Building a Sound Material Cycle Society: Learning from Japan

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Science has evidenced that we are putting tremendous pressure on our planet. According to the Global Footprint Network, humans currently consume resources at a rate 1.7 times faster than what the Earth can reproduce [1]. The UNEP Emissions Gap Report (2020) estimated that we will see a temperature rise of at least 3°C this century if we fail to make greater efforts to tackle climate change [2]. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has signalled the rapid deterioration of nature. Loss of biodiversity and ecosystem integrity will compromise our achievements on 80% of determined SDG targets, making it even harder to achieve progress on poverty, hunger, health, water, cities and climate [3]. As the International Resource Panel has consistently reminded us [4], we have now run out of time and we must take urgent action to limit our ruthless and endless extraction of resources.

Japan is no exception to this. The start of the Meiji era and the rising influence of Western cultures ushered in Japan's prompt move toward a society based on mass-production, mass-consumption, and mass-disposal. The country's rapid industrialisation driving its high economic growth also brought with it massive amounts of waste as well as causing pollution and damage to public health. In response, Japan enacted the Public Cleansing Law in 1954 to enhance the waste management system, with the aim of improving public hygiene. The Act on Emergency Measures concerning the Development of Living Environment Facilities was introduced in 1963, with a view to improving the living environment and public health. Along with this act, the Five-Year Plan for the Development of Living Environment Facilities was formulated, establishing a relevant policy environment for the advancement of waste management resources, including incineration and landfills, and advocated for the mechanisation of waste collection systems in partnership with local governments and private enterprises.

Environmental pollution control measures were further strengthened by the enactment of the Basic Act for Environmental Pollution Control in 1967. The government made considerable revisions to the Public Cleansing Law (1954),

renaming it the Waste Management and Public Cleansing Law, 1970 (Waste Management Law) and introducing stricter regulations. This also defined the division between municipal solid waste and industrial waste. While tasking municipal governments to manage municipal waste directly, the government designated the authority of the handling industrial waste to specific waste-generators, establishing the Polluter Pay Principle. To safeguard public health and the living environment, the Japanese government also instituted some emission control standards relating to air and water pollution, such as Air Pollution Control Act (enacted 1968) and Water Pollution Control Act (enacted 1970). Japan also created the Environment Agency in 1971 to establish an environmental administration system to implement those laws, Because of these strong regulatory mechanisms and establishment of modern technologies, significant progress was made in the waste management sector in the 1980s. However, the continuous growth of waste generation both in quantity and character, scarcities of landfills and struggles in getting community support for the construction of new waste treatment facilities in their neighbourhoods due to Not In My Back Yard (NIMBY) sentiments, Japan had to find new polices for waste reduction and recycling. The Law for Promotion of Utilization of Recyclable Resources, 1991 and the Extended Producer Responsibility Basic Environment Law, 1993 reflect the legislative shift toward the realisation of a circular society. In order to regulate specific waste streams, the Containers and Packaging Law, 1995, the Home Appliance Law, 1998, the Food Waste Law, 2000, the Construction Waste Law, 2000 and the End-of-Life-Vehicle Law, 2002 were also enacted. However, the most significant policy shift could be found with the formulation of the Fundamental Law for Establishing a Sound Material-Cycle (SMC) society in 2000, which advocates for a sustainable society minimising the consumption of natural resources and environmental loads through shared responsibility among authorities, businesses and citizens. It urged the prevention of material use and waste generation (Reduce), the cyclical use of material and products (Reuse and Recycle) and ensuring proper disposal of waste. The government also developed a Fundamental Plan for Establishing the SMC society in a comprehensive and systematic manner [5].

Since its establishment in 2000, Japan has made notable progress in achieving the qualitative targets set for illustrating the status of the realisation of a SMC society. For example, resource productivity increased by about 58%, the

cyclical use rate (resource base) was increased by 60% and the final disposal amount was down by about 74% [6]. However, all these indicators are now reaching maximum level because of regional decline, ageing population and economic stagnation in Japan [7]. In addition, the emerging waste streams such as plastics and marine litter, food lost and waste, disaster waste, and other hazardous and chemical wastes are being addressed and required further progress on applying 3R efforts. Considering the current situation, Japan's Cabinet enacted the Fourth Fundamental Plan in 2018 to re-examine a SMC society, integrating measures towards a sustainable society.

The Fourth Fundamental Plan is based on the vision of circulating a resource throughout its entire lifecycle establishing regional circular and ecological spheres. It promotes local resource efficiency and regional vitalisation based on a harmonised approach toward circulation, low-carbon, and unity with nature. Historically, Japan was famous for creating such a society in harmony with nature based on the "Mottainai Spirit" (the spirit of avoiding being wasteful in life), particularly in the Edo period (before 1868). Compared to the current society, people lived in harmony with nature, affecting lower carbon emissions. They formed the society, respecting the material cycle of optimal size based on the regional qualities and resource circulation. For example, the people in Edo commonly used the term "Sanri Shiho," which means that you can stay healthy and live longer if you eat vegetables grown within a radius of "Three Ri" (approximately 12 km) [8]. All organic matter such as kitchen waste, night soil and ash were converted into fertiliser for suburban farming and those products were then sent back again to community.

These concepts have passed down over generations and are currently gathering more attention than ever towards establishing a sustainable society. Oki Town in Fukuoka Prefecture is popular for its recycling-based society. The fundamental change in waste management policies started since the town recognised that the operation costs of its incinerator were escalating because of increasing garbage. In 2006, Oki built its biomass-recycling centre called Kururun, which accepts kitchen waste from both residents and commercial establishments, as well as septic tank sludge and raw sewage. Using a methane fermentation process, the recycling centre produces biogas that covers 80% of the facility's electricity consumption. It also produces about 15 tonnes of liquid fertiliser every day, which is used by the farmers in the town for free, establishing a closed-loop bio waste recycling system. The creation of Kururun also helped to raise awareness on ecological education, the 3Rs and sustainable lifestyles among the residents. Oki has also announced the Oki Town Mottainai Declaration in 2008, becoming the second local government in Japan to take actions in establishing zero-waste society. Oki residents have since increased efforts to sort their waste and currently, household garbage are separated into 29 types in this town with a population of 14,000. Because of these efforts, the amount of total waste incinerated in the town has dropped by 60% and the amount of landfilled waste by 99% at its peak. In addition, waste management costs have reduced from JPY 230 million to about JPY 27 million over the past 13 years [9] Currently, Oki Town with five other nearby municipalities - Okawa, Chikugo, Yanagawa, Miyama and Omuta - are mobilising efforts to improving their plastic recycling. In 2021, they

inaugurated the Fukuoka Chikugo Plastic Recycling Loop Group Council aiming to realise a carbon neutral society [10]

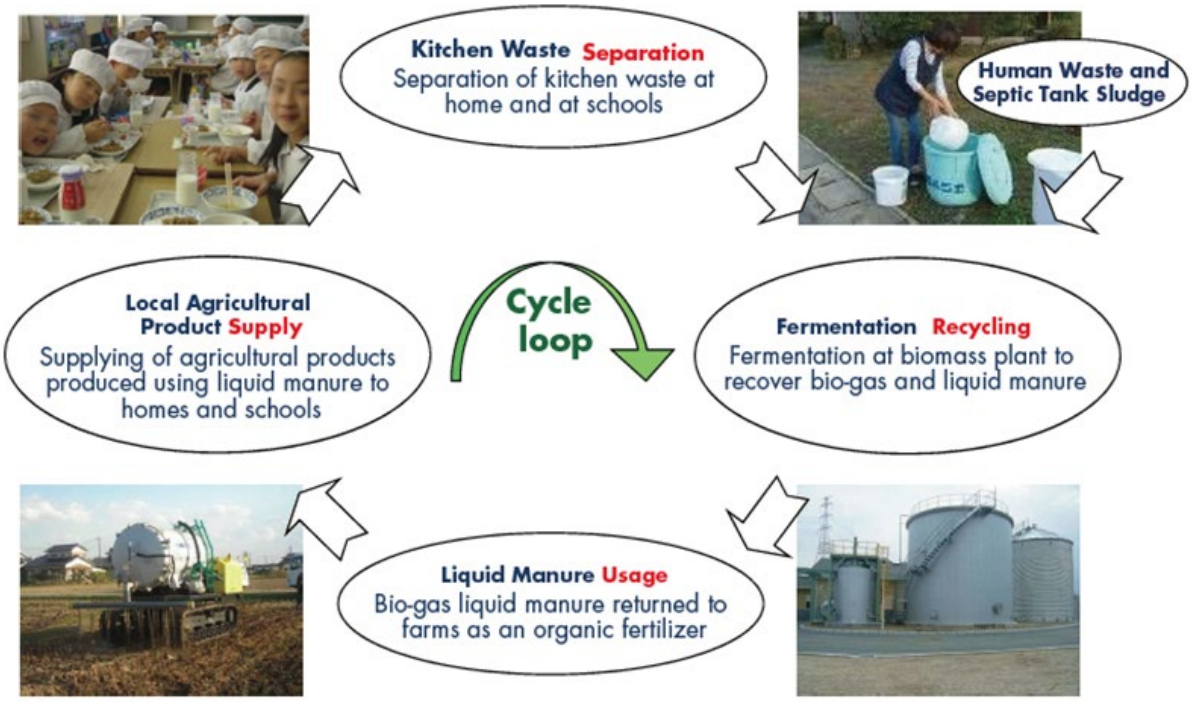
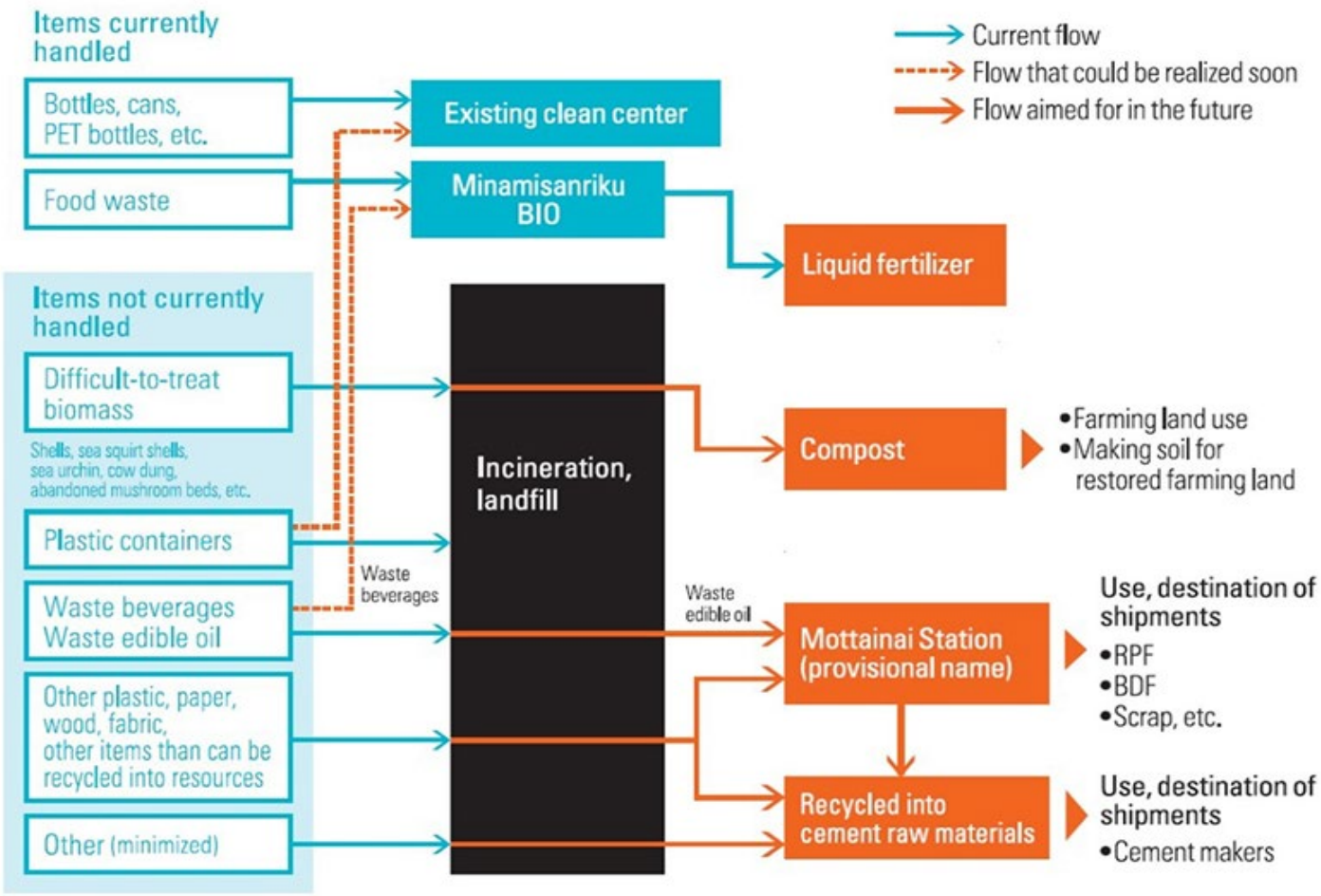


Figure 2: Structure of cooperative recycling efforts (Source: Oki Town; revised by author)

Creating a sound material cycle society in Oki Town [9].

We can find a similar experience from Minamisanriku town in Miyagi Prefecture. This town was seriously damaged by the Great East Japan

Earthquake in 2011. Since 2014, AMITA CORPORATION, a private company, has been engaged with the town and its local citizens in developing the town's vision and supporting the realisation of the vision, including installation and operation of biogas facilities, environmental certification screening, and symbiotic agricultural guidance. Minamisanriku BIO, the biogas facility, started operations in October 2015, accepting separated kitchen-waste from households, business sectors and septic tank sludge. Using about 1,889 metric tonnes of bio-waste, the plant produced around 89,835kWh of electricity and 1,969 metric tonnes of liquid fertiliser that was distributed to farmers in 2021, playing a major role in establishing a SMC society [11][12]. It also concentrated on strengthening the regional economy, by providing local employment and selling liquid fertiliser to local farmers. The liquid fertiliser is also distributed to all residents free for their gardens at around 30 local liquid fertiliser tanks. Minamisanriku BIO is getting attention both locally and internationally as one of the regional efforts in establishing cooperation between the government, citizens and the private sector in creating a SMC society. Recognising the realisation of the biomass industrial city initiative centered on resource recycling and sustainable regional development in the town, Minamisanriku received the Minister of the Environment award for the local community category at The 9th Good Life Award (192 entries) sponsored by the Ministry of the Environment in 2021[13].



A flow of total regional resource cycling in Minami Sanriku [11].

While most Asian countries are now experiencing rapid economic development, with increasing resource consumption and generation of waste, there is an urgency to establish a SMC society and overcome the triple planetary crisis (climate, nature and pollution) that we are facing. Based on its wealth of experience, trials and errors, Japan can contribute by sharing innovative science and technology as well as social actions that are rooted in people's lifestyle, such as minimizing waste generation, separating waste, creating a circular society based on local wisdom and experience related to the concept of Mottainai. Success will largely depend on the right mix of strong regulatory policies and innovative actions implemented at the local level in partnership with government, citizens and private sector.

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