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NEWSLETTER

ON

LIFESTYLE FOR ENVIRONMENT (LIFE):

TOWARDS CIRCULAR ECONOMY

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EDITORIAL

Literally, circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products. The present issue of newsletter is provided with a very pertinent topic on Lifestyle for Environment (LiFE): Paving the Way for India's Global Leadership in Circular Economy and Millet mission for sustainable food security and Lifestyle for Environment (LiFE) movement towards Circular Economy.

First article described on the role of Mission Lifestyle for environment (LiFE) in fostering a circular economy in India and propelling the nation to a leadership position in the global circular economy sector and also describes how mission LiFE impact on the key sectors of the Indian economy such as manufacturing, agriculture, waste management, energy, and construction. The article mainly describes the India's environmental sustainability and the opportunities that lie ahead for India's circular economy journey.

The second article describes how millet crops help for sustainable food security and reducing poverty especially in developing countries and their waste products utilized as value added products which have immense role to the world circular economy.

Prof. Kausik Mondal

IN THIS ISSUE:

Lifestyle for Environment (LiFE): Paving the Way for India's Global Leadership in Circular Economy

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Abstract

The circular economy paradigm is gaining momentum worldwide as a sustainable approach to resource management and economic development. This article explores the concept of circular economy and its potential benefits for India's environmental sustainability. Furthermore, it discusses the role of Mission Lifestyle for environment (LiFE) in fostering circular practices and propelling India to a leading position in the global circular economy sector. The article presents a comprehensive framework, outlining the key elements of LiFE and its impact on various sectors of the Indian economy. Finally, it highlights the challenges and opportunities that lie ahead for India's circular economy journey.

Key words: Lifestyle, Sustainable, Global, Economy and Environment

1. Introduction

The concept of sustainable consumption and lifestyles should be understood within the context of resource value chains, encompassing resource extraction, manufacturing, processing, consumer use and disposal. While mainstream frameworks for sustainable consumption and production primarily emphasize resource efficiency and circular economy in upstream and mid-stream stages, lifecycle approaches must consider the entire lifecycle of goods and services, including resource extraction, production, consumption, and disposal. Given that supply is driven by demand, including individual lifestyle choices, it is essential to also focus on downstream stages and the interconnectedness of resource value chains (MoHUA Report, 2021). The "Lifestyle for the Environment - LiFE Movement" was introduced by India's Prime Minister, Shri Narendra Modi, at the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow in 2021. This movement promotes an environment-conscious lifestyle that emphasizes mindful and intentional utilization, steering away from thoughtless and destructive consumption, and encourages sustainable choices by individuals who prioritize the well-being of the planet, known as "Pro-Planet People" (fig.1).

Fig.1. Mission LiFE launched by Hon'ble Prime Minister of India (Source: moef.nic.in)

The core principles associated with LiFE encompass reduction, reuse, recycling, and the adoption of circular economy practices. India's updated National Determined Contribution (NDC) under the Paris Agreement seeks to promote a sustainable and healthy way of living based on the country's traditions and values of conservation and moderation. A key element of this endeavour is the mass movement known as "LiFE" or "Lifestyle for Environment," which is considered instrumental in combating climate change (LiFE, 2021). The LiFE movement in India is underpinned by three fundamental aspects. Firstly, it emphasizes the importance of mass movements, known as Jan Andolans, which serve as effective social instruments for initiatives like cleanliness drives and voluntary relinquishment of subsidies for cooking fuels. Secondly, it recognizes the significance of demand-driven growth and consumer-led innovations, both in terms of market dynamics and policy frameworks. Lastly, the LiFE movement aims to internationalize the issue of lifestyles as a matter of global concern, recognizing the interconnectedness of individual choices and their impact on the environment worldwide.

The transition towards a circular economy has emerged as a pivotal concept in the pursuit of sustainable development. It represents a departure from the traditional linear "take-make-dispose" model to one that promotes the restorative and regenerative use of resources. By reimagining products, services, and systems, the circular economy aims to decouple economic growth from resource consumption and environmental degradation. As countries worldwide embrace this transformative approach, India, with its burgeoning economy and pressing environmental challenges, has

recognized the immense potential of the circular economy to drive sustainable development.

1.1 Background and significance of circular economy

The concept of a circular economy has gained considerable traction over the past decade due to its potential to address a multitude of pressing environmental issues. Unlike the linear economy, where resources are extracted, processed, used, and discarded, a circular economy promotes the circulation of materials, energy, and information in a closed-loop system. It emphasizes the principles of reduce, reuse, recycle, and recover to maximize the value and lifespan of resources while minimizing waste and pollution.

In India, the pursuit of a circular economy is crucial due to the country's rapid economic growth, population expansion, and resource constraints. With a population of over 1.3 billion and a growing middle class, the demand for goods and services is surging, resulting in increased resource consumption and waste generation. Additionally, India faces challenges such as land degradation, air and water pollution, and inefficient resource management systems. Embracing the circular economy presents an opportunity for India to decouple economic growth from resource depletion and environmental harm, promoting sustainable development.

1.2 Overview of India's environmental challenges

India's environmental challenges are multifaceted and require urgent attention. Rapid urbanization, industrialization and population growth have strained the country's natural resources and ecosystems. Air pollution, driven by industrial emissions, vehicle exhaust and biomass burning, has resulted in severe public health implications. Water scarcity and pollution pose significant challenges, affecting both human and ecological systems. Inefficient waste management systems and increasing volumes of waste exacerbate environmental degradation and contribute to the mounting landfills.

Addressing these challenges requires a paradigm shift in resource management practices and the adoption of sustainable approaches that align with the principles of the circular economy. By embracing circular practices, India can reduce waste generation, optimize resource use, promote sustainable production and consumption and create new economic opportunities.

1.3 Objectives

This article aims to shed light on the role of Mission Lifestyle for environment (LiFE) in fostering a circular economy in India and propelling the nation to a leadership position in the global circular economy sector (fig.2). The specific objectives of this article are:

- To provide an overview of the circular economy concept and its potential benefits for India's environmental sustainability.
- To introduce Mission Lifestyle for environment (LiFE) and its objectives in promoting circular practices.
- To outline the impact of LiFE on key sectors of the Indian economy, including manufacturing, agriculture, waste management, energy, and construction.
- To analyse the challenges and opportunities that lie ahead for India's circular economy journey.
- To propose strategies for India to leverage LiFE and emerge as a global leader in the circular economy.
- To highlight the crucial role of government, industry, and civil society in driving the circular economy transition.

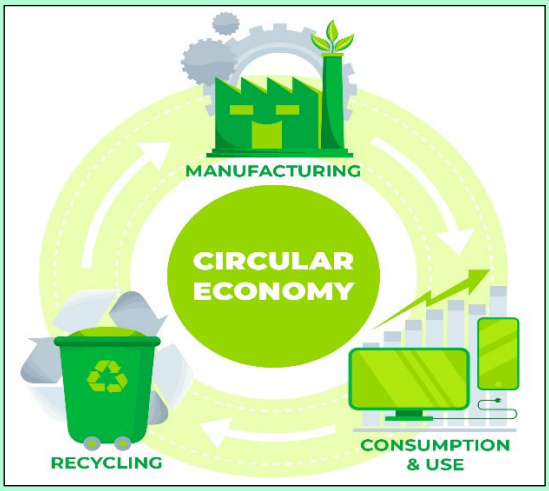

Fig.2. Flow Chart: A complete Cycle of Circular Economy

By addressing these objectives, this article seeks to contribute to the understanding of the circular economy paradigm and its potential for India's sustainable development. It also aims to inspire policymakers, businesses, and citizens to embrace circularity and catalyse the necessary transformative changes for a more sustainable future.

2. Circular Economy: A Path to Sustainability

2.1 Definition and Principles of Circular Economy

The circular economy is an innovative and regenerative economic model that aims to redefine the way resources are produced, used, and disposed of. It is grounded in the principles of restorative and regenerative design, emphasizing the need to keep materials and products in use for as long as possible, extracting their maximum value, and minimizing waste generation

At its core, the circular economy is guided by several key principles:

a) ***Design for longevity and durability:*** Products are designed with the intention of extended use, repairability, and upgradability, reducing the need for frequent replacements.

b) ***Resource preservation through recycling and reuse*****:** Materials and components from products are recycled or reused to create new products or re-enter the production cycle.

c) ***Waste prevention and elimination****:* Waste is minimized through efficient production processes, resource optimization, and the use of innovative technologies.

d) ***Value preservation and regeneration:*** The circular economy seeks to retain the value of products and materials by maximizing their utilization and recovering their energy or materials at the end of their lifespan.

e) ***Collaboration and systems thinking:*** Collaboration across sectors, industries, and stakeholders is encouraged to develop innovative solutions and create a systemic shift towards circularity.

2.2 Key Benefits of Circular Economy for India

The successful implementation of a circular economy in India necessitates the development of a supportive ecosystem that encourages the identification and adoption of innovative business models. Currently, India's urban cities, home to approximately 377 million people, generate around 55 million tonnes of Municipal Solid Waste (MSW) each year, encompassing organic waste and recyclables such as paper, plastic, wood, and glass. However, as per the IBEF report (India Brand Equity Foundation), these figures are projected to escalate to 125 million tonnes annually by 2031. Despite these volumes, only 75-80% of the MSW is collected, with a mere 22-28% undergoing proper processing, while the remaining portion is indiscriminately dumped in landfills. This trend is anticipated to result in a staggering increase in MSW generation, reaching 165 million tonnes by 2031 and surging to 436 million tonnes by 2050 (***Plastic Waste Management Rules, 2021; E-Waste Management Rules, 2022; IISD, 2021*****).**

India is poised to become the world's third-largest economy by 2030, accounting for approximately 8.5% of global GDP. Implementing a circular economy has the potential to not only drive India's economic growth but also deliver significant environmental advantages, establishing a sustainable and resilient framework. Notably, the recycled Polyethylene Terephthalate (PET) plastic industry in India is valued at around US$ 400-550 million, as reported by the National Chemical Laboratory (NCL) and the

Hon'ble Prime Minister, Shri Narendra Modi during his speech, addressed the gathering on "Circular Economy" on the occasion of World Environment Day 2021 - *"In the circular economy that is being talked about today, the focus is on such products and processes, in which there is least pressure on resources. The government has identified 11 sectors which can make good use of resources by recycling them through modern technology. A lot of work has been done in the last few years on the Kachra to Kanchan (Waste to Wealth) campaign and now it is being taken forward very fast in mission mode. Be it waste from households and farms, scrap metal or lithium-ion batteries, recycling is being encouraged through new technology in many such areas. Action plan related to this, which will have all aspects related to regulatory and development, will be implemented in the coming months. Friends, it is very important to organize our efforts to protect the climate and environment. We will be able to give a safe environment to our coming generations only when every citizen of the country makes a united effort to maintain the balance of water, air and land".*

PET Packaging Association for Clean Environment (PACE). India boasts an impressive PET recycling rate of 90%, surpassing Japan (72%), Europe (48%) and the United States (31%). Consequently, India presents immense opportunities for the development of a circular economy (IBEF Report 2022-23; Ellen MacArthur Foundation, 2021; Confederation of Indian Industry, 2021; UNIDO, 2019; WBCSD, 2018;TERI, 2020; NITI Aayog, 2020; CEE, 2019).

The adoption of a circular economy model in India offers numerous benefits for sustainable development across various sectors:

a) ***Resource efficiency and security****:* The circular economy reduces dependence on finite resources by promoting resource efficiency, recycling, and reuse. This mitigates resource scarcity risks and enhances India's resource security.

b) ***Environmental conservation and pollution reduction:*** By minimizing waste generation and optimizing resource use, the circular economy reduces the strain on natural ecosystems, conserves biodiversity, and decreases pollution levels, addressing India's pressing environmental challenges.

c) ***Job creation and economic growth:*** The circular economy presents significant opportunities for job creation, particularly in sectors such as recycling, remanufacturing, and repair services. It fosters local economic development and promotes a more inclusive and sustainable economy.

d) ***Cost savings and competitiveness:*** Adopting circular practices can lead to cost savings for businesses through reduced raw material consumption, energy efficiency, and waste management. This enhances the competitiveness of Indian industries in both domestic and international markets.

e) Innovation and technological advancement: The circular economy drives innovation by encouraging the development of new business models, technologies, and processes. It promotes the integration of digital solutions, Internet of Things (IoT), and Artificial Intelligence (AI) for enhanced resource management and monitoring.

3. Mission Lifestyle for environment (LiFE): An Overview

3.1 Introduction to LiFE and its Objectives

Mission Lifestyle for environment (LiFE) is an ambitious initiative launched by the Indian government to accelerate the transition towards a circular economy. Introduced under the Ministry of Environment, Forest, and Climate Change, LiFE aims to foster sustainable production and consumption patterns while promoting environmental stewardship. The mission recognizes the need to address India's environmental challenges and harness the economic potential of circular practices.

The primary objectives of LiFE are:

a) Promoting resource efficiency: LiFE seeks to optimize resource use by encouraging industries and businesses to adopt sustainable production techniques, efficient technologies, and innovative business models that minimize waste generation and maximize resource recovery.

b) Encouraging circular consumption patterns: LiFE focuses on transforming consumer behaviour and promoting responsible and circular consumption practices. It aims to create awareness among citizens about the importance of reducing, reusing, and recycling products, as well as embracing sustainable lifestyles.

c) Facilitating cross-sector collaboration: LiFE recognizes the importance of collaboration among various stakeholders, including government agencies, industry players, academia, and civil society organizations. The mission aims to foster partnerships and knowledge exchange to drive circular innovation and implementation.

d) Driving policy and regulatory reforms: LiFE works towards formulating policies and regulations that support the transition to a circular economy. It aims to create an enabling environment that incentivizes circular practices and ensures compliance with sustainable standards.

3.2 LiFE's Role in Promoting Circular Practices

LiFE plays a crucial role in promoting circular practices across different sectors of the Indian economy. It serves as a catalyst for change by providing strategic direction, facilitating collaboration, and creating platforms for knowledge sharing and capacity building.

LiFE encourages the adoption of circular practices in various ways:

a) Circular design and innovation: LiFE promotes the integration of circular design

principles in product development processes. It encourages businesses to rethink product lifecycles, emphasizing design for durability, repairability, and recyclability. By fostering innovation in materials, processes, and business models, LiFE enables the creation of products that are inherently circular (CII, 2021).

b) Resource efficiency and waste management: LiFE advocates for resource efficiency in industrial processes and waste management systems. It supports the implementation of waste minimization techniques, including waste-to-energy conversion, recycling, and upcycling. By promoting the efficient use of resources and the reduction of waste, LiFE contributes to the circular economy agenda.

c) Circular economy in key sectors: LiFE focuses on specific sectors such as manufacturing, agriculture, waste management, energy, and construction to drive circularity. It works with stakeholders in these sectors to develop sector-specific strategies, promote circular business models, and foster innovation. For example, LiFE collaborates with manufacturers to encourage product take-back and remanufacturing, supports farmers in adopting sustainable agriculture practices, and facilitates the implementation of circular waste management systems.

d) Awareness and capacity building: LiFE places significant emphasis on creating awareness and building capacity among citizens, businesses, and policymakers. It conducts campaigns, workshops, and training programs to promote understanding of the circular economy concept and its implementation. By empowering individuals and organizations with knowledge and skills, LiFE encourages the adoption of circular practices at all levels.

4. LiFE's Impact on Key Sectors of Indian Economy

4.1 Circular Economy in Manufacturing and Industry

The manufacturing and industrial sectors in India play a significant role in the country's economic growth but also contribute to resource depletion and environmental degradation. LiFE's interventions in this sector have the potential to transform the manufacturing landscape by promoting circular practices and resource efficiency.

LiFE's impact on the manufacturing and industry sector includes:

a) *Sustainable product design*: LiFE encourages manufacturers to adopt sustainable design principles that prioritize durability, repairability, and recyclability. By integrating circular design principles, manufacturers can optimize resource use, reduce waste generation, and extend product lifecycles.

b) *Resource optimization and industrial symbiosis:* LiFE promotes resource optimization techniques such as industrial symbiosis, where waste and by-products from one industry become resources for another. By facilitating collaboration and knowledge sharing among industries, LiFE encourages the creation of closed-loop systems and minimizes resource waste.

c) *Remanufacturing and product take-back:* LiFE supports the implementation of remanufacturing processes, where used products are refurbished to extend their lifespan. It also encourages manufacturers to establish take-back systems for end-of-life products, enabling the recovery of valuable materials and reducing waste.

d) *Eco-industrial parks and clusters:* LiFE facilitates the development of eco-industrial parks and clusters, where industries co-locate to share resources, infrastructure, and waste management facilities. This collaboration promotes resource efficiency, reduces transportation costs, and fosters circularity within the industrial ecosystem.

The circular economy practices in manufacturing and industry supported by LiFE contribute to several sustainable development goals (SDGs), including SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). By embracing circularity, the manufacturing sector can reduce its environmental footprint, enhance resource efficiency, and contribute to India's commitments under the Paris Agreement and Nationally Determined Contributions (NDCs)(Paris Agreement, 2015; UNSDG, 2015).

4.2 Circular Practices in Agriculture and Food Systems

Agriculture and food systems in India face challenges such as resource depletion, food waste, and environmental degradation. LiFE's interventions in this sector aim to promote

circular practices, sustainable agriculture, and responsible consumption.

LiFE's impact on agriculture and food systems includes:

a) Sustainable farming practices: LiFE encourages farmers to adopt sustainable farming techniques, such as organic farming, precision agriculture, and agroforestry. These practices minimize chemical inputs, conserve water, and enhance soil health, promoting ecological balance and sustainable food production.

b) Waste reduction and valorisation: LiFE supports initiatives that reduce food waste and promote the valorisation of agricultural by-products. This includes the development of efficient supply chains, cold storage facilities, and food processing units that can maximize the utilization of agricultural resources.

c) Circular models in food processing and packaging: LiFE promotes circular models in food processing and packaging, such as the use of biodegradable and compostable packaging materials. It encourages the adoption of resource-efficient practices, including recycling and reusing packaging materials.

d) Circular economy in livestock farming: LiFE focuses on promoting circularity in livestock farming through initiatives like biogas production from animal waste, the utilization of organic fertilizers, and the recycling of animal by-products for feed or industrial applications.

The circular practices in agriculture and food systems supported by LiFE contribute to several SDGs, including SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). By adopting circular approaches, the agriculture sector can enhance food security, conserve natural resources, reduce greenhouse gas emissions, and achieve India's sustainable development targets (UNEP, 2019).

4.3 Circular Solutions for Waste Management and Recycling

India faces significant challenges in waste management, with growing waste volumes and inadequate infrastructure for collection, segregation, and disposal. LiFE's interventions in waste management and recycling aim to transition from linear waste management practices to circular solutions (fig.3).

LiFE's impact on waste management and recycling includes:

a) Waste segregation and collection: LiFE promotes the implementation of effective waste segregation systems at source and the establishment of efficient waste collection networks. This enables the diversion of recyclable and organic waste from landfills.

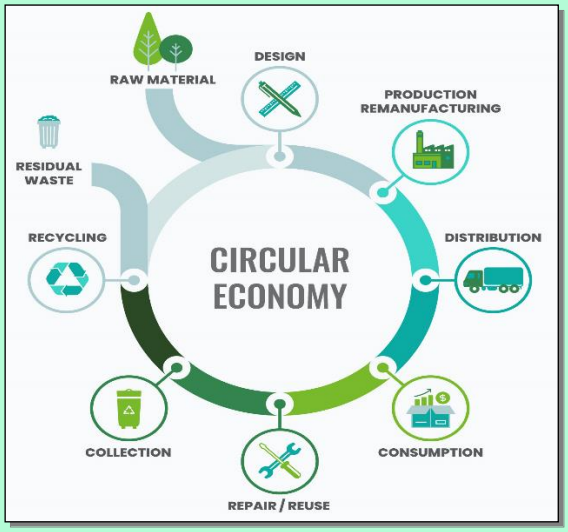

Fig.3. Cicular Economy – A complete Cycle from processing to Residual Waste (PC: freepik.com)

b) Circular business models: **LiFE** supports the development of circular business models in waste management and recycling, such as waste-to-energy plants, composting units, and material recovery facilities. These models enable the recovery of valuable resources from waste streams, promoting resource conservation and reducing environmental pollution.

c) Awareness and capacity building: LiFE conducts awareness campaigns and capacity-building programs to educate citizens about the importance of waste segregation, recycling, and responsible waste management practices. By promoting citizen participation, LiFE fosters a culture of waste reduction and recycling.

d) Extended Producer Responsibility (EPR): LiFE encourages the implementation of EPR programs, where producers are held responsible for managing the end-of-life disposal of their products. This approach promotes the design of products for recyclability and incentivizes producers to take responsibility for their products throughout their lifecycle (fig.4).

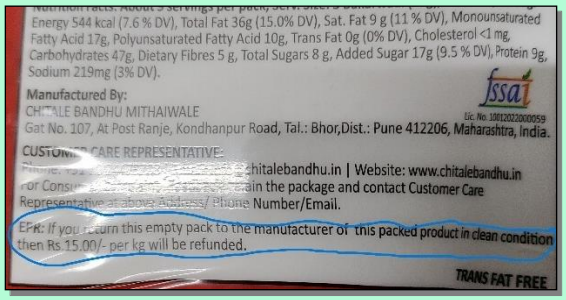

Fig.4. Best Practices: EPR in practice by Manufacturere – A sense of responsibility towards cicircularity. (PC – Kumar Rajnish)

The circular solutions for waste management and recycling supported by LiFE contribute to several SDGs, including SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). By transitioning to circular waste management practices, India can reduce environmental pollution, conserve resources, and achieve its commitments under the Swachh Bharat Mission and SDG targets (Swachh Bharat Mission, MoHUA, 2021).

4.4 Circular Economy in the Energy Sector

The energy sector plays a critical role in India's sustainable development, and a transition to a circular economy approach in this sector can drive resource efficiency, reduce emissions, and enhance energy security. LiFE's interventions in the energy sector aim to promote circular practices, renewable energy, and energy efficiency.

LiFE's impact on the energy sector includes:

a) Renewable energy integration: LiFE supports the integration of renewable energy sources, such as solar and wind, into the energy mix. This reduces reliance on fossil fuels, mitigates greenhouse gas emissions, and promotes sustainable energy generation.

b) Energy efficiency and optimization: LiFE promotes energy efficiency measures across various sectors, including industries, buildings, and transportation. It encourages the adoption of energy-efficient technologies, demand-side management, and energy audits to minimize energy consumption and optimize resource use.

c) Circular models in the energy sector: LiFE facilitates the development of circular models in the energy sector, such as the utilization of organic waste for biogas production, the integration of waste heat recovery systems, and the recycling of batteries and components from renewable energy systems.

d) Decentralized energy systems: LiFE supports the implementation of decentralized energy systems, such as microgrids and community-based renewable energy projects. These systems enable local energy production, improve energy access in remote areas, and promote community participation in the energy transition.

The circular economy approaches in the energy sector supported by LiFE contribute to several SDGs, including SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action). By embracing circularity in the energy sector, India can enhance energy security, reduce carbon emissions, and achieve its commitments under the Paris Agreement and NDCs.

4.5 Circular Strategies in the Construction and Infrastructure Sector

The construction and infrastructure sector in India is resource-intensive and generates significant amounts of waste. LiFE's interventions in this sector aim to promote circular strategies, sustainable construction practices, and efficient resource management (MoEF& CC, National Resource Efficiency Policy, 2021).

LiFE's impact on the construction and infrastructure sector includes:

a) Sustainable construction materials and practices: LiFE encourages the use of sustainable and recycled construction materials, such as fly ash, recycled aggregates, and reclaimed timber. It promotes sustainable construction practices, including energy-efficient building design, water conservation, and waste reduction.

b) Construction waste management: LiFE focuses on improving construction waste management practices, such as on-site segregation, recycling, and reuse of construction and demolition waste. It supports the development of recycling facilities and promotes the use of recycled materials in construction projects (fig.5).

c) *Green infrastructure and urban planning:* LiFE advocates for the incorporation of green infrastructure and sustainable urban planning principles. This includes the integration of green spaces, sustainable drainage systems, and energy-efficient building design in urban development projects.

d) Retrofitting and adaptive reuse: LiFE encourages the retrofitting of existing buildings

and the adaptive reuse of structures to extend their lifespan and reduce resource consumption. It promotes the refurbishment of buildings to meet energy efficiency standards and the conversion of underutilized spaces for alternative uses.

The circular strategies in the construction and infrastructure sector supported by LiFE contribute to several SDGs, including SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production). By adopting circular practices in the construction and infrastructure sector, India can reduce waste generation, conserve resources, and create sustainable and resilient cities.

The circular economy approaches supported by LiFE contribute to India's commitments under various national and international frameworks, including the Sustainable Development Goals (SDGs), LiFE mission objectives, and Nationally Determined Contributions (NDCs) (United Nations Development Programme, 2020). By embracing circularity, India can make significant progress in achieving SDGs related to responsible consumption and production, sustainable cities and communities, and climate action. LiFE's interventions across key sectors of the Indian economy lay the foundation for a more sustainable and prosperous future, where economic growth is decoupled from resource depletion and environmental degradation.

5. Challenges and Opportunities

The transition to a circular economy in India presents both challenges and opportunities. Overcoming these challenges and capitalizing on the opportunities is crucial for the successful implementation of circular practices and the realization of sustainable development goals.

5.1 Policy and Regulatory Barriers

Challenges:

a) Fragmented regulatory landscape: India's policy and regulatory framework related to the circular economy is often fragmented across various sectors and lacks a comprehensive approach. This fragmentation can create inconsistencies, hindering the adoption of circular practices.

b) Limited enforcement and compliance: Even when policies and regulations exist, their effective enforcement and compliance can be challenging. Weak enforcement mechanisms, lack of monitoring systems, and limited awareness among stakeholders contribute to low compliance rates.

c) Incentive misalignment: In some cases, existing policies and incentives may inadvertently encourage linear practices and hinder the adoption of circular approaches. Aligning incentives to promote circularity and providing financial support for circular initiatives are crucial for overcoming this challenge.

Fig.5. Waste Collection without seggregation – a regular business by municipal corporation. (PC-Kumar Rajnish)

Opportunities:

a) Policy coherence and integration: There is an opportunity to enhance policy coherence by developing a comprehensive and integrated circular economy policy framework. This framework should align with existing national policies, such as waste management rules and renewable energy programs, to create a supportive environment for circular practices.

b) Strengthened enforcement and monitoring: Improving enforcement mechanisms and monitoring systems can enhance compliance with circular economy regulations. Strengthening institutional capacity, investing in technology-driven monitoring solutions, and promoting transparency can help address this challenge.

c) Incentivizing circular practices: Policy instruments such as tax incentives, subsidies, and green procurement policies can be designed to promote circular practices. Aligning financial and fiscal policies to reward resource efficiency, recycling, and sustainable production can incentivize businesses to adopt circular approaches.

5.2 Technological Advancements and Innovation

Challenges:

a) Lack of access to advanced technologies: The adoption of circular practices often requires access to advanced technologies, such as recycling and remanufacturing technologies. Limited availability and high costs of these technologies can be barriers to their widespread adoption, especially for small and medium-sized enterprises (SMEs).

b) Technological readiness and capacity: Building technological readiness and capacity to implement circular practices can be a challenge, particularly in sectors where circular solutions are still in the early stages of development. Research and development efforts are needed to advance circular technologies and make them accessible to a wider range of industries.

c) Infrastructure requirements: Implementing circular practices may require investments in infrastructure, such as waste collection and recycling facilities. Identifying appropriate infrastructure needs, securing financing, and ensuring efficient infrastructure planning are challenges that need to be addressed.

Opportunities:

a) Technological advancements: Rapid advancements in technology, including digital solutions, artificial intelligence, and automation, offer opportunities to optimize resource use, improve recycling processes, and enhance circularity. Encouraging research and development, fostering innovation ecosystems, and promoting technology transfer can unlock the potential of these advancements (fig. 6).

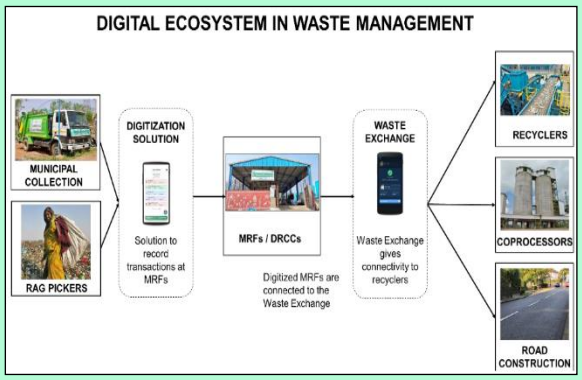

Fig.6. Digital Intervention in Waste management (Source: Ministry of Housing and Urban Affairs, MoHUA, GoI)

b) Collaboration and knowledge sharing: Collaboration between industry, research institutions, and technology providers can accelerate the development and adoption of circular technologies. Creating platforms for knowledge sharing, fostering partnerships, and facilitating technology transfer can harness the potential of technological advancements for circular economy implementation.

c) Support for SMEs: Supporting small and medium-sized enterprises in adopting circular practices is essential. This can be achieved through providing technical assistance, access to financing, and capacity-building programs tailored to the specific needs of SMEs.

5.3 Awareness and Capacity Building

Challenges:

a) Lack of awareness and understanding: Many stakeholders, including businesses, consumers, and policymakers, may have limited awareness and understanding of the circular economy concept and its potential benefits. This lack of awareness can hinder the adoption of circular practices.

b) Limited technical expertise: Building the necessary technical expertise and skills to implement circular practices can be a challenge. Training programs and capacity-building initiatives are required to enhance the understanding of circular economy principles and develop the necessary skills.

Opportunities:

a) Education and awareness campaigns: Raising awareness about the circular economy through education campaigns, workshops, and public outreach programs can foster a broader understanding and acceptance of circular practices. Engaging educational institutions, civil society organizations, and media can play a vital role in disseminating information about the circular economy.

b) Capacity building and skill development: Developing training programs and capacity-building initiatives to enhance the technical expertise and skills required for circular practices is essential. Collaborating with educational institutions, industry associations, and vocational training centers can help build the capacity of professionals and workers in sectors relevant to the circular economy.

5.4 Collaboration and Partnerships

Challenges:

a) Fragmented stakeholder engagement: Collaboration among diverse stakeholders, including government agencies, industry players, civil society organizations, and

academia, can be challenging due to fragmented engagement and limited coordination.

b) Trust and information sharing: Building trust and facilitating the sharing of information, best practices, and experiences among stakeholders can be a challenge. Confidentiality concerns, competitive dynamics, and limited platforms for collaboration can hinder effective partnerships.

Opportunities:

a) Multi-stakeholder platforms*:* Establishing multi-stakeholder platforms at local, regional, and national levels can foster collaboration, knowledge exchange, and coordination among stakeholders. These platforms can facilitate dialogue, joint problem-solving, and the sharing of resources and expertise.

b) Public-private partnerships*:* Engaging the private sector through public-private partnerships can leverage industry expertise, resources, and innovation to drive circular initiatives. Collaborative initiatives, such as industry consortia, joint research and development projects, and technology sharing agreements, can accelerate the transition to a circular economy.

c) International collaborations*:* Engaging in international collaborations and partnerships can provide opportunities for learning from global best practices, accessing technology and financing, and sharing experiences. Platforms such as international forums, conferences, and research collaborations can facilitate such collaborations.

By addressing these challenges and capitalizing on the opportunities, India can foster a conducive environment for circular practices. Effective policies, technological advancements, awareness and capacity-building initiatives, and collaborative partnerships are key enablers for the successful transition to a circular economy and the achievement of sustainable development goals (SDGs), LiFE objectives, and Nationally Determined Contributions (NDCs) (World Economic Forum, 2021**)**.

6. India's Path to Global Leadership in Circular Economy

6.1 Leveraging LiFE for International Collaborations

India has the opportunity to leverage Mission Lifestyle for environment (LiFE) to foster international collaborations and partnerships in the circular economy. By actively engaging with global stakeholders, India can learn from best practices, access technological advancements, and share its own experiences and expertise.

a) Collaboration with international organizations*:* India has network and collaboration with international organizations such as World Economic Forum, and United Nations Environment Programme (UNEP), UNDP, and other similar organisation to access global networks, resources, and expertise. This collaboration can facilitate knowledge exchange, capacity building, and the development of joint initiatives in the circular economy.

b) Participation in international forums and platforms*:* Active participation in international forums, conferences, and platforms dedicated to the circular economy can enable India to showcase its initiatives, learn from global experiences, and build networks with international stakeholders. This engagement can enhance India's visibility and influence in the global circular economy arena.

6.2 Scaling up Circular Initiatives and Investments

To lead in the global circular economy sector, India must scale up its circular initiatives and investments. This involves creating an enabling environment for circular practices and attracting investments in circular projects and businesses (fig.7).

Fig. 7. Five Business Models for Circular Economy by MoHUA, Government of India
Source: Circular Economy in Municipal Solid and Liquid Wastes, Ministry of Housing and Urban Affairs, 2021 Report)

a) Policy and regulatory support*:* The government should provide a supportive policy framework that incentivizes circular practices, removes barriers, and encourages investments. Clear guidelines, fiscal incentives, and streamlined regulations can attract investments in circular projects and businesses.

b) Financing mechanisms: India can develop dedicated financing mechanisms, such as green bonds, venture capital funds, and impact investment funds, to mobilize funding for circular initiatives. These mechanisms can attract domestic and international investments

and support the growth of circular business models.

***c) Circular economy clusters**:* Creating circular economy clusters or industrial parks that provide a conducive environment for circular businesses can foster innovation, collaboration, and knowledge exchange. These clusters can attract investments, promote resource efficiency, and support the development of circular supply chains (Ellen MacArthur Foundation, 2015).

***d) Public-private partnerships**:* Collaborations between the government, industry, and financial institutions can facilitate the scaling up of circular initiatives. Public-private partnerships can drive investments, share risks, and promote innovation in circular projects.

6.3 Showcasing Success Stories and Best Practices

India can showcase its success stories and best practices in the circular economy to position itself as a global leader. Highlighting these examples can inspire and motivate other countries to adopt circular practices and learn from India's experiences.

***a) Knowledge sharing platforms**:* Establishing knowledge sharing platforms, such as online portals, case study databases, and annual circular economy reports, can provide a repository of success stories and best practices. These platforms can facilitate learning, promote replication of successful models, and enhance India's reputation as a circular economy leader.

***b) Recognition and awards**:* Recognizing and awarding organizations, NGOs, Industries, and individuals that have demonstrated excellence in the circular economy can encourage others to follow suit. Awards and recognition programs can showcase innovative circular practices and inspire others to adopt similar approaches.

c) International events and exhibitions: Participating in international events, exhibitions, and trade fairs focused on sustainability and circular economy can provide a platform to showcase India's circular initiatives. These events offer opportunities to network, share experiences, and attract global attention to India's circular economy achievements.

6.4 Role of Government, Industry, and Civil Society

The collective efforts of the government, industry, and civil society are essential for India's leadership in the global circular economy.

***a) Government Role**:* The government should provide policy support, regulatory frameworks, and incentives for circular practices. It can facilitate knowledge exchange, capacity building, and international collaborations. Additionally, the government should prioritize circularity in public procurement, infrastructure development, and waste management systems.

Government of India latest Initiatives: (MoEF&CC)

The recently unveiled Union Budget for 2023-24 has placed significant emphasis on sustainable development and the establishment of a circular economy, highlighting the nation's commitment to curbing its carbon emissions and achieving net-zero status by 2070. In line with this vision, the budget introduces a range of fresh initiatives aimed at fostering a green industrial and economic transformation.

One notable scheme introduced is known as **GOBARdhan**, which has been allocated a substantial budget of Rs 10,000 crore. This innovative program strives to cultivate a circular economy by establishing 500 "waste-to-wealth" plants nationwide. Among these plants, 200 will be dedicated to producing compressed biogas (CBG), while the remaining 300 will be community-based facilities. The primary objective of GOBARdhan is to convert waste into valuable resources, effectively reducing the country's carbon footprint while simultaneously promoting sustainability.

Furthermore, the government has launched the Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI), which endeavours to safeguard and restore mangrove ecosystems along the coastline and salt pan lands. By undertaking this initiative, the government aims to not only preserve these critical habitats but also generate livelihood opportunities for local communities, fostering a harmonious relationship between environmental conservation and sustainable income generation.

To promote the importance of wetland conservation, the government has introduced the **Amrit Dharohar scheme**. This comprehensive program, scheduled to be implemented over the next three years, seeks to raise public awareness about the unique conservation values of wetlands and encourage their optimal utilization.

Additionally, the budget highlights the promotion of **coastal shipping as an energy-efficient mode of transportation** for both passengers and freight. By leveraging public-private partnerships and viability gap funding, the government aims to bolster coastal shipping and capitalize on its inherent environmental friendliness and cost-effectiveness. This endeavour aligns seamlessly with the government's overarching goal of fostering sustainable development.

b) Industry role: Industries have a crucial role in driving circular practices through innovation, adoption of sustainable business models, and investments in circular projects. They can establish circular supply chains, adopt resource-efficient practices, and develop sustainable products. Industry associations can play a key role in advocating for circularity, facilitating collaborations, and sharing best practices.

c) Civil Society Role: Civil society organizations, consumer groups, and non-governmental organizations can raise awareness about the circular economy, advocate for policy changes, and promote responsible consumption and production. They can engage in citizen-driven initiatives, promote behavioural change, and contribute to the development of circular communities.

By harnessing the collective efforts of the government, industry, and civil society, India can take a leadership role in the global circular economy sector. By implementing robust policies, attracting investments, showcasing success stories, and promoting collaborations, India can accelerate the transition to a sustainable and circular future, while achieving the Sustainable Development Goals (SDGs), fulfilling its Nationally Determined Contributions (NDCs), and inspiring global action.

7. Conclusion

7.1 Summary of Key Findings

The circular economy presents a transformative pathway for India to achieve sustainable development, address environmental challenges, and foster economic growth. Through the Mission Lifestyle for environment (LiFE) initiative, India has the opportunity to lead in the global circular economy sector. The key findings of this article are as follows:

- The circular economy is an innovative economic model that aims to redefine resource use, minimize waste, and maximize value creation.
- LiFE's objectives encompass promoting resource efficiency, circular consumption patterns, cross-sector collaboration, and policy and regulatory reforms.
- LiFE's impact on key sectors of the Indian economy, such as manufacturing, agriculture, waste management, energy, and construction, is significant. Circular practices in these sectors contribute to sustainable development goals, LiFE objectives, and Nationally Determined Contributions (NDCs).
- Challenges exist in policy and regulatory barriers, technological advancements and innovation, awareness and capacity building, and collaboration and partnerships. However, these challenges can be addressed through policy coherence, technological advancements, education and awareness campaigns, and multi-stakeholder collaborations.
- India can leverage LiFE for international collaborations, scale up circular initiatives and investments, showcase success stories and best practices, and foster the active involvement of the government, industry, and civil society to lead in the global circular economy.

7.2 Future Prospects and Recommendations for India's Circular Economy Journey

The future prospects for India's circular economy journey are promising, but concerted efforts are required to ensure success. The following recommendations are provided for India to continue its path to global leadership in the circular economy:

a) Strengthen policy and regulatory frameworks: India should develop a comprehensive policy framework for the circular economy, ensuring policy coherence, streamlined regulations, and effective enforcement. Incentives should be aligned to promote circular practices, and financial mechanisms should be developed to attract investments.

b) Foster technological advancements and innovation: India should invest in research and development to advance circular technologies, improve resource efficiency, and support the development of scalable and cost-effective solutions. Collaboration with research institutions, industry, and international partners can accelerate technological advancements.

c) Enhance awareness and capacity building: Education and awareness campaigns should be intensified to enhance understanding and acceptance of the circular economy. Capacity-building initiatives should focus on developing technical expertise and skills required for circular practices, with a special emphasis on training programs for small and medium-sized enterprises (SMEs).

d) Promote collaboration and partnerships: Collaboration among the government, industry, civil society, and international stakeholders is crucial. Public-private partnerships can drive investments, share risks, and promote innovation. Multi-stakeholder platforms and international collaborations can facilitate knowledge exchange, capacity building, and the adoption of global best practices.

e) Monitor progress and evaluate impact: It is essential to establish monitoring mechanisms to track progress in the adoption of circular practices and evaluate their environmental, social, and economic impact. Regular assessment and reporting will enable informed decision-making and identify areas for improvement.

In conclusion, India has a unique opportunity to lead in the global circular economy sector through the LiFE initiative. By leveraging international collaborations, scaling up circular initiatives, showcasing success stories, and fostering collaboration among stakeholders, India can achieve its sustainable development goals, fulfil its NDCs, and inspire global action towards a more sustainable and prosperous future.

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Millet mission for sustainable food security and Lifestyle for Environment (LiFE) movement towards Circular Economy

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Abstract

The 'super-orphan-crop' millets are highly productive, environmentally sustainable, low-cost, highly nutritious food that can fulfils the food security of global rising population and reduce poverty especially in developing countries. These are the C4 group plants having high photosynthetic efficiency and carbon fixation capacity. The indigenous, invariably and less attended millets crops should encourage in farming systems for healthy nutritious feed to the human society. Every parts of the millet crops are utilized as value added products without waste generation which have immense role to the world circular economy.

Key words: Lifestyle for Environment, Millet mission, Food security and Circular economy

1. Introduction

Now the world is facing disastrous effects such as climate change, rising of sea level, floods, heat waves, wildfires, cyclones etc. Climate change and increasing human population has also causing immense distress globally (Fróna et al., 2019). So, the global food security is alarming due to these abnormal climatic effects. These disastrous effects make it even more imperative to shift toward a climate-resilient agriculture system (Bisoffi et al., 2021; Rasul, 2021). The extensive introduction of indigenous 'orphan crops'in climatic stress condition can provide the food security with nutritious food sources (Ye and Fan, 2021).The sustainable crop substitutes millet cultivationare the demand of the recent time to meet the global food security and to improve income of Marginal farmers(Fig.1).

Fig.1. Benefits of Millet crop

The millets are a group of small-seeded sustainable crops that can grow in arid lands with minimal inputs and are resilient to different climatic condition. They are drought resistant crops and can grow well in hot temperatures, requiring less water and do not require the use of pesticides or herbicides like the conventional rice and wheat. Millet grains are one of the oldest consumed foods known to ancient human civilization of Asia and Africa for centuries. Millets are the age old high-yielding cereal crops with high nutritional content and ecological responsibility to be used as staple food and animal fodder. The tiny gluten-free millet is with high vitamins and minerals content compared to rice and wheat. Millets have the huge potential to provide security of food, nutrition, fodder, fiber, health, livelihood development and ecological sustainability. Millets are highly nutritious with good quality protein, minerals, dietary fiber, niacin, thiamine and riboflavin, methionine, lecithin, and vitamin-E. Due to high nutritional value, millets may help prevent many diseases, like cancer, reduce the risk of cardiovascular disease, tumor suppressor, lower blood pressure, lower fat accumulation, delay appetite, and many more.

The Lifestyle for Environment (LiFE) is a sustainable environmental Globalmovement introduced by Prime Minister at COP-26 submit in Glasgow in November 2021, there

after the LiFE mission became a visionary movement in India. This movement envisions the circular economy by making mindful choices everyday life activities and promotes a sustainable way of living which has less impact on the environment, and promote a balance between the needs of the present generation with that of the future.

As part of the LiFE mission, Environmental Information, Awareness, Capacity Building and Livelihood Programme (EIACP), Govt of India, the RPs and Hubs with the Ministry of Environment, Forest and Climate Change (MoEFCC) are organizing mass scale awareness programmes on circular economic and nutritional benefits of millets. The Millet mission introduced by Govt. of India Mission LiFE programme through different Govt. sponsored schemes (Fig.2).

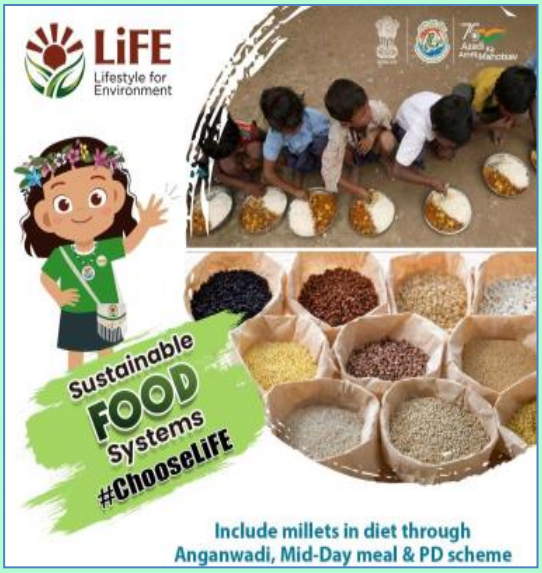

Fig.2. Millet introduced in Mission LiFE, Govt. of India through Midday meal, Anganwadi & PDS programme
(Source: https://missionlife-moefcc.nic.in/)

2. Different types of millet

Different varieties of millets classified into two groups based on grain size, major or minor are commonly consumed across the world (Chandi & Anoor, 2016). The major millets include sorghum, pearl, and finger millet, while minor millets include foxtail, proso, kodo, barnyard, and little millet (Bora et al., 2019) (Fig.3). Millets have significantly high content of calcium (finger millet), phosphorous, zinc, magnesium (barnyard millet), iron (pearl millet), dietary fiber, niacin, and folic acid than staple crops, namely wheat and rice (Bell, 2012).

Fig.3. Different types of millet

3. Sustainable Agriculture by Millets cultivation

Adoption of millet crop offers a multitude of benefits, not only for farmers but also for the overall ecosystem because of their minimal water requirements, resistance to pests, and adaptability to challenging environments. Millets do not get destroyed easily like other crops and can stored long period. The value-added products from millet have the potential to add value to business and has a large potential for growth as consumers believe that millets and millet-based foods contribute directly to their health.Value-adding millet grains foods provides farmers with a good opportunity to increase income generation, promotes production, and fosters marketing, all of which lead to the creation of jobs, income, and nutritional security (Fig.4).

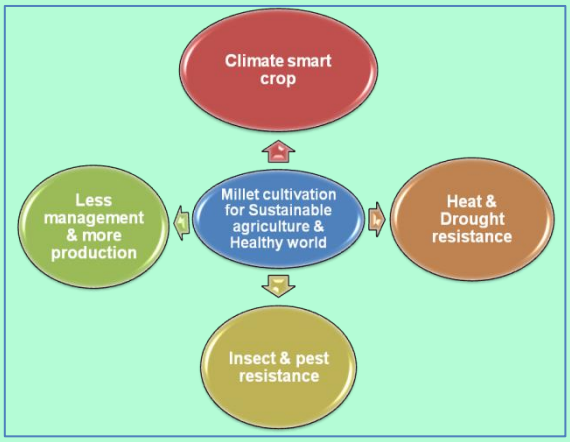

Fig.4. Millet in Sustainable agriculture

3.1 Food Security

As this year 2023 is declare as the International Year of the Millet by the United Nations, this '**superfood**' Millet can be brought to the fore as an important food grain for the dietary habits of humans. Millet cultivation can tackle food security worldwide in varied environmental conditions as they are nutritionally and productively superior to current staple food rice and wheat. The millets can use as sustainable food source to eradicate world hunger and climate change problems.

3.2 Nutritional security

Millets are gluten-free, low glycemic index, and have high antioxidant properties and are good source of essential nutrients such as carbohydrates, protein, fiber, soluble and insoluble fats, vitamins (riboflavin, niacin, thiamin, Vitamine-B complexes etc), minerals (calcium, zinc, iron, magnesium, copper, manganese, iodine etc), beneficial amino acids, Phenolic compounds and a number of bioactive compounds. The potential health benefits of millet include protecting cardiovascular health, preventing the onset of diabetes, helping people achieve and maintain a healthy weight, managing inflammation in the gut and provide adequate diet supplements.

3.3 Safety from diseases

Millets help to protect the cells against damage and potential diseases like high blood pressure, diabetes, high cholesterol, reduce inflammation and protect against chronic diseases including heart disease and cancer. It is an excellent source of nonnutritive components, like essential minerals, calcium, iron, zinc, vitamins-B complexes which have the properties of antioxidant, antidiabetic, anticancer, anticardiovascular, antimicrobial, anti inflammatory, antiulcer, and wound-healing. It can use as good food supplements for diabetics patients.

3.4 Economic security

Apart from the direct benefits to nutrition and food security, millets are an important crop for small-scale farmers as they require minimal investment and have a low input cost as well as their low water requirement and less harvesting period. Farmers earn sustainable income by low investment through this climate stable millet cultivation.

4. Millets in Circular economy

The circular economy refers to an economic model whose objective is to produce goods and services in a sustainable way, by limiting the consumption and waste of resources based through three principles, 'eliminate waste and pollution, circulate products and materials and regenerate nature'. The steps of circular economy are, Sustainable procurement, Ecodesign, Industrial and territorial ecology, Economics of functionality, Responsible consumption, Extending the duration of use and Recycling.

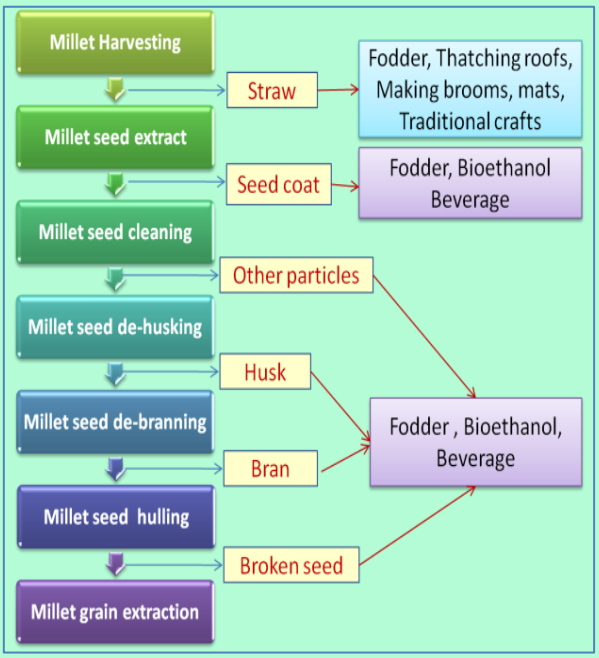

Fig.4. Millet grain & byproducts used in circular economy

In circular economy products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting system where materials never become waste and nature is regenerated. The circular economy tackles climate change and other global challenges, like biodiversity loss, waste generation and pollution, by decoupling economic activity from the consumption of finite resources. Through environmentally sustainable resource management we can reduce the depletion of natural resources, decrease waste generation, and ultimately mitigate the environmental

impacts associated with traditional practices. As a whole this system is beneficial for people, economy and environment.

The millet cultivation has the potential role in circular economy as their whole product is economically used without waste generation (fig. 4).

4.1 Millet grain as food products

Millet is a versatile grain and is consumed as a staple food in many regions of world. Millet based delicious food products are Roti, upma, khichdi, porridge, ugali, popped millet , malt food, dosa, dumpling, laddu, Pizza, Burger, snack/roasted mix grains, fermented food products etc. can be prepared and these are good nutrition value and health benefits. Millet flour is used for making bread, flatbreads, pancakes, and other baked foods.

4.2 Millet as beverages

Broken millet grains used as a viable feedstock for alcohol industry followed by pearl millet grain (lower grade grain quality) and sorghum. Certain types of millet, such as finger millet and pearl millet, are used in the fermentation process to produce alcoholic beverages. Some traditional fermented beverages are prepared from millets in tribal communities of Africa and India.

4.3 Utilization of Millet husk and straw

The husk and straw of Millet are used as a fodder for livestock and poultry. It provides a good source of nutrition and energy for animals and is often used in different animal feed formulations.

Bioethanol is produced from different millet plant biomass having high level of sugar, which is used as blending with petrol and diesel. The millet straw used for thatching roofs, making brooms, weaving mats, creating decorative items and traditional crafts. Some millet plants also used as cover crop and protect soil erosion in hilly areas due to their extensive root system

5. Conclusion

Encouraging the farmers to adopt millet cultivation through subsidies and better market access and promoting millet based value-added products to increase demand and profitability. Enhancing the research and giving the efforts for improvement of quality seed production. To encouraging partnerships between farmers, processors, and retailers to create sustainable millet value chain and share best practices and knowledge in millet production and marketing. Organizing awareness programme and encouraging common people on the importance and circular economy of millet for food security, income generation and livelihood development.

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FORTHCOMING EVENTS

Event	Date	Place & Correspondence
International Conference on Environment, Agriculture and Biotechnology (ICEABT)	14th December, 2023	Delhi,Uttar Pradesh India http://academicsconference.com/Conference/34963/ICEABT/
International Conference on Renewable, Environment and Agriculture (ICREA)	26th December, 2023	Puri,Odisha India http://sarc.net.in/Conference/21387/ICREA/
International Conference on Food Technology, Agriculture and Fisheries (ICFTAF)	4th January, 2024	London, United Kingdom http://scienceplus.us/Conference/28395/ICFTAF/
National Conference on Advances in Science, Agriculture, Environmental & Biotechnology (NCASAEB)	7th January, 2024	Kolkata,West Bengal India http://nationalconferences.org/Conference/15255/NCASAEB/
International Conference on Environmental Science and Green Technology (ICESGT)	10th February, 2024	Sydney, Australia http://technoconferences.com/Conference/12097/ICESGT/

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