches; It was scanned with some keywords such as “waste”, “zero waste”, “waste management”.

Data Collection

As to the database, “Science Direct” database was selected. The keywords releated with “Zero Waste” were searched carefully, which is considered to be present in the titles, keywords and/or abstracts. The type of document in the search bar was “articles and thesis”, and time limits were selected as to include the last five years between 2015 and 2019. The most selected articles in the first search are covered in the “Science Direct” database, for example, Waste Management, Journal of Cleaner Production and Resources, Conservation and Recycling, thus it has been selected for this study.

Findings

Among 30 selected articles, the highest number of published articles have been found from the Waste Management Journal. List of all 30 journals that published Zero Waste related articles are given in Table 1.

Table 1.

Number of Selected Articles with Their Published Journal

Journal	Number of articles	Authors
d/SEAS Working Paper	1	Cuccia (2018)
Procedia Engineering	1	Elgizawy et al. (2016)
ITAA	1	Michaelson and Veena Chattaraman (2017)
Waste Management	4	Zelenika et al. (2018), Pietzsch et al. (2017), Hottle et al. (2015), Yang et al. (2017)
Journal of Cleaner Production	2	Song and Li (2015), Binnemans et al. (2015)

Int. J. of Sustainable Water & Environmental Systems	1	Khattab and Haggar (2016)
Transportation Research Procedia	1	Mesjasz-Lech (2018)
Marine Policy	1	Willisa et al. (2018)
Procedia Manufacturing	3	Getrude et al. (2018), Rasmeni and Madyira (2019), Kroll and Hoyer (2019)
PhD thesis	1	Enes (2019)
Procedia Environmental Sciences	1	Shanmuganathana et al. (2016)
Agriculture and Agricultural Science Procedia	1	Amirtaa et al. (2016)
Resources, Conservation & Recycling	2	Manomaiviboola et al. (2018), Walker and Xanthos (2018)
MS thesis	1	Ingvarsson (2018)
Advances in Social Science, Education and Humanities Research	1	Nizar et al. (2018)
Int. J. Knowledge-Based Development,	1	Yigitcanlar (2018)
Journal of Physics: Conference Series	1	Nizar et al. (2018)
Book	1	Ali and Kumar (2019)
MATEC Web of Conferences	1	Liyanage et al. (2019)
AIP Conference	1	Affandy et al. (2017)
Antioxidants	1	Li et al. (2019)
Urban Science	1	Hannon and Atiq (2018)
2nd International Conference on Energy Materials and Applications	1	Homchuen et al. (2017)

For analysing or understanding Zero Waste, only two types of data analysis have been found such as qualitative and quantitative whereas five different types of methods of collecting data have been found. All methods and analysis types are given in Table 2.

Table 2.

Methods and Types of Data Analysis of All Selected Articles

Number of articles	Method and type of data analysis
6	Survey, Quantitative
2	Case study, Quantitative
12	Review, Qualitative
9	Wet lab/Lab-based research, Quantitative
1	Participatory action research

Nowadays, waste and waste management problems created a global threat because of its rapid-increasing rate. Researchers are finding a solution to this problem and some most recent scientific publications regarding this global issue are given in Table 3 with specific objectives and valuable results.

Table 3.

Objective and Results of the Selected Articles

Authors	Objectives and results
Cuccia (2018)	The goal of this review was to finding out how waste management systems work perfectly, saving processes influencing Behn's accountability paradigm and most conducive causal loops to explain behaviour of waste cumulated in landfill. Developed SD modelling techniques were successful for the implementation of a Zero Waste strategy reduction of waste via increasing of organic waste, waste recycled and waste reused as well as reduction of waste management cost.
Elgizawy et al. (2016)	The main objective of this paper was to develop a model for providing an integrated solution for developing countries in slum development and Zero Waste management to achieve a higher impact on the local community and on the

	national level were the main objectives. Learn to earn Model a waste recycling model is very effective in this integration.
Michaelson and Chattaraman (2017)	Investigating the aesthetic preference and purchase intentions for Zero Waste designed apparel were the aims of this paper. In consumer's aesthetic preferences and purchase intentions for ZW apparel, the main take-away for designers was the critical role-playing.
Zelenika et al. (2018)	The objective of this study was to examine the impact of volunteer staffed bins on contamination rates at three baseball games at the university. According to this study, the volunteer staff reduced contamination by 96.1, 96.9, 97.0 and 84.9% on average in the organics bin, recyclable containers bin, paper bin and garbage bin, respectively.
Song and Li, (2015)	This review revealed the challenges and opportunities to transform traditional waste management toward Zero Waste vision. According to this important study, if all the people work together to reduce, reuse, and recycling waste materials then the Zero Waste goal can be achieved.
Khattab and Salah El Haggar (2016)	The objective of this review was to propose a Zero Waste practical approach for urban communities. But in urban communities, Zero Waste cannot be possible by only removing waste, we have to give bird eye view on water, air, materials, energy and natural resources in general.
Pietzsch et al. (2017)	The goals of all authors of this paper were to comprehend the concept of Zero Waste and find out its benefits, challenges, and critical success factors. The main finding of this large review was for getting successful Zero Waste, the only well-designed educational practice has to be done and this practice can change the user behaviour that will be responsible for Zero Waste.
Mesjasz-Lech (2018)	The objectives of this paper to identify the trends in the size of the flow of municipal/city waste and find out the benefits of Zero Waste. On the basis of this article, the dimension of Zero Waste includes economic, financial, environmental and industrial benefits as well as different benefits to the community for e.g people's lifestyle, health risk reduction etc. It is also being noted that joint effort and initiatives can help in achievement in reverse logistic goals.
Willis et al. (2018)	Evaluation of various strategies that reducing plastic waste and investment analysis, as well as waste abatement policies and programs implemented by local governments were the main objectives of this paper. The results of this analysis displayed that integrated solutions are best at reducing coastal waste loads. Programs on illegal dumping, litter prevention, recycling, education and Clean Up significantly reduced waste along a council's coastline.
Getrude et al. (2018)	Assessment of the positively influenced strategies was the main objective of this paper. The result was a favourable response in recovery and recycling and it also has as an economic, social and environmental impact for plastic manufacturing and recycling companies.
Rasmeni and Madyira (2019)	Finding the existing practice of solid waste properties, treatment and management as well as the environmental impact of its disposal were the major aims of this comprehensive review paper. In this review, we understand that the migration of people dramatically increases the total population that is responsible for huge waste generation. So, research on waste to energy conversion can be a major concern.
Esra Enes (2019)	Solution for management of cut-and-sew waste through analysis of the Turkish fashion industry was the main objective of this thesis publication. Cut-and-sew stage-dependent garment waste can be reduced to Zero Waste by optimization of fabric factors and there are various design techniques to minimize pre-consumer and post-consumer waste problem in the fashion industry include upcycling, reconstruction, and Zero Waste fashion design.
Kroll and Hoyer (2019)	Highlighting a highly economical waste recycling machine was the aim of this paper. Nearly, 60% reduction in energy consumption has been achieved for this machine called Reaktruder that developed for small and medium-sized companies.
Shanmuganathana et al. (2016)	The objective of this paper was to reveal a microfiltration-granular activated carbon dependent (MF-GAC) sustainable membrane absorption hybrid system by treating reverse osmosis concentration. According to this study, MF-GAC is a

	cost-effective system for treating reverse osmosis concentration to remove dissolved natural and persisting organics prior to discharge into the environment in a safe manner and the effluent can be recirculated and mixed with other feed to a reverse osmosis process to maximize water reuse.
Amirtaa et al. (2016)	The activity analysis of *P. ostreatus* on woody waste biomass for food (mushroom) production and bio-pretreatment of tropical hardwood for biogas fermentation were the aims of this study. This bio–pretreatment enhance biogas fermentation as 2-3 folds higher than the cow dung and also this fungal species very potent to make economical alternative materials source that can be used for sustainable crop production.
Manomaiviboola et al. (2018)	The aim of this research was to manage solid waste by producing a community-based management (CBM) system. This PAR (Participatory action research) showed that a CBM system can improve the sustainable solution for the management of municipal solid waste.
Ingvarsson (2018)	The objective of this thesis was to analyse the activity level of three insect species, *House Cricket (Acheta Domesticus), YellowMealworm (Tenebrio Molitor)* and *Black Soldier fly (Hermetia Illucens)* on food waste and the result indicated that the Black Solider Fly can be reared on unprocessed food waste. On the other hand, the House Cricket requires food waste, but the Yellow Mealworm food waste supplemented by external products such as yeast, carrots or wheat bran.
Hottle et al. (2015)	This paper evaluated seven different waste management strategies of waste management system through three games. In this study, contamination rates in both the recycling and compost bins were tracked throughout the series and these were reduced from 34% in the first- game to 11% on the second night where the 23% contamination rates at the third game.
Nizar et al. (2018)	Finding economic benefits through the urban community after the implementation of Zero Waste principles was the principal objective. This study identified that the economic benefits of the Zero Waste concept can increase income for the community.
Yigitcanlar (2018)	Through this review, the authors wanted to find out cities can be truly smart without having Zero Waste. Smart cities are sustainable and balanced on the economic, societal, environmental and industrial development, but for a truly smart and sustainable world, smart cities are with Zero Waste.
Nizar et al. (2018)	Searching the duration of implantation of the concept of Zero Waste in waste management. This implantation process depends on different socio-political factors. If all concepts such as disposal etc. positively interfered with the socio-political then the implementation of Zero Waste concept will be quick.
Ali and Kumar (2019)	Asserting the guiding principles that help to develop a strategic Zero Waste framework were the goals of this research paper. By different online surveys, eighteen strategic identified elements as important guiding principles for the development of a holistic Zero Waste framework.
Binnemans et al. (2015)	Discussing the possibilities to recover rare earths from secondary resources was the objective of this study. This review clearly indicated that the Zero Waste valorization recovery of metals and residues will be possible.
Yang et al. (2017)	The aim of this study was to promote Zero Waste of municipal incinerator fly ash and by the full-scale melting in electric arc furnaces (EAFs) of steel mini-mills showed very satisfactory results.
Walker and Xanthos (2018)	This article was a perspective analysed review. In this analysis, mainly broadly focused on Zero Plastic Waste. And it can be done by reducing and recycling single used plastic.
Liyanage et al. (2019)	Investigation of the adaptation of Zero Waste concept to eliminate Construction and Demolition waste was the goal of this study. Construction and Demolition waste such as cement, timber, brick, concrete, aluminium, plastic, steel, tile, paper and cardboard generation impose adverse impacts upon the environment, social and health of the population and that can be removed by Zero Waste.
Affandy et al. (2017)	The objective of this study was to search the working model in the management Community-Based Zero Waste Movement. According to this study, per person generate 0.2 kg waste and the waste compositions include wet trash, plastic, paper,

	metal, glass, latex, wood, fabric and others as 65, 14, 10, 3.3, 1, 1, 2.3, 2.3 and 0.3%, respectively. By the 3RWB models, wet waste and organic waste can be easily removed.
Li et al. (2019)	The aim of this study was to develop a direct oleo-extraction method on the basis of zero-waste biorefinery concept and here used solvents were vegetable oils and their amphiphilic derivatives and results showed that refined soybean oil performed the best concerning the yield of both major phenolic antioxidants and VACs in rosemary in the Zero Waste bio-refinery concept.
Hannon and Zaman (2018)	Searching the phenomenon of Zero Waste was the objective of this study. On the basis of this study, the implementation of Zero Waste goal is increased if community engagement occurs.
Homchuen et al. (2017)	This study aimed to determine the suitable method for recycling zeolite waste from refinery industries and the result of this study was the chemical process is more effective than the electrical process for regenerating zeolite.

Discussion

At the end of this critical review, the recommendations from different researchers are enormous and some are very economical, easy to implement, environment-friendly and sustainable. Ingvarsson (2018) and Amirtaa et al. (2016) showed that biotreatment dependant waste management is very easier and environment-friendly. But in another research by Cuccia (2018) reported that the changes in human behaviour or habit by education on waste generating and waste processing is the main possible root in Zero Waste concept. On the basis of Manomaiviboola et al. (2018), community-based management of waste by NGO-based, local government-based, private-based or group-based is more effective. Affandy et al. (2017) also find out some technologies for the management of waste as recycling, renew or getting products or chemical compounds.

Suggestion

Considering the above discussion, the main recommendation is to conduct research on waste to energy conversion. It is also recommended that it is the appropriate time to observe how to achieve the Zero Waste goal by proper implementations that are already established by various research methods. According to the specific result from this article, larger scale research work on development technologies regarding this economical sustainable and environment-friendly concept has to be done. If the local government, NGOs and the private sector work together, then achieving the goal will be easy and rapid.

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