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BIBLIOMETRIC ASSESSMENT OF THE IMPACT OF CIRCULAR ECONOMY STRATEGIES FOR WATER CONSERVATION RESEARCH

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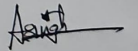
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**BIBLIOMETRIC ASSESSMENT OF THE IMPACT OF CIRCULAR
ECONOMY STRATEGIES FOR WATER CONSERVATION
RESEARCH****Dr. Nidhi Soni**

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Studies**ABSTRACT**

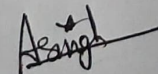
Rising populations, growing economies, and shifting consumption patterns have intensified the demand for water resources at a time when 36 percent of the world's population lives in water-scarce regions. More than 2 billion people live in highly water stressed countries, and about 4 billion people experience severe water scarcity. Water stress will continue to intensify as demand for water grows.

This paper seeks to emphasize the various concepts used to tackle the concept of sustainability applied to water and how it relates to the circular economy thinking and case studies of different models used for treating water piously in different countries of the world. This Paper seeks to present some very important aspects of measuring water consumption and to advance the tools to measure virtual water, water footprint, and thus better define when water is sustainable and what does "circular Economy" is all about. The study will also highlight the role of viability gap funding to promote circular economy. With the help of bibliometric analysis of 241 documents through Scopus database, in-depth research executed to grab a gist over the availability of literatures. Co-authorship, co-occurrence, citation, bibliographic coupling are some of the mapping that has been implemented.

KEYWORDS: Circular Economy, Sustainability, Virtual water, Water footprint, Bibliometric analysis, VOS Viewer.

INTRODUCTION

Circular economy provides a framework for redefining growth and designing an economy that is restorative and regenerative by design, bringing benefits for society and the environment. According to Kirchherr, Reike, and Hekkert 2017 and Kalmykova, Sadagopan, and Rosado 2018 there is no standardized definition for circular economy. All the competing definitions which are existing emerged in response to the linear model of economy which is based on the unsustainable assumption which says that resources are abundantly available, easy to source, and cheap to dispose of i.e. take, make, consume, and waste. According to European Commission 2014 report, the linear model has resulted in environmental degradation and pollution. Circular economy principles draw and build on concepts developed years ago. Notable among them are the spaceman economy given by Kenneth E. Boulding in 1966, he has taken the experience on the space station that every tool, food or material becomes essential and making good use of them is necessary for the success of the mission and the crew's own survival. Precisely for this reason, recycling in space is the order of the day - even the astronauts' urine is recycled on the space station and implements it to Earth. And that's why he proposes to move from a cowboy economy to an astronaut economy, in other words, from a linear economy to a circular one. According to UNESCO and UN-Water



2020, Global consumption has increased drastically, over the past hundred years and continues to mount. Projections suggest that by 2050, global demand for water will increase by 20 to 30 percent, unless consumption patterns shift dramatically. By then, more than half the world's population will be at risk of water stress. Intense water scarcity could displace as many as 700 million people by 2030. To tackle the aforementioned problem we must understand the few very important concept to save the earth from water scarcity and to promote the sustainable use of water.

The two very important concepts evolve to conserve water or to reduce water scarcity i.e. virtual water and water footprint. The amount of water used in food or other items during manufacture is referred to as virtual water. Trade in virtual water facilitates water-scarce nations to import high-water-consuming goods while exporting low-water-consuming goods. To provide a consumption-based indicator of water use of an individual, the idea of the water footprint has been introduced in accordance with the concept of virtual water (Hoekstra & Hung, 2004; Hoekstra & Chapagain, 2007). The water footprint can be divided into an internal and an external water footprint. The internal component covers the use of domestic water resources and the external component covers the use of water resources elsewhere.

In India according to usage, the states of Rajasthan, Punjab, Uttar Pradesh, Tamil Nadu, and Haryana have the greatest levels of water scarcity. This indicates that in the event of food self-sufficiency, these states' water resources are most likely to run out. From a production standpoint, these states have even more water shortage because the majority of them are also net exporters of virtual water analysis, it is possible to conserve water. Like in Chennai (India) by adopting the Water in Circular Economy and Resilience (WICER) Principles, state is increasing resiliency and recovering water and energy from wastewater. Similarly in Sao Paulo (Brazil), by establishing the wastewater treatment plants in metropolitan area had improved the quality of water and also helped in conservation. Another case study which is highlighted by the World Bank is of Cambodia: Phnom Penh, by following circular economy has improved operational efficiency and Reduce nonrevenue water. China: Lingyuan City – Unconventional Water Resources in Water-Scarce City: Recycling Treated Municipal Wastewater for Industrial Users and to restore the ecosystem. Likewise Portugal is also implementing circular economy and resilience principles in the long-term strategy of urban utilities.

The aforementioned case studies are the part of a series prepared by the World Bank's Water Global Practice to highlight existing experiences in the water sector. The purpose of the series is to showcase one or more of the elements that can contribute toward Water in Circular Economy and Resilience (WICER) system.

LITERATURE REVIEW

According to limits to growth theory of Meadows in 1972, if the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.

Performance economy of Stahel and Reday-Mulvey in 1976 and Stahel in 2006, gave this concept, the focus is on the maintenance and exploitation of stock in a sustainable manner.

The Industrial ecology of Frosch and Gallopoulos, 1989; Graedel and Allenby, 1995 attempts to induce balance and cooperation between industrial processes and environmental sustainability.

In the book *cradle-to-cradle: Remaining the Way We Make Things*, of Braungart and McDonough, 2002 presented an integration of design and science that provides enduring benefits for society from safe materials, water and energy in circular economies and eliminates the concept of waste.

According to Kirchherr, Reike, and Hekkert 2017 and Kalmykova, Sadagopan, and Rosado 2018 there is no standardized definition for circular economy. A comprehensive and widely used definition is the one developed by the EllenMacArthurFoundation (Ellen MacArthur Foundation, 2015a). The UN-Water 2020 ("UN-Water Analytical Brief on Unconventional Water Resources" UN-Water, Geneva, Switzerland, Agenda) also recognizes that objectives of environmental, social, and economic sustainability can no longer be met separately, in isolation from each other. In 2017, the World Economic Forum, in cooperation with the United Nations Environment Programme (UNEP), launched the Platform for Accelerating the Circular Economy. The platform encourages and enables public and private sector leaders to commit to accelerate collective action. In 2018, UNEP also entered into an agreement with the Ellen MacArthur Foundation to scale up and accelerate the shift toward circular economy. In 2019, UNEP launched the "circularity platform" to provide an understanding of the circularity concept, its scope, and how critical it is for achieving the targets of the Paris Agreement and the 2030 Agenda for Sustainable Development. In 2017, the World Business Council for Sustainable Development published a report for CEOs on the importance of circular economy in businesses (*WBCSD 2017*) and has since launched a program on circular economy, recognizing it as a key element in mitigating climate change, biodiversity loss, and resource scarcity. In the Planetary boundaries of Rockstrom 2009, feature the principle of maximizing the value of resources recognizing that the Earth's resources are limited, and that the planet itself has a limited capacity for managing and assimilating pollution (Kalmykova, Sadagopan, and Rosado, 2018), therefore it is mandatory to recycle the used resources to overcome the problem of pollution by incorporating circular economy. Although most of the strategies grouped under circular economy are not new in isolation, the concept offers a new framing under a useful conceptual umbrella (CIRAIG 2015; Blomsma and Brennan 2017).

In 2019, the Organization for Economic Co-operation and Development (OECD) launched the Programme on Circular Economy in Cities and Regions, acknowledging that "transitioning to a circular economy is key for a prosperous, inclusive and sustainable future." In 2020, the United Nations Development Programme (UNDP) and UNEP published a joint guidance note on circular economy and climate change mitigation. The note calls for circular economy strategies to be included in revisions of Nationally Determined Contributions under the Paris Agreement, given that circular economy could help reduce the current emissions gap by half (*UNEP and UNDP 2020*). Business and corporations around the world are also taking concrete actions and implementing circular business models (*EMF 2020*). The World Bank has hosted a series of learning events on Circular Economy and Private Sector Development and is launching a Global Program for Pollution Management and Circular Economy. Leube, in 2017 emphasizes the significance of circular product design, shifting towards a circular economy, with the implementation of 'cradle to cradle' approach for sustainable design and reuse of separate materials as per the used designing. Bibliometric analysis has been implemented in order to create a science map through VOSviewer with the database of Scopus (Kozlakidis et al., 2020; Garg et al., 2023).

NEED & RELEVANCE (Research Gap)

There is no standardized definition for circular economy. There is a lack of awareness, as most individuals may not value sustainability over convenience or are ignorant of the

advantages of circular processes, the fundamental mechanics of the circular model may not be fully understood, despite extensive research on this model. Although the circular economy idea has gained popularity recently, there are still several obstacles in the way of its actualization. The lack of widespread adoption of circular design concepts is one of the main obstacles to the circular economy because many items are still created with a linear model cycle in mind, which results in waste and inefficiency. The amount and complexity of materials in today's waste stream frequently exceed the capacity of the recycling infrastructure that is in place.

OBJECTIVES OF THE STUDY

- To emphasize the various concepts used to tackle the concept of sustainability applied to water and how it relates to the circular economy thinking.
- To generate the concept of circular economy.
- To present pertinent literature review that present circular economy thinking and water.
- To perform science mapping through bibliometric analysis on VOSviewer software with Scopus database.

RESEARCH METHODOLOGY

The study is empirical in nature and based on mainly secondary sources of data. The secondary sources of data include published, documented and internet sources.

To analyze the availability of the study, bibliometric analysis has been executed on the basis of Scopus database. The paper aims at identifying the most influential authors, citations, bibliographic coupling in terms of countries, highly cited journals and some other significant information. The data was accessed on 29th February, 2024.

Content	Description
Terminology	TITLE-ABS-KEY("Circular Economy" AND "Water Conversation")
No. of Documents	241 documents from Scopus database
Document Category	209 journals, 20 Conf. Proceedings, 7 Books, 5 book series
Time Frame	2014-2024

RESULT ANALYSIS

1. CO-AUTHORSHIP ANALYSIS

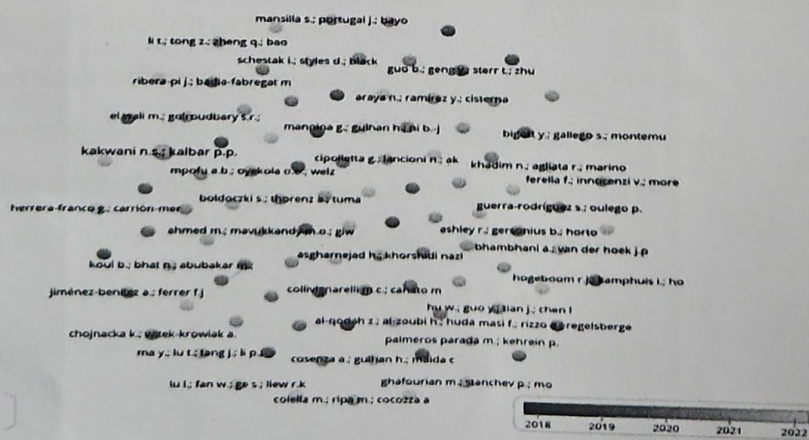


Fig.1.1 Co-Authorship Analysis (Author's Creation)

Co-authorship analysis has been performed on 241 documents and overlay visualization has been presented. Several colored nodes (blue, green, yellow) signifies years from 2018-2022. Min. no. of docs 1 and citations 10 out of 242, 102 meet the threshold. 101 clusters has shown in the analysis.

CO-OCCURRENCE (AUTHOR KEYWORDS)

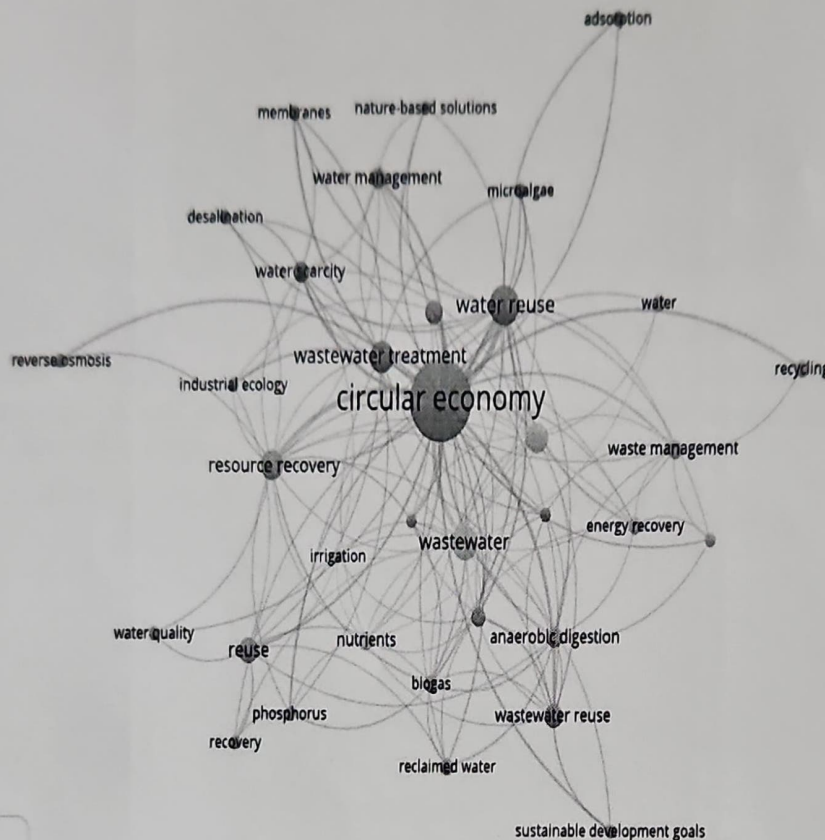


Fig.1.2 Co-Occurrence Analysis (Author’s Creation)

Co-occurrence analysis has been performed and minimum number of occurrence 4, 844 keywords out of which 35 met the threshold. The network visualization has been presented with 35 items, 8 clusters, 153 links, total link strength 275. Below are the names indicated to all the cluster nodes with variation in colors.

- Cluster 1 (Red node)-Circular Economy,32 links, 128 tls, 115 occ.
- Cluster 2 (Green node)- Resource recovery,18 links, 34 tls,16 occ.
- Cluster 3 (Blue node)-Waste water reuse,11 links, 19 tls, 10 occ.
- Cluster 4 (Yellow node)-Waste water,18 links,33 tls,21 occ.
- Cluster 5 (Purple node)-Anaerobic digestion, 14 links,18 tls, 7occ.
- Cluster 6 (Sky blue node)-Waste Mgt., 10 links, 12 tls,6 occ.

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2. CITATION ANALYSIS (SOURCES & COUNTRIES)

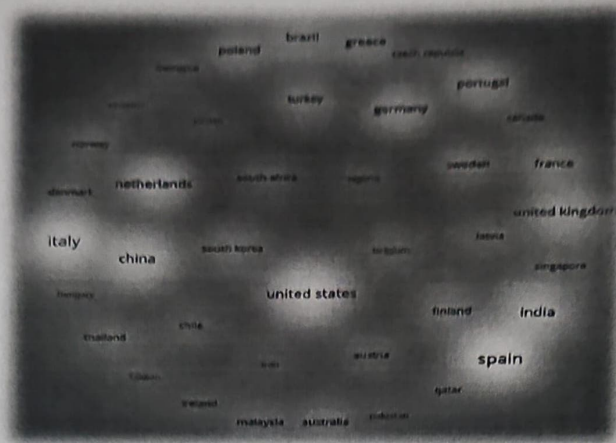


Fig. 1.3 Citation Analysis (Author’s Creation)

Minimum number of document taken for analyzing country is 2 and Minimum number of citation of country is 10, out of 70 countries, 40 meet the threshold. Spain, Italy and India are under the top 3 countries respectively in terms of research done.

BIBLIOGRAPHIC COUPLING (AUTHORS & COUNTRIES)

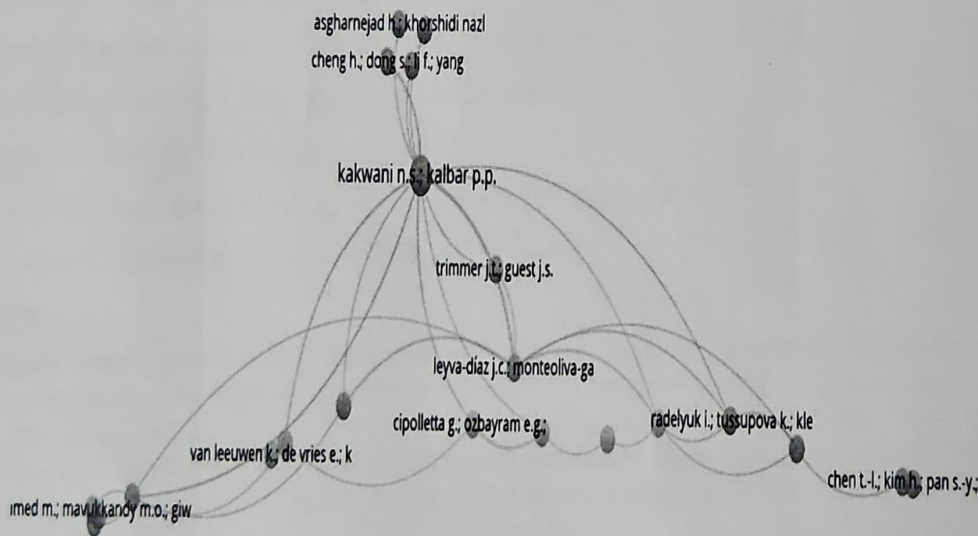


Fig. 1.4 Bibliographic Coupling (Author’s Creation)

The authors found 30 citations, 40 met threshold on the 242 authors. With the help of OSviewer, 6 clusters, 34 links, 47 total link strength has been identified. Top influential authors are: 1.N.S. Kakwani, P.P Kalbar, 2. M.Ahmed, 3.T.Chen

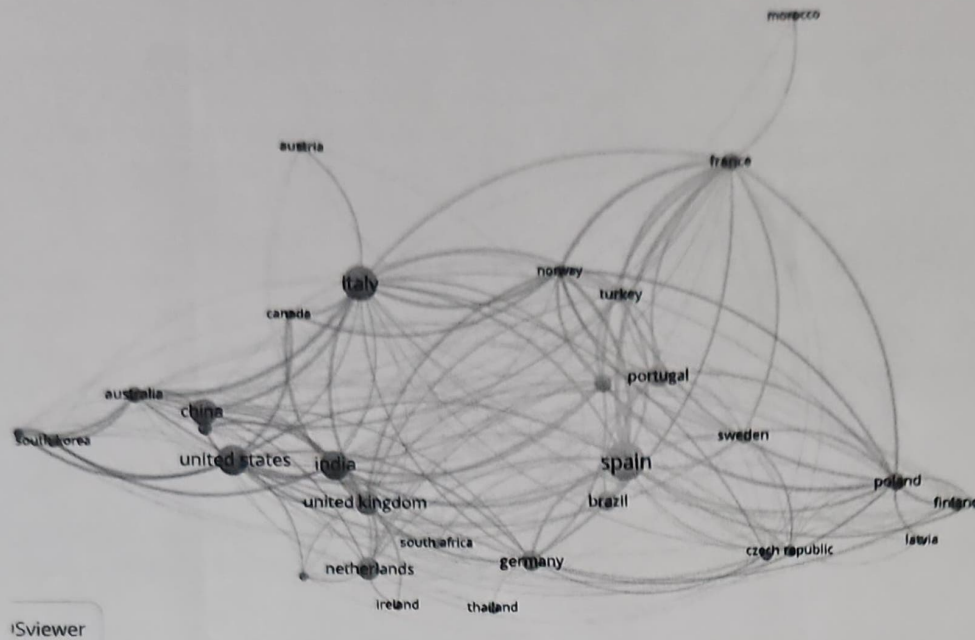


Fig. 1.4 Bibliographic Coupling (Author's Creation)

Out of 70 countries, 32 met threshold, minimum number of documents is 3. 10 number of citation in which 32 items, 6 clusters, 291 links, and total link strength is 13968.

- Spain (Yellow node) 30 links, 2655 tls, 44 docs
- Italy (Purple node) 29 links 2078 tls, 34 docs
- India (Red node) 28 links, 1315 tls 24 docs
- United Kingdom (Green node) 26 links 1389 tls, 16 docs
- France (Blue node) 23 links, 1841 tls, 9 docs

Suggestions

Governments must implement targeted policies to support circular initiatives, such as extended producer responsibility (EPR) scheme, Tax incentives for businesses adopting circular practices, Grants and funding for circular economy research and innovation, Regulations that encourage the use of recycled materials in production, etc. Government in tandem with private entity must raise awareness campaigns for fostering sustainable consumption habits.

Investment in advanced recycling technologies, such as chemical recycling and modular recycling facilities, can help to overcome these challenges. By deploying these technologies, industries can recover higher-value materials, leading to a more robust and effective or encouraging circular design.

It is imperative that governments collaborate with industry leaders or through viability gap funding, encourage the implementation of circular design concepts. This can involve providing financial support for the study and creation of circular design techniques, rewarding companies that implement sustainable practices, and incorporate these ideas into curricula in schools and colleges.

CONCLUSIONS

The Paper highlighted the concept of Circular economy in the context of water conservation, emphasizing the increasing demand for water resources and the necessity for sustainable water management approaches. It delves into case studies of water treatment models from different parts of the country. Put emphases on key concepts like virtual water and water footprint, etc. Moreover the study underscores the transitioning to a circular economy to combat water scarcity and promote sustainability. Further the study attempted to answer the questions like how does virtual water and water footprint concepts contribute in understanding water conservation applying the concept of circular economy. Adding more questions like which country showcase the successful water treatment models and in what ways does the viability of funding of PPP model plays a role in providing assistance to circular economy practices for water management.

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