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CIRCULAR ECONOMY TACTICS AND SUSTAINABLE DEVELOPMENT: A COMPARATIVE STUDY OF INDIAN INDUSTRIES

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ABSTRACT

A circular economy maximises the amount of time that materials, goods, and services can be used for. In a circular economy, resources are used less frequently, materials, goods, and services are redesigned to use fewer resources, and "waste" is recovered and used as a resource to create new goods and materials. Any circular economy adaption is crucial to reducing global warming. As a result, any study about circular economy technologies, their attendant drawbacks, and policy suggestions for improvement assume primary importance in contemporary times. Towards that end, this paper examines the growing trends in three key industries in India – namely, agriculture, manufacturing, and technology – in an attempt to analyse the relative success of these adaptations and their wider impact. Qualitative and quantitative insights are drawn through case studies of companies working in India. The analysis is further bolstered by comparing the scenario in India with global trends that highlight the work that needs to be done. Accordingly, the paper concludes by underlining the most important advantages and disadvantages as well as suggesting suitable policy courses for the future.

Keywords: Sustainable Development, Resources, Circular Economy

1. Introduction

India is one of the fastest-growing economies in the world, and its population is expected to reach 1.6 billion by 2050 (SDG Knowledge Hub, 2019). This rapid growth is bound to put a strain on the country's natural resources and environment. The Indian government has recognized the need to transition to a more sustainable economic model and has announced plans to introduce a circular economy. This could bring substantial annual benefits, along with a significant reduction in congestion and pollution, which would consequently have a snowball effect on the economy (Bharat and Roy-Basu, 2023). To expedite the transition of the country from a linear to a circular economy, 11 committees have been formed—to be led by the

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concerned line ministries and comprising officials from MoEFCC and NITI Aayog, domain experts, academicians, and industry representatives—for 11 focus areas (NITI Aayog, 2021). The committees will prepare comprehensive action plans for transitioning from a linear to a circular economy in their respective focus areas (NITI Aayog, 2021).

Circular economies have been recognized as a mechanism that could help firms realize economic advancements in an environmentally sustainable manner. A study by Mazzuchelli et al. (2022) found that Italian manufacturing firms that adopt circular economy practices have better financial performance than those that do not. In fact, by adopting social behavior, firms could enhance their reputation among customers, reducing marketing costs to acquire new customers and retain existing ones. Circular economy practices such as product design for recycling and reuse, and the use of recycled materials, can lead to higher revenues and profits (Mazzuchelli et al., 2022). The study also found that the benefits of circular economy practices are greater for firms that operate in more competitive industries. This is because circular economy practices can help firms reduce their costs and differentiate themselves from their competitors (Mazzuchelli et al., 2022). Keeping in mind the large impact of circular economies on several sectors, the paper undertakes a comparative study of the same. Examining three key industries in India – manufacturing, agriculture, and technology – the paper seeks to weigh in on the debate about the utility of circular economies. To construct its argument, the paper relies on qualitative and quantitative data as well as scholarly literature that currently exists on the topic.

2. Background

Circular economies have been increasingly adopted in key Indian industries. Manufacturing, agriculture, technology, and construction industries are the major contributors to waste and pollution in India (Sarma et al., 2023). The circular economy strategies adopted are helping to reduce the environmental impact of the manufacturing and agricultural industry by reducing waste and pollution, improving resource efficiency, and increasing resilience (NITI Aayog, 2021; Sarma et al., 2023). In this section, we examine how these industries have taken to the circular economy approach and the impact it has had.

Agriculture is a major user of resources, including land, water, and energy. Circular economy practices can further help to improve resource efficiency in agriculture by reducing the use of external inputs and by recycling and reusing agricultural waste products. For example, precision agriculture can help to optimize the use of water and fertilizer, while anaerobic digestion of manure and crop residues can produce biogas and fertilizer (Sarma et al., 2023). Secondly, agriculture is vulnerable to climate change and other shocks, such as pests and diseases. Circular economy practices can help to increase the resilience of agriculture to these shocks. For example, diversifying crops and using recycled manure can help to reduce the reliance on irrigation and

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chemical fertilizers (Selvan et al., 2023). The transition to a circular economy in agriculture will create new jobs and economic opportunities in areas such as waste management, recycling, and renewable energy production. For example, there is a growing demand for compost and anaerobic digestion systems, which can be used to recycle agricultural waste products (Sarma et al., 2023). A circular economy has the potential to have a significant impact on the technological industries, which are major contributors to waste and pollution. Circular economies can help to reduce the environmental impact of agriculture while also improving its economic performance. For example, composting manure and crop residues can reduce greenhouse gas emissions and water pollution, while using recycled manure and crop residues can reduce the need for synthetic fertilizers and pesticides (Sarma et al., 2023).

The technology industry is also adopting the circular economy approach. For example, some technology companies are using recycled materials in their products and are designing products that are easier to repair and recycle. The circular economy is helping to reduce the environmental impact of the construction industry by using recycled materials and designing buildings that are more energy-efficient (Sarma et al., 2023). Electronic waste (e-waste) is one of the fastest-growing waste streams in the world, and it is estimated that only twenty percent of e-waste is currently recycled (United Nations Environment Programme, 2019). A circular economy can help to reduce the environmental impact of the technological industries by designing products for durability, repairability, and recyclability, increasing the recycling and reuse of e-waste, and creating new jobs and economic opportunities. A study by Chetna et al. (2022) identified a number of digitalization technologies, such as artificial intelligence, the Internet of Things, and big data analytics, that can be used to improve the design, manufacturing, recycling, and reuse of products. Artificial intelligence is also being used to design products that are more durable, repairable, and recyclable. For example, Google AI has developed an algorithm that can design smartphone batteries that are more durable and have a longer lifespan (Cordella et al., 2021). The Internet of Things is being used to track the use and condition of products in real-time (Chetna et al., 2022). For example, the company Circular Edge has developed a sensor that can be attached to electronic devices to track their use and condition. This data can then be used to identify and repair products before they reach the end of their useful life (Chetna et al., 2022). Big data analytics is being used to optimize the recycling and reuse of products. For example, the company IBM has developed a platform that uses big data analytics to optimize the recycling of e-waste. The platform helps to identify the most valuable materials in e-waste and to develop the most efficient recycling processes (Staub, 2019). Therefore, a circular economy has the potential to have a significant impact on the Indian economy, which is a major contributor to waste and pollution.

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However, there are a number of critiques of the circular economy concept, and there is some guarded optimism about its application in India. One of the main critiques of the circular economy concept is that it is too idealistic and unrealistic (Corvellec et al., 2021). Critics argue that it is not possible to completely eliminate waste and pollution and that the circular economy will require significant changes to the way we produce and consume goods. Another critique of the circular economy concept is that it is too focused on technological solutions. Critics argue that the circular economy should also focus on social and economic solutions, such as changing our consumption patterns and reducing our reliance on material goods (Corvellec et al., 2021). India with its large and growing population presents both challenges and opportunities for the circular economy. On the one hand, the large and growing population of India will generate a lot of waste and pollution (Bharat and Roy-Basu, 2023). This will be a challenge for the circular economy to address. On the other hand, the rapid development of India presents an opportunity for the country to leapfrog the traditional linear economy and adopt a circular economy model. The use of recycled materials is expected to increase in all industries (Sarma et al., 2023). This will help to reduce the demand for virgin materials and reduce the environmental impact of manufacturing. Products are increasingly being designed for circularity. This means that products are designed to be durable, repairable, and recyclable. India can learn from the experiences of other countries and avoid the mistakes they have made.

3. Discussion

This section will examine the particular measures that have been instituted in order to circumvent the criticisms that were highlighted in the previous section. Zero Waste Farming (ZWF), for instance, is a circular economy approach to agriculture that aims to eliminate waste by designing agricultural systems that are closed-loop and regenerative (Sarma et al., 2023). ZWF farms use a variety of techniques to achieve this, such as crop rotation, which helps to improve soil health and reduce the need for synthetic fertilizers and pesticides; composting, which converts agricultural waste into nutrient-rich soil amendments; and integrated pest management (IPM), which uses a combination of biological, cultural, and mechanical methods to control pests and diseases (Centre for Creativity & Sustainability, n.d.). It has several advantages ZWF farms can reduce their reliance on synthetic fertilizers and pesticides, conserve water, and improve soil health (Quilang et al., 2019). This can lead to a significant reduction in greenhouse gas emissions and other pollutants (Quilang et al., 2019). These farms are more resilient to climate change and other shocks because they are more diverse and less reliant on external inputs and can be more profitable than conventional farms because they have lower input costs and produce higher quality produce.

Saahas Zero Waste Farming Initiative in India is a program that helps farmers transition to ZWF practices (Aggarwal and Mahajan, 2021). The program provides farmers with training and

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technical support, as well as access to markets for their produce. The Saahas Zero Waste Farming Initiative has been successful in helping farmers reduce their environmental impact and improve their yields. For example, one farmer in the program was able to reduce his use of synthetic fertilizers by 50% and his use of pesticides by 75%. He also saw a 20% increase in his yields (Aggarwal and Mahajan, 2021). Farmers who do not use ZWF practices are more likely to rely on synthetic fertilizers and pesticides, which can pollute the environment and harm human health. They may also be more vulnerable to climate change and other shocks, as their crops may not be as resilient (Aggarwal and Mahajan, 2021).

However, there are higher upfront costs due to which these farms may need to invest in new equipment and infrastructure, such as composting facilities and crop rotation equipment. They can be more labor-intensive than conventional farming practices, especially in the early stages of transition. Moreover, ZWF farmers need to have a good understanding of ecological principles and how to manage complex agricultural systems.

In the case of the manufacturing sector, similar strategies have been adopted. Product-as-a-service (PaaS) is a circular economy business model where the manufacturer remains the owner of the product throughout its life cycle (Tata Sustainability Group, n.d.). This means that the manufacturer is responsible for maintaining and repairing the product, and for recycling or reusing it at the end of its life. This is useful for reducing waste and resource consumption by extending the life cycle of products and keeping them in circulation for longer (Tata Sustainability Group, n.d.). This is because manufacturers have a vested interest in designing products that are durable and easy to repair. Its models can also help to improve product quality and innovation as manufacturers are able to collect data on how their products are used and feed this data back into the design process. Remanufacturing is a process of restoring used products to their original condition. Remanufactured products are typically of equal or higher quality than new products, and they can be sold at a lower price (Okorie et al., 2021). It can reduce waste and resource consumption by keeping products in circulation for longer. The key reason to remember here is that remanufactured products are made from used components, which reduces the need to extract and process new raw materials. These products are typically less expensive than new products as they do not have to incur the full cost of manufacturing a new product.

Philips Lighting offers a PaaS model for its lighting systems. Under this model, Philips owns and maintains the lighting systems and charges customers a fee for their use (Phipps, 2018). This model has helped Philips to reduce waste and energy consumption and to improve the quality and reliability of its products. The company has been able to reduce the amount of electronic waste it produces by 90% (Koninklijke Philips, 2015). It has also been able to save its customers money, as they are no longer responsible for the upfront cost of purchasing lighting systems (Koninklijke Philips, 2015). Companies that do not use a PaaS model may be more likely to

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produce products that are designed to be disposable, which can lead to increased waste and resource consumption. Customers may also have to spend more money on replacing products that are not durable or easy to repair.

Xerox has a remanufacturing program for its printers. Xerox collects used printers from customers and remanufactures them to sell as refurbished products. This program has helped Xerox to reduce waste and save customers money (Xerox, 2018). It has been able to reduce the amount of electronic waste it produces by 70% (Xerox, 2018). Companies that do not remanufacture products may be more likely to generate electronic waste, which can be difficult and expensive to recycle. Customers may also have to spend more money on purchasing new products, rather than being able to purchase remanufactured products at a lower cost.

However, there can be a few drawbacks of PaaS. Its models require manufacturers to invest in new infrastructure and supply chain management systems in order to support the return, repair, and reuse of their products. Additionally, it can be more expensive for customers than traditional purchase models. The reason behind this is that customers are not buying the product itself, but rather the right to use it. Although remanufacturing can create jobs in the collection, repair, and resale of used products, it can be more expensive than recycling and requires specialized skills and equipment. This is because some products are made from materials that are difficult to recycle or reuse.

4. Conclusion

The case studies above show that the circular economy has immense potential to positively impact economic viability, social responsibility, and environmental sustainability. India is one of the largest producers of waste in the world, with over 62 million tonnes of municipal solid waste generated annually (International Trade Administration, 2023).

The current linear economic model is leading to the depletion of natural resources, pollution, and climate change. Hence, a circular economy is needed which has the potential to revolutionize the way we manufacture, produce, and consume goods and services. It has brought several advantages to manufacturing, agriculture, and technology areas. In manufacturing, it has reduced waste and resource consumption, improved product quality and durability, reduced production costs, and increased job creation. In agriculture, it has improved soil health and water conservation, reduced the use of synthetic fertilizers and pesticides, increased resilience to climate change, and improved livelihoods for farmers. In technology, it has reduced electronic waste, extended product life cycle, increased energy efficiency, and reduced environmental impact. However, higher upfront costs, the complexity of implementation, and the need for consumer behavior change remain a challenge. Certain policies could be used to overcome these

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limitations like providing financial incentives like subsidies for businesses to invest in circular economy practices, investing in research and development of circular economy technologies, and introducing regulations that promote the circular economy.

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