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Role of triangular cooperation (government-scientific & research organization-private sector) in advancing 3R and circular economy in Asia-Pacific

(Background Paper for Webinar IV)

Final Draft

This background paper has been prepared Prof. Sadhan Kumar Ghosh, for the 10th Regional 3R and Circular Economy Forum in Asia and the Pacific. The views expressed herein are those of the author only and do not necessarily reflect the views of the United Nations.

High Level 10th Regional 3R & Circular Economy Forum in Asia and the Pacific

Advancing Circular Economy in Asia Pacific towards the SDGs under COVID Pandemic

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Role of Triangular cooperation (Government-Scientific & Research Organizations-Industries) in advancing 3R and Circular Economy in Asia – Pacific

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Forewords

The study paints an impressive picture of the triangular cooperation among the government, industries and academic & research organization towards promoting 3R and circular economy concepts and principles. With the growing income inequality for decades, concerns about technology-driven displacement of jobs, and rising societal discord globally, the combined health and economic shocks of 2020 pandemic situation due to outbreak of COVID, have put economies into free fall, disrupted labour markets and fully revealed the inadequacies of our social contracts. World is witnessing millions of individuals have lost their livelihoods and millions more are at risk from the global recession, structural change to the economy and further automation. Additionally, the pandemic and the subsequent recession have impacted most of those communities which were already at a disadvantage in tandem with the disrupted industrial scenarios. Automation, in tandem with the COVID-19 recession, is creating a 'double-disruption' scenario for workers worldwide.

However, the efforts to support those affected by the current crisis lag behind the speed of disruption. It is now urgent to enact a Global Reset towards a socio-economic system that is more fair, sustainable and equitable, one where social mobility is reinvigorated, social cohesion restored, and economic prosperity is compatible with a healthy planet. If this opportunity is missed, we will face lost generations of adults and youth who will be raised into growing inequality, discord and lost potential. We need a new circular economy model to build truly sustainable businesses – a fact that is recognized by the business leaders gathering at the World Economic Forum in Davos. The policy decisions and actions we make today will determine the course of entire generations' lives and livelihoods. Despite the current economic downturn, a large majority of employers recognize the value of human capital investment while it is observed that job creation is slowing but job destruction accelerates. (The Future of Jobs Report, Oct 2020, World Economic Forum).

The future of work has already arrived at a new-normal environment for a large majority of the online white-collar workforce. Companies need to invest in better metrics of human and social capital through adoption of environmental, social, economic and governance (ESEG) metrics and matched with renewed measures of human capital accounting. Different actors may have different reasons for paying close attention to TrC_3rCE. It is the author's view that TrC_3rCE is important as a gateway to a new form of national and international cooperation to achieve resource circulation and sustainable development goals.

Sustainable progress and the future employment will need controlled resource consumption and effective utilization of materials throughout the supply chain. A robust policy instrument by the government supported by the academic & research institutions to strengthen the ideas with latest theoretical and technological intervention will help industries implementing the policy instrument effectively for the benefit of country and the society at large. In these initiatives, the think tank, the universities and R&D institutes as well as the industries should be given financial and resource support by the government to make a robust triangular cooperation. The triangular cooperation of these three actors - the government, academic & research organizations and industries play a vital role in promoting the concepts of 3R and circular economy to achieve SDG 2030 agenda. ***The study in this report proposes the Triangular Cooperation model which will help promoting 3Rs (Reduce, Reuse and Recycle) and the circular economy, abbreviated as TrC-3rCE, in countries all over the world.***

Abbreviations and Acronyms

COVID	'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for disease, [coronavirus disease]
epcd^2	extract-produce-consume-dispose-deplete
EPR	Extended Producer Responsibility
GDP	Gross Domestic Products
GPI	Global Partnership Initiative.
ISWA	International Society of Waste Association
ISWMAW	International Society of Waste Management, Air and Water
JARCOM	JICA-ASEAN Regional Cooperation Meeting
J-SEAM	Japan-Southeast Asian Meeting for South-South Cooperation
NGO	Non-Governmental Organization
NGO	Non-Government Organization
OECD	The Organization for Economic Co-operation and Development
PET	Poly Ethylene Terephthalate
SBM	Swachh Bharat Mission
SDG	Sustainable Development Goals
SS	Swachh Survekshan
SWM	Solid Waste Management
TrC-3rCE	Triangular Cooperation for promoting 3R & Circular Economy
ULB	Urban Local Bodies
UNDP	United Nations Development Program
UNOSSC	UN Office for South-South Cooperation

Executive Summary

Over the last few decades, the Asia–Pacific region has experienced the most dynamic economic development of any of the world's regions, leading to a rapid increase in resource use and associated emissions. The region is now a major driver towards overshooting global resource use limits. Although it experienced setbacks after the pandemic COVID-19 with the global economic and pandemic crisis, the region is regaining momentum slowly at present. The region's growing young population is also expected to provide a demographic dividend in the coming decade. To control the materials consumption rates, triangular cooperation will be helpful in promoting 3Rs (Reduce, Reuse and Recycle) and the circular economy, abbreviated as TrC-3rCE, a way forward towards resource efficiency. TrC-3rCE needs bonding among three actors – the support of government to academic and research organizations; while academic and research organizations will develop and innovate new ideas, technologies and processes for implementation by industries in cooperation with them for the benefits of the country and the society as a whole. This report is prepared based on the data and information available in the literatures. The study explores the existing cooperation models, namely South-South cooperation, Triangular Cooperation and other initiatives.

The study proposes the Triangular Cooperation which will help promoting 3Rs (Reduce, Reuse and Recycle) and the circular economy, abbreviated as TrC-3rCE, in countries all over the world. The actors in the TrC-3rCE may include cooperation among the Governments, academic & research organizations and industries within the country for their individual and/or mutual benefit and beyond the boundaries whereby partnerships between two or more developing countries, supported by a developed country (ies) or multilateral organization(s), to implement development cooperation programmes and projects promoting 3R and circular economy. The report has been divided into five parts as follows.

Chapter 1 deals with the Introduction includes the context of background, opportunities and challenges in promoting triangular cooperation for promotion of 3R (Reduce, Reuse and Recycle) and circular Economy. Chapter 2 deals with Approach and mechanisms of triangular cooperation activities. This chapter describes existing cooperation mechanisms and the proposed TrC-3rCE. The chapter proposes a TrC-3rCE model that may help in initiate and strengthen TrC-3rCE.

Chapter 3 and 4 present the Policies and actions to promote triangular cooperation activities through a few Case studies in Asia-Pacific countries (Australia and New Zealand, People's Republic of China, India, Japan, Republic of Korea, Malaysia, Mauritius and Vietnam) and in a few countries beyond Asia Pacific (Brazil, Israel, Italy and South Africa) and role of various actors in cooperation. The status and results of Cooperation and collaboration through international Research Projects also has been presented in chapter 4. Chapter 5 present the way forward & the learning from the case studies presented and Policy framework and Recommendation of a future vision and policy framework for promoting 3R and circular economy through triangular cooperation. The chapter raised five relevant questions those may be put forward for feedback.

The report acknowledges the contributions of the literature in the reference section. Finally, it may be added that the views and opinions expressed in the reports are based on the available literatures and do not necessarily represent the official views or positions of the organization the authors work for or is affiliated with.

Chapter 1

Context of background, opportunities and challenges in promoting triangular cooperation

Domestic material consumption is one of the dashboard indicators included in the Resource Efficiency Scoreboard. It is defined as the annual quantity of raw materials extracted from the domestic territory of the focal economy, plus all physical imports minus all physical exports. Over 2007-2016 domestic material consumption fell by 58.3% in Spain, 40.8% in Ireland and 45.1% in Slovenia. This was mainly driven by a fall in the physical extraction of non-metallic minerals in those countries, largely due to the crisis in the construction industry. In the same period, GDP fell by 0.4% in Spain while increased by 39.7% in Ireland and 1.4% in Slovenia.(http://ec.europa.eu/eurostat/documents/24987/6390465/Irish_GDP_communication .pdf). Trends for Irish GDP reflect the upwards revision for 2015, primarily due to the relocation to Ireland of a number of big companies.

The 3R (Reduce, Reuse and Recycle) and circular economy is a way of rethinking our approach to waste and to reduce materials consumption which has a close relationship with research and development and relationship with other stakeholders. Humans are the only creatures on the planet who create waste. The traditional models for manufacturing processes primarily involve extracting raw material, creating new products, and disposing them after use [extract-produce-consume-dispose-deplete ($epcd^2$) (Ghosh, S. K. 2020), which is not a sustainable model. The circular economy is a way of revisiting our approach to every single stage of a product's life cycle and the whole supply chain of the processes. By designing processes and products for long life for use, subsequent reuse and recycling, by shifting towards sharing models, rather than ownership, and by managing waste responsibly, we can make our worlds more circular, more sustainable and resource efficient. In true sense, a fully circular economy society means a world without waste. The task ahead is a complicated one, and it involves everyone and their collaboration and cooperation: the governments, international organizations, academia and research institution, industry, financial institutions, start-ups, NGOs, and the public at large. We need to change our thinking in the society. To achieve inclusive and sustainable industrial development, the strength of circular economy and 3R concepts and principles act as the union between the environment and the economy which can benefit industry as well as mitigate climate change. The Asia-Pacific region, hosting two-thirds of the world's growing population, is the powerhouse of global economic growth and industrialization**.** In advancing 3R and Circular Economy the cooperation among the Government, Scientific & Research Organizations, Industries, NGOs and ultimately the general citizens have significant roles to play. The triangular cooperation in advancing 3R and Circular Economy in this report will be abbreviated as TrC-3rCE. Cooperative activities are helpful and may results in significant performance of the involved actors and sometimes beyond the boundaries.

The resource-dependence theory is one of the dominant theoretical rationales explaining how the external resources of organization have an impact on the organizational behaviour. It is underpinned by the idea that resources are key factor for the operation and innovation. However, the resources inside the organization are basically insufficient in itself, and it chooses to procure external resources to maintain the organization against constantly changing environment through cooperation (Pfeffer, J., et al, 2003). R&D activities related to products and processes are sometimes carried out only within the walls of the company, in a traditional point of view. These are considered as barriers for the collaborative efforts.

Environmentally, circular models have the potential to achieve sustainable consumption of resources, significantly reduce the extraction of materials and emissions from landfills, and efficiently manage waste and wastewater, arrest use of fossil fuels encouraging green energy utilization and low carbon processes. With over 50 per cent of global greenhouse gas emissions currently related to material management, the TrC-3rCE may potentially close approximately half of the emissions gap between current policies and the 1.5°C target of the Paris Agreement.

TrC-3rCE takes place when countries, international organizations, civil society, private sector, private philanthropy and others work together in groups of three or more, to co-create flexible, cost-effective and innovative solutions for reaching any goal. TrC-3rCE helps in developing policies and strategies leading to implementation of the concepts and principles of the 3R and Circular economy in innovative and collaborative ways. It helps to provide solutions to overcome today's most pressing environmental, economic and social challenges, ensuring sustainable development in partners within the countries and beyond the boundaries. The partners work together for success of a particular goal. Triangular cooperation also offers opportunities to develop a common understanding of development of policy instruments and to discuss standards, criteria and values (OECD, Development Co-operation Directorate Triangular Co-Operation: Why Does It Matter?). The TrC-3rCE is required within a country, within a region and of course, globally. To address the unsustainable pattern of industrial development in many developing countries based on a "pollute first and clean up later" approach in Asia and the Pacific, the emerging Industrialization 4.0 needs to adopt more resource-efficient and non-linear approaches. Proactivity, instead of reactivity, is needed to steer development onto an inclusive, environmentally sustainable pathway for the future.

The living conditions has been brought to the fore by COVID-19, which has devastated the lives of millions in cities. Access to clean water and sanitation, along with social distancing, are key responses to the pandemic. Yet in slums it has proved difficult to implement these measures. This means an increased risk of infection, not only within slums, but in whole cities. TrC-3rCE will be helpful to improving the living conditions under this situation due to pandemic outbreak of COVID 19. TrC-3rCE has been proved in many countries as a very important aspect in the initiatives of innovation, clean water and sanitation for the society. For a successful TrC-3rCE, the collaboration of pivotal partners, facilitating partners and beneficiary partner is very important (Figure 1). There is an urgent need to drive towards circularity together. Attention by the Countries needed to the ways in which the successful countries are implementing. There are examples of TrC-3rCE where the actors benefitted with significant results. Some of successful cases have been cited in this report from several countries.

Figure 1.
A generic scheme of Cooperation

The government should give financial support to the academic and research organizations to develop new ideas and sustainable innovative technology that will help industries to develop suitable business and national & international markets. It is important to strengthen mechanisms of cooperation within the country and expand it for international collaboration. As knowledge flow does not respect borders and high-tech competition for resource efficiency has become global, efficiency in knowledge production & use will often involve global solutions, where TrC-3rCE will play a supportive and catalytic role.

Chapter 2

Approach and mechanisms of triangular cooperation activities

2.1 Introduction

In recent years, the international community became cognizant that international cooperation, namely, North-South cooperation, South-South cooperation, and Triangular cooperation, are imperative to promote inclusive and sustainable development, especially in view of achieving internationally agreed development agenda.

The most popular well known triangular cooperation is South-South cooperation, a broad framework of collaboration among countries of the South in the political, economic, social, cultural, environmental and technical domains, involving two or more developing countries, it can take place on a bilateral, regional, intraregional or interregional basis. In South-South cooperation (SSC), the triangular cooperation (TrC) is collaboration in which traditional donor countries and multilateral organizations facilitate South-South initiatives through the provision of funding, training, management and technological systems as well as other forms of support as referred by the United Nations Office for South-South cooperation (UNOSSC) (H. Kato and S. Honda, 2013). South-South collaboration, was initiated according to the Buenos Aires Plan of Action (BAPA) for Promoting and Implementing Technical Cooperation among Developing Countries endorsed by the General Assembly in 1978 (resolution 33/134).

TrC and SSC are often discussed together, as both of them encourage cooperation among developing countries. These two types of cooperation are continuing to evolve, however, so that the distinction between the two is blurring. The only difference is that TrC involves a Northern partner, while SSC does not. For example, there are a number of SSC projects already in place that have a "triangular" structure involving three or more actors, and some TrC projects in which countries in the South are helping one another without much direct involvement from the North. In broader perspective, the traditional dichotomy of the "North" and the "South" will become increasingly pointless in the coming decades. More recently, South-South and triangular cooperation became a key factor in the implementation of the new Sustainable Development Agenda 2030.

3R and Circular economy are thought to be one the very important principles to achieve resource efficiency for sustainable development and the solution that can have economic, social, and environmental co-benefits through reduced demand for natural resources, reduced emissions, job creation and fostering innovation. Over US$1 trillion a year could be generated by materials cost savings by 2025 for the global economy and 100,000 new jobs created within the next five years if companies focused on encouraging the build-up of "circular" supply chains to increase the rate of recycling, reuse and remanufacture. This would maximize the value of materials when products approach the end of their use as per the report by World Economic Forum, in collaboration with the Ellen MacArthur Foundation at the Annual Meeting 2014 in Davos, Switzerland. However, it is regretful that this promising estimate will now change due to pandemic COVID, this year.

In major consumer goods sectors, the magnitude of the material resource savings generated from a circular economy could result in up to US$ 706 billion annually. Considering that the Asia-Pacific region accounts for more than 60% of the global share of key fast-moving consumer goods sectors, the scale of potential benefits would positively impact the region's economic development.

It has been experienced that policy framework at international, regional, national, and local levels can only encourage the stakeholder in implementing the concepts of 3R and circular economy in any country. The policy and strategies are the first step to implement 3R and Circular Economy

and they act as instrumental to initiate the process. Policies existing in a country need to be supported by the stakeholders through innovation, technology, research & academic activities associated with an effective planning. Industry and business houses utilize the outcomes of these activities and implement the concepts and principles for sustainable development and resource conservation developing a sustainable supply chain and business models. These need a cooperative approach within all the stakeholders and hence a triangular cooperation among the main stakeholder help in effective implementation of the 3R and circular economy principles.

In its Strategic Plan 2014-2017, UNDP proposes to make SSC and TrC a core way of working and to fully utilize its programmatic reach and resources at the global, regional and country levels to support SSC and TrC. UNDP aspires to provide a global operational arm for supporting SSC and TrC that is also accessible to the UN Development System. UNDP and UNEP have strong role to play as knowledge broker, capacity development supporter and partnership facilitator in TrC-3rCE.

2.2 Influence of resources in academic & research organizations in Industry cooperation

Since the 1980s, when the globalization began in earnest, developed countries such as the US and Europe have begun to pay attention to creating new growth engines based on science and technology in order to overcome the deterioration of national competitiveness in the world market (Gyeong, M. N., et al, 2019). This turned out to be a change in the national policy. In order to enhance the national competitiveness by utilizing limited resources efficiently, they have promoted science and technology-oriented policy. Accordingly, investment of governments in liberal arts and fundamental sciences has been reduced and support for applied sciences has been increased with an expectation that those studies will enhance national competitive power in actual market by utilizing resources in the universities and research organisations. Since then, the concept of competition has been introduced into university support policies, and universities and professors have begun to work for external grants like the private sector. This has led to the paradigm shift to academic capitalism. In several countries, namely, Israel, Japan, India, People's Republic of China (PR CHINA), many European countries, Republic of Korea, the UK, USA and a few other countries at present the cooperation between university and industry is mainly promoted by government.

The Triple Helix's statist model provides the idea that the hybridization of innovative elements from university, industry and government create innovation in production, transfer and application of knowledge. There are studies how the universities capacity and government's policy effect on the achievement of university–industry cooperation (Etzkowitz, H., et al, 2000 & 2003). Triple Helix's statist model aims to understand the organic relationship between industry, academia and government and to present policy implications. The model provides the idea that the hybridization of innovative elements from university, industry and government create innovation in production, transfer and application of knowledge.

It is defined by the system theory as a set of three elements: (i) components that the institutional spheres of university, industry, and government, with a wide array of actors; (ii) relationships between components (cooperation and conflict moderation, collaborative leadership, substitution and networking); and (iii) functions, described as processes taking place in what we label the 'Knowledge, Innovation and Consensus Spaces'. This hybrid leads to an innovation of organization with a variety of systematic forms. In many countries the government R&D budget has been increasingly allocated to specific policy programs focusing interdisciplinary cooperative R&D activities between universities and private firms. The government policies to promote university-industry R&D cooperation have been strengthened.

2.3 Definition and Principles of Triangular Cooperation

Triangular cooperation refers to development partners, countries, and international organizations providing financial or technical support to facilitate development activities between two developing countries as per World Health Organization (WHO). The definitions for South-South and triangular cooperation are based on the Nairobi outcome document of the High-level United Nations Conference on South-South Cooperation 64/222, negotiated in the UN High-Level Conference on South-South Cooperation and adopted by the UN General Assembly in December 2009.

Building resilience is a multidimensional challenge and a cross-cutting issue that will impact progress towards the SDGs and the achievement of the 2030 Agenda for Sustainable Development. The national government as well as the City governments in the country are responsible to set the regulatory framework for creating the enabling conditions for cities fit for the resource efficient and resilient society by encouraging, engaging, incentivizing and implementing (e^2i^2). 3Rs and Circular economy principles in to the national and urban policy levers can bring changes to the utilization and management of materials in cities; Changes to material choices, uses and management, can also open up local production opportunities.

The UN's working definition for triangular cooperation (TrC) is given by, "Southern-driven partnerships between two or more developing countries, supported by a developed country (ies) or multilateral organization(s), to implement development cooperation programmes and projects". The Framework of operational guidelines on United Nations support to South-South and triangular cooperation defines South-South cooperation (SSC) to be "a process whereby two or more developing countries pursue their individual and/or shared national capacity development objectives through exchanges of knowledge, skills, resources and technical know-how, and through regional and interregional collective actions, including partnerships involving Governments, regional organizations, civil society, academia and the private sector, for their individual and/or mutual benefit within and across regions. South-South cooperation is not a substitute for, but rather a complement to, North-South cooperation".

Through triangular cooperation, Southern development assistance providers can benefit from the financial and technical support, experience and technical know-how of multilateral and developed-country partners. The increased capacity to tackle development challenges, strengthened partnerships and enhanced regional integration benefits everyone. The triangular cooperation (TrC) which is now in operation in several regions and countries is not focused very much on promoting 3R and circular economy but as a whole for sustainable development by many ways of intervention.

> ***The study proposes the Triangular Cooperation which will help promoting 3Rs (Reduce, Reuse and Recycle) and the circular economy, abbreviated as TrC-3rCE, in countries all over the world. The actors in the TrC-3rCE may include cooperation among the Governments, academic & research organizations and industries within the country for their individual and/or mutual benefit and beyond the boundaries whereby partnerships between two or more developing countries, supported by a developed country (ies) or multilateral organization(s), to implement development cooperation programmes and projects promoting 3R and circular economy.***

2.4 Triangular Cooperation Model and various approaches

International organizations, too, are engaged in a wide variety of TrC activities (United Nations 2012, OECD 2013). These organizations use their international or global mandates to act more as catalysts. TrC-3rCE will be helpful to green and clean technology relying on energy

efficiency and renewable energy. TrC-3rCE will definitely lead to getting rid of eco-efficiency losses within materials flow chain by satisfying the principles of 3R and CE. Design aspect is another controlling factor that drives the process towards resource efficiency. Collaboration among the actors helps in strengthening the inputs for redesign of the supply chain considering materials flow, suppliers availability, innovation and technological backups, support of policy instruments, customer demands, availability of reverse logistics system, mainly, return materials, repair, and remanufacturing. Triangular Cooperation could be particularly important for the horizontal exchange of local knowledge. Such exchange is becoming increasingly necessary, as we live in a world faced with multitudes of issues with no ready-made solutions, and hence "development cooperation must take the form of mutual learning and joint solution discovery (Tanaka 2012: 5)."

Policies on emerging issues are usually formulated by the consultation process engaging different stakeholder through their participation that is adopted by different national and local government. Stakeholder in the consultation process includes government officer and experts, scientists, academicians, industries, experts from national and international organizations and NGOs. The resolved issues are taken up for formulation of various legislations in the country. Policies and legislation help in setting strategies and targets. Researchers tried to understand the collaborative capability on CE (Choi and Hwang, 2015; Govindan and Hasanagic, 2018). Findings highlight that small companies could benefit in technology transfer and organizational learning by collaborating with companies moving towards circular business models inside the country or beyond boundaries. In the collaboration, the local suppliers could be chosen and trained to ensure recycling and reuse of products and materials. Additionally, role of Government to facilitate an environment to ease the transition from linear to circular model was found to be evident. A model for collaboration was proposed (J. L. Mishra, et al, 2019) as an enabler for CE as shown in Figure 2.

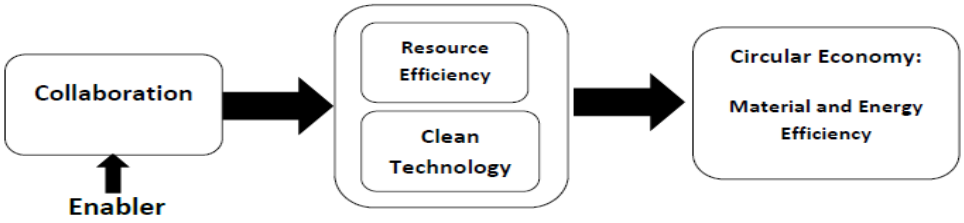

Figure 2. Theoretical Framework: Collaboration as an Enabler for CE

When the legislations are related to resource efficiency, material consumption, 3Rs, Circular Economy, innovation and technologies play vital role, where the academia, research organizations and industries have to be involved for effective implementation of these legislations. The experts from academia and research organizations carry out researches on those issues; innovation, new ideas and technologies are evolved for effective utilization of resources in support of the formulated legislation. Legislations in a country is binding to be followed by the citizens, but, and effectiveness of the implementation depends on many factors, namely, the ease of implementation, user friendliness of the formulated legislation, available technology, cost of the processes involved, innovation, competitiveness, governance, acceptance by the people, possible business models etc. Industries and local governments are the real players in effective implementation of the formulated policies instruments, strategies and targets evolved from the legislation. Hence, a robust cooperative management is essential part in promoting the 3R and Circular Economy in any country as well and in international perspective. This may be termed as Triangular Cooperation for promoting 3R and circular Economy (TrC_3rCE).

2.5 Proposed model of Triangular Cooperation (TrC_3rCE)

The proposed model of Triangular Cooperation to promote 3R and Circular Economy (TrC_3rCE) involves three main actors (Figure 3): the government (Central, Local and urban), universities and research & development organizations and industries and private sectors. The outer periphery consists of the foreign countries, international organizations, Non-government organizations and the civil society at large.

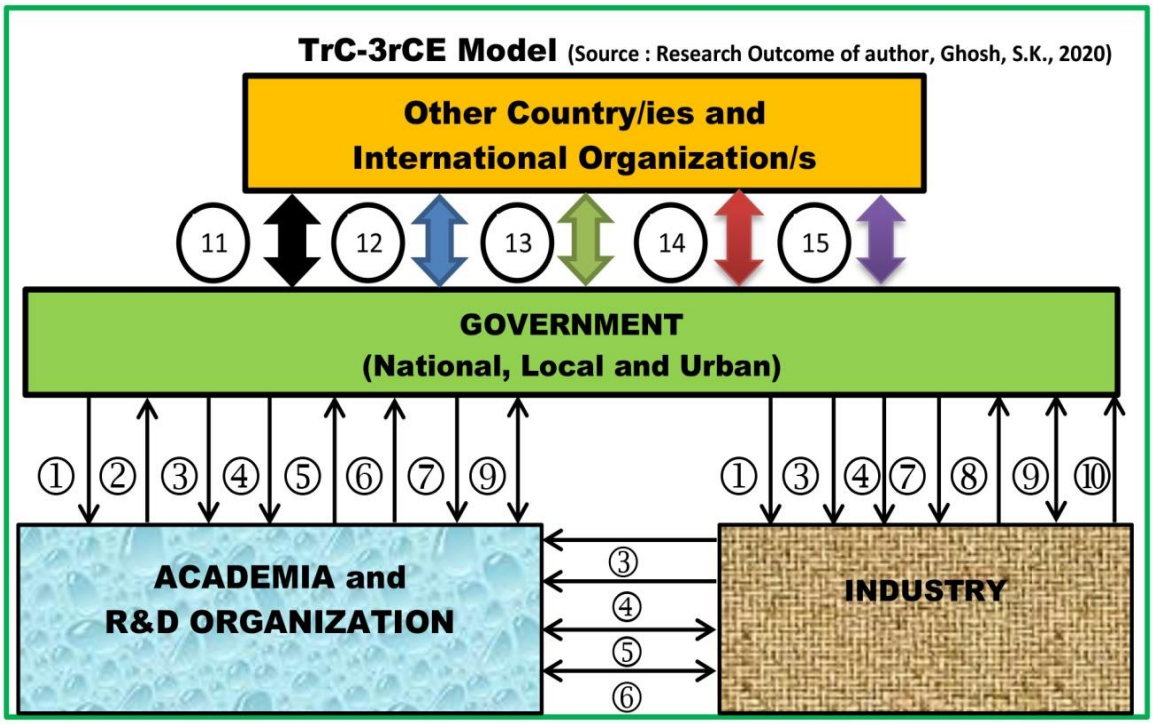

Figure 3. The proposed model of TrC_3rCE

There are interactions of the three main actors (Figure 3) are demonstrated in the proposed model of TrC_3rCE. The possible interactions within three main actors and other stakeholders in TrC_3rCE are described in table 1.

Table. 1. Interactions within three main actors and other stakeholders in TrC_3rCE

Interactive Components	Director of Interaction	Interactive Components	Director of Interaction	Interactive Components	Director of Interaction
1. Policy	Government to Academic and R&D institutes and to Industry	5. Innovation, theory of Sustainable production & consumption	Academic and R&D institutes to a) Government and b) to & from Industries	9. Inputs for Policy Instruments and International Collaboration Requirements	Academic and R&D institutes and Industry to Government
2. Policy Theory & Hypothesis	Academic and R&D institutes to Government	6. Sustainable Technology	Academic and R&D institutes to a) Government and b) to &	10. Revenue generation & Employment	Industry to Government

			from Industries		
3. Funding & Resource Support	Government to Academic and R&D institutes and Industry; And Industry to Academic and R&D institutes	7. Monitoring of Implementation	Government to Academic and R&D institutes and Industry;	11 to 15. International Collaboration	Government to Other country and international organizations and empower Academic and R&D institutes and Industry to collaborate with them;
4. Requirements	Government to Academic and R&D institutes and Industry;	8. Production and Market	Industry to Government		

The TrC_3rCE will definitely require initiative of the government at the first point whereas the other two actors have to come forward with commitments. TrC_3rCE will be helpful in achieving effective waste management, resource efficiency, green economy, low carbon technology, automation, IoT implementation and the capacity building. Nest two chapters will describe a few case studies on triangular cooperation. In most of the cases the cooperation takes place with letter funding but need to establish a system as proposed.

Chapter 3.

Policies and actions to promote triangular cooperation activities: case study in Asia-Pacific countries and address the role of various aspects such as government-scientific & research organization-private sector.

3.1 Introduction

The Asia and the Pacific region have seen rapid economic growth, urbanization and lifestyle changes that are unprecedented which is retarded to a greater extent due to the pandemic outbreak of COVID 19 since January 2020. Scientific analysis, however, shows the current approach to development in the region reflects a significant sign of triangular cooperation (TrC_3rCE) among the actors in implementing resource efficiency. Though a part of the region is highly vulnerable to climate change; unchecked, its adverse effects can reverse the recent gains in development while the region has made significant commitments to mitigate climate change. Almost all the countries submitted their Intended Nationally Determined Contribution (INDC) targets to the United Nations Framework Convention on Climate Change before the Paris Conference. In many of the countries in the region, the progress in implementation of the concepts and principles of 3R and circular economy is slower. In this region, Japan and the Republic of Korea with their sound material-cycle society, have a higher echelon of implementation status of 3R and circular Economy with strong TrC_3rCE, whereas, Australia, the People's Republic of China (PR CHINA) and India have established the legislation based on 3R and circular Economy in waste management related areas, industry activities and resource efficiency with TrC_3rCE, and are at the ongoing stage of implementation of those policies yet to be matured.

In the pattern of development in Japan and the United States in the late nineteenth century can be seen many of the features that were to shape the interplay between the U.S. and Japanese innovation systems in the late twentieth century. In Japan, the tradition of scanning the globe for the best available technology, then importing, adapting, and improving the foreign technology, was born out of the necessities of its crash industrialization program. Japan's drive for industrialization and the adoption of Western technology led to the establishment of its national university system and the founding of elite private universities, like Keio and Waseda, modeled after their founders had observed abroad. The superior DRAM manufacturing technology, in particular, was perceived by many in industry to be linked to cooperative government-industry R&D projects that had been organized by the Japanese government in the 1970s which included joint labs, supported by both government and industry funds, to which companies sent R&D personnel; and dissemination of research outcomes on a preferential basis among the membership of the joint R&D consortia. The success of Japanese producers in employing these strategies in their rapid ascent to the leading edge of semiconductor technology led many in the U.S. industrial and the policy communities to urge that similar steps be taken in the United States.

A few case studies in this article may be helpful in understanding the way the aspects of resource efficiency are achieved. There are so many examples of TrC_3rCE in the region but only a few have been handpicked, namely, Republic of Korea, Japan, India, Malaysia, Mauritius, Australia & New Zealand and Vietnam. This section will briefly define various case studies of TrC_3rCE in Asia-Pacific countries addressing the roles of various aspects such as government-scientific & research organization-private sector.

3.2 Case Studies

3.2.1 Closing the loop on single use food packaging in Australia and New Zealand

The rapidly growing food sectors develop a take away habit which results in many single used plastic containers being discarded every year. Due to impractical approach to this food sector habit, most take away packaging often ends up in landfall, water bodies and destined ultimately to marine environment. Re-usable containers should be developed in such a way that should be practically implemented. BioPak's compostable foodservice packaging made from renewable plant-based materials offers a partial solution for the foodservice items that remain single-use. Packaging uses 26% of all plastics produced, and 90% of plastic packaging becomes 'waste' after only one use. Despite many decades of recycling, the collection rate for plastic packaging is about 14%, of which only 4% is recycled to new plastics, and a staggering 32% leaks out of the collection system and into the environment, visible on nearly every beach and water body. The collection service has been rolled out across Australia and New Zealand, reaching over 2,000 postcodes. BioPak is working with local, industrial composting services and waste management partners. So far, 200 companies having joined together, resulting in 660 tons of compostable packaging and food scraps being diverted from landfill and creating 66,000 bags of nutrient rich compost. BioPak has partnered with the Australian Organic Recycling Association (AORA) and is working collaboratively with the waste management industries and local governments to increase access to composting infrastructure and scale the operations. Simply substituting a compostable alternative is not circular on its own. By also providing a collection and composting service, BioPak has created a circular system, ensuring that packaging and importantly, the food it contains does end up being composted thus contributing to the preservation of healthy soils. BioPak has made its compost service available to more than 2000 postcodes across Australia and New Zealand. Since launch, 200 companies have joined together, diverting 660 tons of compostable packaging and food scraps from landfill and creating 66,000 bags of nutrient rich compost.

3.2.2 TrC_3rCE initiatives in the People's Republic of China (PR CHINA)

The People's Republic of China (PR CHINA) helps a few poor countries to move past challenges and unlock the potential of the circular economy and to promote green, low-carbon, circular and sustainable form of development. People's Republic of China (PR CHINA) building on its own experience in new business models include investments in plastic recycling sectors in African countries. About 60 Chinese factories are engaged in plastic recycling in Tanzania, 20 Chinese plastic recycling firms operate in Ghana, and three more are registered in Ethiopia. The report also cites the planned construction of the People's Republic of China (PR CHINA) - African Circular Economy Industrial Park in South Africa, led by GEM Co. Ltd, a Shenzhen-based company specializing in resource recycling, as well as a Chinese government-funded project to assess the potential of industrial parks and zones in Azerbaijan, Tajikistan, Turkmenistan and Uzbekistan, as part of the BRI. There are many more examples of TrC_3rCE within the country.

3.2.3 TrC_3rCE SBM for waste management, sanitation & research support in India

India is rapidly transforming from an agricultural-based economy to an industrial and services-oriented nation. In India a matured TrC_3rCE exists at present which started its renewed journey in 2014 with the launching of Swachh Bharat Mission (SBM) in 2014 and revision of rules related to management of municipal wastes, e-waste, hazardous wastes, construction and demolition wastes, plastics wastes, and biomedical wastes in 2016 and battery wastes draft rules 2020, and EPR Policy 2020 (Draft), National Resource Efficiency Policy 2019 (Draft)

based on 5R and CE and the existing Environment Protect Act (EPA) 1986 in addition to many others. This initiative pulled the urban local bodies (ULB), industries, academic & research organization, NGOs and CBOs to create a cooperative environment to enhance the resource efficiency and use of renewable sources reducing the consumption rates and resource depletion. These activities in many cases are supported by a few European countries, Japan, USAID and a few multilateral organizations. As a result of the TrC_3rCE in India, several significant achievements could be visible. The collection efficiency of municipal wastes is 75-80 per cent while only 22-28 per cent of this are recycled (Down to earth, September'2018). Targets in EPR plans are in implementation in electronic and electrical industries since 2017-18.

India has a number of bilateral supports to many countries, a few of which are, Bhutan, Bangladesh, Nepal, Afghanistan, Mauritius, Seychelles, Maldives, African nations, Caribbean nations and a few others.

Industries established different plants for energy and materials recovery plants subsequent to segregation of wastes at source and collection, namely, composting plants, biomethanation plants, MRF for dry waste recycling, RDF plants, co-processing of wastes in cement plants, use of fly ash in road making & cement plants, Wastewater & sewage treatment plants, Fecal sludge treatment plants (FSTP) and many other recovery processes and enhanced the resource efficiency. These will lead the disposal of a smaller inert portion with a target of 10 to 20% of waste to landfill sites. As per direction of National Green Tribunal (NGT), the exiting landfill sites are carrying out bioremediation for material recovery.

Swachh Bharat Mission has a direct effect on improving the water quality of rivers and reducing marine littering through the sanitation and waste management targets in cities and villages. Various initiatives have been taken in India to curb the use of plastics as well as to reduce generation on plastics waste, recovery, recycling and reducing marine littering. CPCB reported that plastic waste contributes nearly to 8% in the solid waste streams while 60 % plastics waste is recycled and there are 4773 registered and 1080 unregistered plastic Manufacturing/Recycling units in India as per PWM rules 2018. This has been possible because of effective TrC_3rCE. Department of Science and Technology (DST) and Department of Biotechnology (DBT) and many other government organization are presently funding different projects which demonstrate the TrC_3rCE.

Another example of TrC_3rCE is Swachh Survekshan (SS), an annual ranking of cities under the SBM launched in 2016 with an objective of survey for large scale citizen participation towards making towns & cities a better place to live in and to promote a spirit of healthy competition among towns & cities, [SS 2020, Government of India]. The SS covered only 73 cities in 1st year, 2017 included 434 cities, in 2018 covered 4203 cities, 4th survey in 2019 covered 4237 cities and 5th survey in 2020 covered 4242 cities with a target of institutionalizing the systems. This is a cooperation of Government-Academia- Local Bodies and Industries. A second phase of Swachh Bharat Mission (SBM) may also be key to reducing contamination, as the UNICEF study suggests. The yet-to-be formalised '*Nal se Jal*' scheme aims to provide piped drinking water to every rural home by 2024 and may overshadow SBM 2.0, experts believe. As per the analyzed samples from rivers in 72 countries and found that antibiotics were present in 65% of them reported by the researchers from the University of York in the UK, which is still a largely ignored aspect until now. The global water demand for manufacturing is estimated to increase by 400 % from 2000 to 2050 surpassing all other sectors. India has a network of water resources of 113 rivers (the figure does not include tributaries) and vast

alluvial basins to hold plenty of groundwater (OECD Environmental Outlook to 2050). Only 13.5% of sewage is effectively treated out of the total treatment capacity in cities (CPCB, 2017c). The Zero Liquid Discharge (ZLD) in Indian industries is very popular and helps in water recirculation as well conservation.

The academic and research organisations are carrying out several research programme that develop several low cost technologies for the implementation of these rules, namely, Cellulosic Alcohol Technology Demonstration Plant at Kashipur, Uttarakhand, agricultural residues to ethanol to control stubble burning, converting plastic to automotive grade gasoline by CSIR laboratories, Bio methanation technology by DRDO, road development using waste plastics, ecofriendly recycling process of waste & zero discharge jute retting machine by Jadavpur University, recycled plastics products, recycled construction products from C&D wastes, a compact modular sewage treatment plant developed by Bhabha Atomic Research Center (BARC) which occupies six times less space and is four times cheaper than the conventional ones and many others1. All these technologies help the country to strengthen the implementation of 3R and CE.

The TrC_3rCE among the actors in India has been able to demonstrate the results of implementation of 3R and CE by enhancing resource efficiency by recovery of resources for all the waste streams and enhancing sanitation and cleaning River Ganges. The cooperation helps in building business and many startups on waste management business.

3.2.4 TrC_3rCE initiatives in Japan

The types of international partnership held in Japan on 3R was national government driven, local government driven, business driven and other types. A number of cooperation initiatives taken in Japan in last couple of years. In 2018 - 19 Panasonic commercial equipment system corporate limited has implemented pilot refurbished project in cooperation with local governments with support from the Ministry of Environment, Japan. International Partnership of government to government took place through the followings in Japan: 1) Bilateral Cooperation on waste management system – a) MOC on industrial waste with Ministry of Industry, Thailand, b) Legislation on 3R and waste management for Vietnam and c) Guidelines for waste-to-energy in Philippines and many others, 2) Multilateral Cooperation, namely, a) Regional 3R & CE Forum in Asia and the Pacific, b) African Clean Cities Platform (ACCP) and, c) World Circular Economy Forum (WCEF), and 3) Technical and Project based Cooperation, a) Joint Crediting Mechanism (JCM) and a few others.

The city-to-city collaboration program by Japan during 2013- 2020, was participated by 36 cities and 14 local government from13 countries (Cambodia, Chile, India, Indonesia, Lao DPR, Malaysia, Maldives, Mongolia, Myanmar, Palau, Philippines, Thailand and Vietnam) and other regions of Japan. Japan has taken a significant initiative of Sound Material-cycle Society 5.0 Economic Redesign for minimizing the consumption of natural resources and reducing the environmental load as much as possible. Japan has many other initiatives towards TrC_3rCE.

3.2.5 TrC_3rCE in Republic of Korea

The Republic of Korea is one of the leading examples of TrC_3rCE and was one of the countries having the paradigm shift to academic capitalism long ago in 1980s. In the Republic of Korea, cooperation between university and industry is mainly promoted by government. The Republic of Korea's position as one of the world's most innovative nations is a remarkable achievement considering that, for the first half of the twentieth century; it was an agrarian-based Japanese colony, then a battle ground. It is second only to Germany in Bloomberg's 2020 Innovation Index, having reigned at the top of the 60-country list for the previous 5 years. In the separate 2019 Global Innovation Index, published by Cornell University, INSEAD and the World Intellectual Property Organization, The Republic of Korea is at number 11 and Germany is in 9th place among the 129 countries ranked. Both indices highlight the Republic of Korea's outstanding performance in research and development (R&D) intensity, an indicator based on R&D investment by government and industry and the number of researchers working in and between both sectors. The Republic of Korea had the greatest share of researchers who moved from industry to academia in 2017 to 2019 among 71 countries, data from academic recruitment firm, League of Scholars, show. The Republic of Korea spends 4.5% of its GDP on R&D. The Republic of Korea has an effective waste management; implementation status of 3R and circular economy are excellent. The recycling rate is very high while the waste leading to landfill is only in single digit.

All the achievements in the Republic of Korea were possible due to triangular cooperation and support by foreign countries and international organizations. Let us take an example of Samsung company, who started as a grocery trader in 1938 is now Republic of Korea's largest chaebol, operating in industries as diverse as electronics, insurance, construction and shipbuilding. In 2018, it produced roughly 15% of the nation's GDP. Its founder, Lee Byung Chul, with help from government protectionist policies, expanded into textiles after the Korean War, electronics in the 1960s, then heavy industries, aerospace and computing during the 1970s and early 1980s. By the 1990s and 2000s, Samsung was a world leader in tablets and mobiles, and in the design and manufacture of computer chips [(OECD Gross domestic spending on R&D (indicator) https://doi.org/10.1787/d8b068b4-en(Accessed 8/5/2020)].

3.2.6 TrC_3rCE in palm oil refining and recovery from waste oil in Malaysia

Though, there is a lack of legal framework on circular economy implementation in Malaysia; Eleventh Malaysian plan nationwide initiatives taken to promote circular economy through sustainable production and consumption, reduction of around 40 per cent greenhouse gas emission intensity from GDP and 22 per cent recycling of MSW by taking base year as 2005 (Fauziah and Agamuthu, 2012); The environmental protection law in Malaysia was introduced in 1974 as Environmental Quality Act (EQA) 1974 (Department of Environment 2018a). Until now, a total of 31 regulations and orders on environmental protection have been ratified since 1974. The initial environmental legislations were focused on protecting environment from pollution originating from palm oil and rubber industry. The expansion of oleochemical industry and production of downstream products has led to complex waste generation (Agamuthu, 2001). The Palm – Oleo Sdn. Bhd plant produce 364 million tons of oils with a

result of 20 million tons of waste. Through the processes of lipo-fractionation, distillation, hydrogenation and fractionation, some valuable products like fatty acids, fatty alcohols and glycerine are extracted from the downstream source. The expansion of industry has resulted in manufacturing of additional products like soaps, noodles, esters; also resulted in total savings of RM 1.00 million a year. Malaysian Investment Development Authority (MIDA) launched incentives for establishment of Waste Eco Park (WEP) in 2016 which encourages recycle and/or recover waste. The university and research institutes in Malaysia are involved in the improvement of technologies for Palm oil refining and effective waste processing.

3.2.7 Government & industry cooperation in resource circulation in Mauritius

Mauritius, a small island in Indian Ocean has experienced continuous development with diversified economics; but with the development solid waste generation also increased over the years at a rate around 3.1 per cent per annum. With the issues of solid waste generation, the concept of circular economy has been gaining increasing attention (Ghisellini et al. 2016). The 3Rs principles have been considered as most preferred options by the Mauritius Environmental Protection Regulations 2001 and 2015; in the solid waste management. Several initiatives have been taken to promote 3Rs in Mauritius through either policy decisions, provision of incentives or promulgation of specific regulation as (United Nations. (2019), namely, a) Deposit refund scheme in glass bottle taken during purchase time, b) Home composting scheme through distributing home composter, c) Incentives on exportation/recycling of PET bottles given by the government, and d) Introduction of excise duty on non biodegradable plastic food containers. Presently more than 30 registered recyclers/exporters involved under Local Government (Registration and exporter) Regulation 2013; in the recycling/exportation of paper/carton, e-wastes, glass, photographic and printing wastes, plastics, textile wastes, used batteries, waste oil, used tyres and timber/wood (Statistics Mauritius, 2019). They introduce SAG program through industrial symbiosis, where waste from on industries is used by other industries as raw materials. About 86 tons of broken wafers from a biscuit manufacturing industry have been used as animal feed. These activities have been supported by the research organisations in the country and outside the country.

3.2.8 TrC_3rCE in Waste Management in Vietnam

National Strategy on Environment Protection by 2020 with a vision toward 2030 detailed plenty of measures to enhance the 3R, cleaner production and Sustainable Development Strategy of Vietnam (2011–2020) included a task to build a system of integrated SWM, in which solid wastes are classified at source, collected, reused, recycled, and thoroughly treated with appropriate advanced technologies (Government of Vietnam, Prime Minister of Vietnam 2012a) while Urgent need is felt for transition to clean energy from increasing reliance of fossil fuels for power sectors. (https://www.worldbank.org/en/country/vietnam/overview). Ho Chi Minh City established Decision 44/2018/QD-UBND to regulate the MSW classification in the city (Ho Chi Minh City People's Committee 2018). National Action Plan on Sustainable Production and Consumption, with a vision to 2030 set six comprehensive tasks and detailed goals for the period of 2016–2020 and 2021–2030. State Government established an Action Program of nine main tasks in 2014 to implement Resolution 24-NQ/TW (Government of Vietnam 2014b). Task 3 directed that "*Continue establishing and improving policies to encourage, support and promote the use of energy-saving technologies and equipment, water-saving, exploitation and use of renewable energy and new materials, and recycling in production and service activities*", and Task 9 addressed to "*promote the consumption of recycled products and environmentally friendly products.* About 35 centralized solid waste treatment plants with composting line in 25 facilities and combustion or a combination, are in

operation in Vietnam with total capacity of 7500 tons/day (average capacity is from 100 to 200 tons/day). Fly ash and slag from Thermal Power Plants have been used for quite a long-time using ash reprocessing technologies with the cooperation of universities and other research organizations with capacity of 80,000 tons/year involving Cement Factories like Hoang Thach Cement Factory with successful production. The enriched ash and slag have been used in large size concrete production for the construction of hydropower dam. [(Ministry of Construction and JICA 2017) (H. T. Hai et al., 2020)]. The amount of waste for landfill would be reduced due to the composting and the incineration in WtE plants from around 87% in 2018 to just 6% in 2030 (Van Den Berg & Thuy, 2018). In Vietnam the TrC_3rCE exists in many areas of intervention. One of the agencies involved in TrC_3rCE is Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE).

Chapter 4.

Case study: This section will provide detail of various case studies of various successful examples of triangular cooperation in the world.

4.1 Introduction

It is well known that many of the countries in European Union (EU) have excelled in the implementation of 3R and Circular Economy. The TrC_3rCE in those countries have taken significantly matured shape. To name a few of those are, Germany, France, Spain, Italy, Slovenia, Finland, Denmark, Norway and a few others while there are countries outside EU in which the TrC_3rCE slowly taking a good shape with success. USA has a mixed state where is some of the states there are matured system and others are lagging behind while UK all through has a matured system. In this section cases have been described in South Africa, Brazil and Italy while a few cases of cooperation through research projects have been described. Though the CE is not matured in South Africa and Brazil, it may be concluded that these two countries have initiated so many activities which will make them resource efficient countries in a few year ahead.

4.2 Case Studies

4.2.1 TrC_3rCE in bioenergy and bioeconomy sectors in Brazil

Circular Economy in Brazil is still in its early stages, while the 3R and circular economy is more developed in the bioenergy and bioeconomy sectors with effective cooperation among government, academia and R&D organizations and industries.. The biofuels programs and the Circular Bioeconomy are better represented in Brazil than the CE in other sectors. Since the year 1975, the country gained experience in bioenergy in the Proalcool Program, having the second largest biofuels program worldwide, with 35.3 billion litres of ethanol produced in 2019 (ANP, 2020; REN21, 2020), behind USA. Other bioenergy and biofuels programs in Brazil include biodiesel and biogas programs with biomass residues, sugarcane bagasse, rice husks, wood residues, as feedstock.

National Biofuels Policy, named RenovaBio, 2017 of the Federal Ministry of Mines and Energy (MME) for the sustainable expansion and production of biofuels (Brasil, 2017) in the transport sector awards decarbonisation credits (CBios, equivalent to 1 ton of CO2e avoided). National Parliamentary Innovation for Bioeconomy a ("Frente Parlamentar para Bioeconomia", in Portuguese), was launched by National Congress in 2019 to foster biotechnology, biomass use to reduce GHG emissions and a better economy with bio-based products (Camara dos Deputados, 2019) which have been supported by the bioenergy associations in the country, industries, the universities and R&D organizations along with the support from farmers. Success of bioenergy and bioeconomy sectors is a significant demonstration of TrC_3rCE in Brazil.

Brazilian sugarcane ethanol is responsible for 60-89% of GHG avoided emissions. The agribusiness represented 21.4% of Brazil's GDP in 2019, including agriculture-related inputs, production, services, and the agroindustry (Coelho & Goldemberg, 2019). According to the Brazilian Energy Balance (EPE, 2019), 45.2% of domestic energy supply (DES) is from renewables. One-third of Brazil's DES was generated using biomass in 2018 (17.4% from sugarcane products, ethanol and sugarcane bagasse). 25% of the energy demand is supplied to the road transport sector, mostly sugarcane ethanol followed by biodiesel from soybean oil. In electricity, biomass was responsible for more than 8.5% (5.6% from sugarcane bagasse

cogeneration) out of a total supply of 636.4 TWh (EPE, 2019). when replacing gasoline (Coelho & Goldemberg, 2019) having two 2G ethanol plants in the country with 6 million litres capacity in 2019 (CGEE, 2017, NovaCana, 2020). In 2019, 94% of new cars (Anfavea, 2020) registered in the country were flex fuel, i.e. run on any blend of ethanol and gasoline (even E-100). The sugarcane industry is a special case in a CE framework, considering its scale in the country. The universities and research organisations in Brazil receive a significant amount of research grant on these areas and developing innovative processes enhancing output of the processes.

4.2.3 TrC_3rCE in Israel

Among all countries, Israel is the only country that spends a greater proportion of its GDP on R&D at 4.9 % whereas the Republic of Korea spends only 4.5%. But the disparity in R&D among the countries shown (Figure 4) are vast in terms of the total spent, in 2018 ranging from USD 16.3 billion in Israel to USD 526 billion in the People's Republic of China (PR CHINA) and USD 551.5 billion in United States. The Republic of Korea spent USD 95.4 billion on R&D in 2018. In Israel there is a robust cooperation among the actors for TrC_3rCE. The results of the investment in research and development helps in bringing revenues in the country as well as implementation of 3R and CE. However, the focus on 3R and CE is not very effective in Israel though

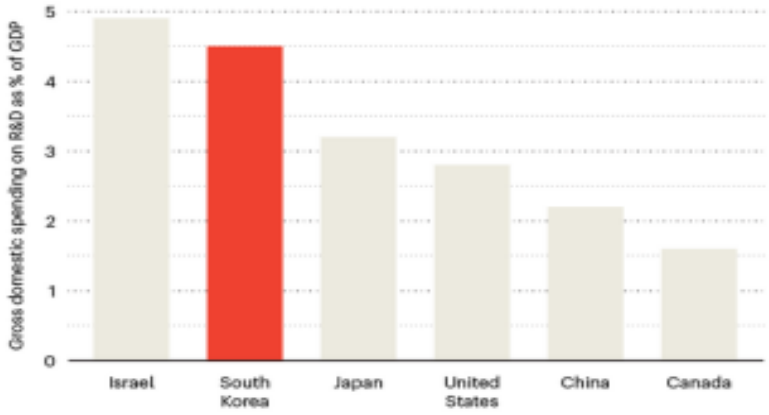

Figure 4. Gross Domestic Spending on R&D as percentage of GDP

4.2.3 Italy in Waste Recycling

Italy works with the wider legal framework of EU legislation towards sustainable development and waste management and internationally recognized as one of the most advanced approaches towards circular economy. The directive 91/156/EEC (CD 1991) formally introduced in the legal framework of waste management concept with prevention, reuse, recycle and recovery as main priority. Waste generated by industry, agriculture and commerce activities legally defined as special waste by the EU legislation (ISRPA, 2017b). Furthermore, the COM (2015) also targeted five priority areas characterized by specificities of their products or value chain, their environmental footprint or dependency of material from outside, these are; plastic, food waste, raw materials, construction and demolition waste, biomass and bio based products. The European Commission proposed other two documents related also to emending the 2020 targets reported in the WFD (2008). They consist in an overall recycling of waste within 2030 of 65% (EC 2015c) and in an increase of recycling rates of specific waste materials (EC 2015d): plastics up to 65%; metals up to 85%; wood up to 75%; glass up to 85%; paper and cardboard up to 85% EC (2018). These recycling rates have been achieved by the waste management

industries in cooperation with the government. Various research models developed by university and research organizations involved in the implementation of CE are, a) LIFE M3P—Material Match Making Platform for promoting the use of industrial Waste in local networks, b) LIFE ECO-PULPLAST—Local circular ECOnomy by an innovative approach for recycling paper industry PULper waste into new PLASTic pallets, c) LIFE12 ENV/IT/000393 PREFER PRoduct Environmental Footprint Enhanced by Regions and d) LIFE PRISCA Pilot project for scale reuse starting from bulky waste stream. The TrC_3rCE made the implementation of 3R and CE objectives in Italy possible.

4.2.4 TrC_3rCE in South Africa for waste recovery and energy efficiency

South African government, business houses, academia & research organizations, NGOs and civil society are at present becoming concerned about the implementation and benefits of CE. The White Paper on Science, Technology and Innovation (STI) (DSI, 2019), the first policy document in South Africa explicitly mentioned the circular economy and identified the opportunity it provides for more resilient economic growth, provides a springboard for a coordinated STI response to a circular economy transition in the country. Operation Phakisa: Chemicals and Waste Economy in 2019 (DEA, 2019a; DEA, 2019, was launched by the national Department of Environmental Affairs (DEA) with an objective to increase the material recovery from discarded waste with a target of 20 Mt/year of waste diverting from landfill and fostering inclusive growth by sustainable production involving the business houses, government, academic and research organisations and the civil society which sets. This is expected to unlock R11.5 billion/year and create 45,000 direct jobs and 4300 SMMEs. A Special Purpose Vehicle, GreenCape, established in 2010 by the Western Cape Provincial Government, has facilitated and supported R17 bn of investment into the green economy where more than 10,000 jobs have been created (GreenCape, 2020b). GreenCape has been able to illustrate the value in government investing in a cross-stakeholder mediator to unlock circular economy opportunities. The Western Cape provincial government has implemented more stringent landfill restrictions that seek to divert 50% of organic waste from landfill by 2022, and 100% by 2027. The National Department of Environment, Forestry and Fisheries (DEFF) has drafted National Norms and Standards for organic waste composting (GN 1135 of 2019) that encouraged the establishment of new waste management businesses, like, composting, biomethanation, RDF etc. The DEFF have also gazetted National Norms and Standards for the sorting, shredding, grinding, crushing, screening or baling of general waste (GN 1093 of 2017),

The South African government had laid a strong foundation from which to drive a circular economy STI agenda, through the development and implementation of the Global Change Grand Challenge (DST, 2007), the Waste Research, the Bio-economy Strategy (DST, 2013b). The National Advisory Council on Innovation (NACI) has identified the circular economy as one of nine priorities of STI domains in the South Africa Foresight study (DSI, 2020). This is the environment which has been created in TrC_3rCE in South Africa.

In South Africa the voluntary Extended Producer Responsibility (EPR) scheme for paper and packaging has been practised industry-funded material organisations, namely, PETCO, PolyCo, PASA, SAVA (plastics), TGRC (glass), MetPac (metal), FibreCircle (paper) since

long while the national government recently moved to implement mandatory EPR. These organisations have been instrumental in getting recycling rates to their current levels in South Africa, by providing support to the value chain and provided guidance to local brand owners and retailers through the publication of Design for Recycling Guidelines, that provide packaging designers with insights on how to embed recyclability into packaging. WWF, a group of leading retailers in collaboration with key recycling stakeholders in the country have rolled out standardised recycling instructions, known as On Pack Recycling Labels (OPRL), [https://www.wwf.org.za/our_news/news/?29161/WWF-announces-simplified-recycling-labels] which will indicate whether the packaging can or cannot be recycled. Six of South Africa's largest retailers have committed to applying the OPRL onto their brands, and will likely expand this to their supply chain. The South African Plastics Pact, industry led collaboration seeks to commit brands to investing in a circular plastics economy since 2019. These private sector initiatives have facilitated the establishment of a number of innovative businesses, ranging from small entrepreneurs to large companies.

The National Energy Efficiency Strategy (NEES) (DoE, 2016), sets a vision to promote energy efficiency for a balanced, socially inclusive and environmentally sustainable economic growth through technological innovation.

4.2.5. Cooperation and collaboration through international Research Projects

Plenty of research projects launched to strengthen the technological and policy related inputs carried out by the academic and research organizations to achieve resource efficiency and sustainability with the support of government, international agencies and industries. The vision presented for "transforming our world for the better" is based on five values (the "5 Ps": People, Planet, Prosperity, Peace, and Partnership) and 17 Sustainable Development Goals (SDGs). The 2030 Agenda stresses the fundamental role that science must play in creating the knowledge needed for realizing this vision of sustainability. Previous international policy documents [e.g., the Brundtland report (WCED 1987)] already stressed the key role of science for sustainable development. The 2030 Agenda represents a fundamental shift in the dialogue between science and policy : until recently, the understanding was that scientists analyzed the earth system's processes and dynamics and urged policymakers to come up with responses (F. Schneider, et al, 2019) . The 2030 Agenda assigns a new role to science, responding to a long-term claim from scientists concerned with sustainable development: to generate knowledge that helps humanity achieve the sustainability vision set out in the 17 SDGs. In most of the countries, the highest share in the R&D budget on environmental research of the government has been allocated for universities and research organizations to support and strengthen the policy drives. According to the Policy Brief by the Scientific Advisory Board of the UN Secretary-General, "science will be one of the most critical means of implementation for the Agenda 2030", and "science is a driver and enabler of inclusive and people-centered sustainable development" (Scientifc Advisory Board 2016). Following research collaboration in consortium among many countries are significant examples of examples of TrC-3rCE.
Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. A novelty in this work programme are the four mutually reinforcing Focus Areas that cut across the programme boundaries and are aligned to major policy priorities: 'Building a low-carbon, climate resilient future' (LC)*;* 'Connecting economic and environmental gains – the Circular Economy' (CE); 'Digitising and transforming European industry and services' (DT); and 'Boosting the effectiveness of the Security Union' (SU). Together these Focus Areas give a combined budget of over €7 billion (2018-2020). An

overview of the new funding opportunities is provided in the introduction to the work programme 2018-2020 and accessible through dedicated search functions. In addition, a dedicated section brings together a spectrum of activities on next generation battery technologies to drive the transition towards a de-carbonised society.

One of such research schemes is Horizon 2020 SC5-12-2018 EU-India water co-operation by Department of Science and Technology (DST) and Department of Biotechnology (DBT), Ministry of Science and Technology of India, Executive Agency for Small and Medium-sized Enterprises (EASME) and Directorate-General for Research & Innovation (DG R&I), European Commission. INDIA-H2O one of seven research projects in India in consortium with research organizations and industries in 2 countries involving 20 universities, research organisations and industries research deals with water and waste water related issues supporting SDG 2030 agenda.

A few other examples of research projects those may be considered within TrC-3rCE scopes are, Ocean Plastic Turned into an Opportunity in Circular Economy- OPTOCEe, 1) OPTOCE - Ocean Plastic Turned into an Opportunity in Circular Economy: The Academic Collaboration to Combat Marine Littering and Micro plastics in Asia under the Norwegian funded OPTOCE-project organized by SINTEF, Norwegian ministry of Foreign Affairs and NORAD, Norway. The OPTOCE project is a part of the Norwegian Development Programme to Combat Marine Litter and Microplasticsc especially connected to major world river basins, dumpsites, landfills and industrial hotspots in line with the 2019, Bangkok Declaration on Marine Littering launched an Academic Collaboration in partner countries. This project will contribute to achieve the Sustainable Development Goals 11.6 and 12.4 on Waste management and Circular economy, as well as SDG 14.1 on Marine litter reduction.

The research projects are being carried out at Centre for Sustainable Development & Resource Efficiency Management, Jadavpur University, Kolkata, India; Asian Institute of Technology, Thailand; The Chinese Research Academy of Environmental Sciences (MEE), Beijing, People's Republic of China (PR CHINA); Key Lab of Advanced Materials for Green Growth, Vietnam National University, Hanoi; And Yangon Technological University, Yangon, Myanmar. The project will definitely help in implementation of the rules pertaining to the plastics waste management and for controlling marine littering in different countries and the cement plants for co-processing of plastic wastes in these countries promoting 3R and CE.

Many significant activities by ISWMAW, ISWA and other international societies are being carried out worldwide who act as TrC-3rCE. The research project taken up by International Society of Waste Management, Air and Water (ISWMAW) in collaboration with twenty-one countries including the UNCRD and IPLA in 2017 for 2018-2022. The title of the research project is, "Global Status of Circular Economy". The project deals with the status of establishing CE related policies and their implementation in various countries. As a result, three documents came out as the outcome of the research where the status from more than 40 countries has been narrated with scopes for improvement. The document title are :, 1. Circular Economy: Global Perspective, (https://www.springer.com/gp/book/9789811510519) (2020), 2. Circular Economy: Recent Trends in Global Perspective (Yet to be released), and 3. Circular Economy – Policy, Innovation, Technology and Business ((Yet to be released). This is a significant initiative of ISWMAW to promote 3R and Circular Economy throughout the globe.

Chapter 5

The Way Forward:

5.1 Learning from the case studies

The case studies in this report as well as the experience worldwide from different reports and literature it has been found that the multi-stakeholder cooperation and collaboration is an important antecedent to CE implementation in both the developing and the developed countries. The mode of cooperation and collaboration may differ based on many factors, namely, geographical, cultural, economic, technological, social and political. The multinational companies who implement concepts of 3R and CE business models generate a beneficial symbiotic relationship with local businesses, academic and research organizations and of course the civil society. These benefits revolve around technology transfer, organizational learning and capacity enhancement which are necessary for achieving the 3R and CE principles through resource efficiency and low carbon technology and the use of IoT. These helps in creating resilient society, livable city with the lowest possible GHG emission, sustainable production and consumption. Therefore, to advance knowledge and practice in this area, we propose a model for collaboration as an enabler for CE. At the front end, the government formulates the policies and strategies and collaborate with international treaties and resolutions those support the reduce, reuse and recycle concepts leading to resource efficiency and finally complying with the CE Principles. Hence, the importance of cooperation and collaboration in advancing CE practices which can yield both tangible and intangible benefits for developing economies towards 2030 Agenda for Sustainable Development/SDGs and the Habitat III New Urban Agenda. The TrC_3rCE model needs a close loop cooperation among the actors with a few peripheral actors. At the core of the model, the interactions among the government, industry, academic and research organizations with the inputs from international organisations and countries with matured systems will evolve the need on a new concept, here the tools for implementation of 3R and Circular Economy. The government formulated the policies and rules. The targets are set by government in consultation with the core actors. The implementation is carried out by the core actors and wider actors on the periphery, who in turn gets the benefits of the policy instruments. More importantly, the government must have a proactive attitude to implement the TrC_3rCE and to involve all the stakeholders.

5.2 Policy framework and Recommendation of a future vision and policy framework for promoting 3R and circular economy through triangular cooperation

The extraction and consumption of natural resources is estimated to be doubled by 2060 compared to 2011 levels (OECD 2019). The climate crisis is accelerating at an unprecedented rate, for which preparedness is an urgent need, while the crisis has many factors that play a role in its exacerbation, there are some that warrant more attention than others. There has been a recent decline in resource productivity both in G20 countries and around the world (UNEP/IRP 2016, 2018). Continuous expansion of resource use and consumption due to globalisation and economic development will result in ever-increasing amounts of waste, and accompanying environmental impacts. The situation has been aggravated more by the pandemic outbreak of COVID 19 since January 2020. This is the time when the resource efficiency is the important parameter need to be achieved by countries in the Asia and the pacific. A greater scope for the improvement exists in the region while a robust mechanism is needed for the TrC_3rCE.

As a Policy framework to establish the system for TrC_3rCE, the country should be able to identify and mobilise respective stakeholders both inside the country and outside the boundary who should be involved in the scheme of TrC_3rCE. The scheme should be considered in mission mode that need to be institutionalized. A monitoring platform in the country may be helpful for effective TrC-3rCE. The platform should carry out the advocacy work stream elaborating voluntary principles on effective co-operation, analytical work stream compiling reports and policy briefs with insights, models and lessons learned and an operational work stream developing tools to facilitate managing TrC-3rCE. There should be a consolidated guidelines document in the country to facilitate knowledge enhancement with updated information for the actors. Industry investment to research and innovation need to be strengthened. Large-scale industrial transformation under a circular economy requires continuous support and a mix of well-designed policy interventions to remove barriers to circularity, make circularity profitable and thereby provide the ground for new business models and business innovation. It will most likely also need financial and other support.

> ***Vision: A robust mechanism for strengthening the triangular cooperation for promoting 3R and circular Economy (TrC_3rCE) to achieve resource efficiency by formulation of legislative framework and policy instruments evolved from a collaborative consultation that is implementable and continually improved by the intervention of actors, such as, local governments, industries, academia, research organizations, NGOs, at large civil society with required inputs and support of developed country (ies) and/or multilateral organization(s), and learning from matured system.***

A model of Triangular Cooperation to promote 3R and Circular Economy (TrC_3rCE) has been proposed in this report vide figure 3 in section 2.4 on page 12. The model involves three main actors: the government (Central, Local and urban), universities and research & development organizations and industries and private sectors. The outer periphery consists of the foreign countries, international organizations, Non-government organizations and the civil society at large.

5.2.1 Recommendations:

1. A robust policy instrument and targeted framework with a reliance on the actors, like, industries, academia, research organizations, NGOs, in formulation of legislative framework and policy instruments by the government to involve them. National strategies to work for TrC_3rCE.
2. Funding to the private industries and academia and R&D organisations for development of innovative sustainable products and processes. Incentives for industry to implement the new policies;
3. Involve the actors in ongoing strengthening process of the implementation strategies and periodic communication and a system for regular feedback for improvement in the system and framework,
4. Countrywide communication channel on the systems and benefits, of transition to “circular economy and society”.

5. Reliance on academic and research organizations for innovative ideas and technology supporting implementation of policies and more investment by industries in R&D.
6. Focus on disciplinary, interdisciplinary, and transdisciplinary research approaches for generating the knowledge needed to implement the 2030 Agenda, and the Habitat III New Urban Agenda that all researchers aiming to contribute to more sustainable development and TrC_3rCE.
7. Creating markets for circular products and services through public procurement using TrC_3rCE and driving innovation and investment
8. Facilitating financing and adapting financing methods for circular economy activities
9. Re-evaluating current taxation and exploring tax differentiation for circular products and services,
10. Integrating the circular economy into SDG 2030, the Habitat III New Urban Agenda and Paris Agreement commitments

5.3 Five (5) policy relevant discussion questions for the panel discussion.

Q1. What can be the suitable mechanism for establishing TrC_3rCE among the governments, academic & research organizations and industries? What is the relevance of TrC_3rCE to the green economy, sustainable development goals and the Habitat III New Urban Agenda?

Q2. How does TrC_3rCE support successful knowledge management and who may be the potential international support organizations?

Q3. What are the institutional and managerial challenges related to TrC_3rCE?

Q4. What is the mechanism of institutionalizing sustainable initiative of TrC_3rCE so that it works effectively?

Q5. What are expected benefits of TrC_3rCE to the country and the society green economy?

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