## Special Article 5

# The Global Environment & Japanese Innovation: Takakura Home Composting (THC) in Surabaya (Indonesia)



Author Tonni Kurniawan

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#### Promoting International Cooperation through Soft Power

Increasing economic activities in Indonesia in recent years have resulted in an accelerated urbanization and an uncontrolled population growth in the country's urban areas. Consequently, the world's fourth most populous country has encountered a number of pressing development challenges, such as an over-generation of municipal solid waste (MSW). The waste generated includes both refuse from households and non-hazardous trash from industrial and institutional establishments.

Due to its cost-effectiveness, open dump is commonly employed for waste disposal in Indonesia. The open dump is a traditional method in which solid waste is dumped on low-lying areas of open land and the refuse is tipped haphazardly without considering any possible environmental or health impacts. As a result, its long-term impacts on public health are unpredictable, since safe disposal and monitoring of landfill leachate are not carried out according to a high standard to protect the environment. Considering that waste dispersion could lower air quality and water resources, the MSW over-generation problem is one of the most important issues that need to be tackled immediately. Unless properly addressed, this kind of environmental problem has the potential to derail the country's progress towards the United Nations Sustainable Development Goals. For this reason, business as usual is not an alternative for Indonesia in fighting the MSW problem, since inactivity or delay costs the country much more than taking appropriate actions. To explore ideal solutions for this particular problem, novel technology in reducing waste generation starting at its source is required. International cooperation with other countries in the framework of North-South cooperation may help the country to cope with its chronic MSW problem.

As a key location of innovative technologies, Japan has a long tradition of promoting sustainability through environmentally friendly ways of life that conserve unused resources. With its soft power in composting technology, the country has recently intensified international cooperation with other countries in the Southeast Asia region, including Indonesia. Through city-to-city cooperation facilitated by the Japan International Cooperation Agency (JICA), visiting experts from the Kitakyushu International Technocooperative Association (KITA) have identified a variety of environmental challenges in Surabaya (Indonesia) such as prevalent MSW problems and addressed them effectively using the Takakura Home Composting (THC) method. This article highlights how this social innovation introduced by the JICA has played an important role in substantially reducing organic waste disposal into local landfills in the country's second-largest city.

## Waste Management in Surabaya Before THC Implementation

As one of the major cities in Indonesia, located on the northern shore of eastern Java, Surabaya is a hub for economic and business activities in East Java Province (*Map*). The province's capital also represents a center of development that mainly serves the eastern part of the country. Despite having a prominent role in the current national development plan, Surabaya has been confronted with the increasing generation of MSW in recent years.

With a 2.1% annual growth of its urban population of more than 2.75

area of 375 square kilometers, Surabaya generates over 2,300 tonnes of MSW every day. In spite of its varying composition, the MSW generated largely consists of organic matter such as garbage from fruits with a moisture content ranging from 40% to 60%. Among the MSW, food waste is the predominant component. Depending on the eco-

million in 2010 and with an

Depending on the economic status of its districts, the daily amount of MSW generated in the city slightly varies from 1.95 kilograms

## Leachate from a local landfill



#### MAP Map of East Java Province



Source: Surabaya Municipality

to 2.05 kg per capita. Out of the waste generated, less than 50% is collected, transported, and disposed of in local open dumps, while the rest is recovered and recycled by scavengers. This is due to the fact that the operational cost for MSW management is quite high, as the expenses associated with waste management represent direct costs such as capital costs of infrastructure, equipment and manpower. As in other developing regions, waste management in Indonesia requires a

## Benowo open dump (Surabaya)



#### CHART 1 Organic waste composting before using THC method



massive investment for a long-term engagement. Therefore, only a few cities in the developing world can afford to collect and/or dispose of their MSW properly in landfills.

In spite of the Surabaya government's efforts to encourage people to recycle and reuse their MSW through various approaches, its generation rate still increases annually by 4%. Most of the waste collected is disposed of at the Benowo dumping site. Based on past trends and future projections, it is anticipated by the Surabaya environmental agency that the municipal garbage stockpiles will total 10 million tonnes, which is its limit, in the next five years. This indicates that an additional site is required for new landfills to meet the need for MSW disposal in the city from 2020 to 2040. Unless immediately tackled, the city will encounter serious urban environmental degradation due to its incapacity to absorb the volume of MSW its residents generate. As a result, the local MSW management will not be able to meet the demand for proper disposal, thus potentially causing a backlog of MSW in the city's urban environment.

Eventually strategic measures need to be undertaken not only with the MSW, which cannot be recycled and is of no further use, but also with the residual matter remaining after the MSW has been separated at a material recovery facility. As no single measure can universally and effectively deal with the MSW problem, composting and landfilling represent the major final disposal practices of MSW in Surabaya. The city's Public Works Agency has formulated an integrated solid waste management (ISWM) plan and its implementation includes the two disposal practices mentioned above. Due to its high operational costs, incineration has not been selected as an option for this purpose.

Prior to carrying out city-to-city level cooperation with Kitakyushu in 2005, solid waste management in Surabaya was solely operated by the agency without involving the private sector, civil society groups and NGOs. The MSWM system included source handling, collection and transfer, as well as waste disposal. The community was responsible for waste handling from households to transfer stations, while the agency collected, transferred and disposed of the waste into the Benowo landfill. Households often transferred their waste into stations without segregating organic and non-organic types. In addition, street vendors did not use recyclable packaging materials in their business operations. Since the MSW was not professionally treated at its source (at household level), the transfer of waste disposal into the local landfills became time consuming and inefficient.

Although insufficient resource allocation, less public participation, and improper waste management from collection and transportation to disposal activities were the main factors for the Surabaya municipality to resort to open dumping methods, a lack of cooperation among responsible agencies, less regulatory capacity, and poor law enforcement represented deficiencies in the city's waste management system before implementing the THC method with the cooperation of Kitakyushu and the KITA in 2005. To address this environmental problem over the long term, since 1994 Surabaya has developed community self-based solid waste management (CBSWM) citywide to reduce MSW generation at its source. The CBSWM scheme represents a variety of community programs that mobilize local communities in Surabaya to be involved in waste separation starting at household level.

Before 2005, both Surabaya municipality and local communities played major roles in the CBSWM scheme. Their organic waste was converted into compost at individual households, while the recyclable waste was sold to other trash collectors. Although public participation in the CBSWM scheme has increased since its introduction, the initial target of 30% waste reduction set by the Surabaya municipality could not be attained prior to the implementation of the THC method. This could be due to the fact that the improvement in MSWM systems through the CBSWM scheme has not kept pace with the rapid increase and diversification of the generated waste that has accompanied the rapid economic development and population growth of the city in recent years. In addition, normally micro-organisms take about three months using existing composters to decompose organic waste into conventional composts (*Chart 1*). To improve their performance in terms of time efficiency, the existing composters needed to be modified accordingly. For this purpose, Surabaya sought cooperation with other international partners mainly from Japan, such as the KITA and the JICA.

#### **Changes in Waste Management in Surabaya**

Since 2005 Surabaya and Kitakyushu have undertaken city-to-city cooperation not only to identify but also to select the most appropriate technology for organic waste composting at its source. For this reason, Surabaya has started a home composting program for organic waste using the THC device, jointly developed by the KITA and the Indonesian NGO Pusdakota. The KITA has been actively involved in promoting international cooperation between major cities in Asia such as Cebu in the Philippines, Hanoi, and Kitakyushu. So far these cities have benefited from international networking promoted by the KITA to improve the capacity of local governments in addressing their waste problems.

In 2005, Koji Takakura, an expert affiliated with the Wakamatsu Environment Research Institute in Fukuoka, disseminated an innovative composting method using "Takakura bins" (dimension: 40 centimeters x  $25 \text{ cm} \times 70 \text{ cm}$ ) to address the solid waste problem in Surabaya.

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CHART 2

ment awards at national level, including the Adipura Prize, one of the most prestigious awards in Indonesia for environmental protection. The city's achievements are reflected in the increasing quantity of garbage banks citywide, the improving number of households that use the THC method across the city, the increasing amount of households' compost for greening and farming activities, and the decreasing quantity of waste disposed of at local landfills.

The accomplishments of

Composting with Takakura bins is ideal for households that consist of five to 10 people. The THC method could be applied for composting not only kitchen waste but also refuse from markets. The THC method possesses key characteristics such as simple methodology, low energy consumption, indoor use, portability, rapid waste decomposition, no odors, and low cost production. This technology successfully gained an Indonesian Intellectual Property Right (P00200600206) in 2010 for an organic waste composting process at household scale.

Although organic waste composting is not a new idea regarding environmental sustainability, generally it encounters public resistance due to bad odors if the composting process is not managed properly. The Takakura bins, which typically represent an incremental innovation, possess some modifications from existing composters. The Takakura method uses fermentative bacteria as seed compost that were initially cultured from fermented food like yoghurt, fruits, and rice husks. Considering safety aspects, the bacteria used in this fermentation are the same as those usually found in local food like *tempe* (fermented bean foodstuff) and *tape* (fermented rice). As they were inactivated for over two hours at over 60°C, the bacteria became inert during the waste composting process. However, the use of locally available bacteria (aerobic micro-organisms) for fermentation purposes significantly shortened the time required for waste decomposition from three months to only half a week without releasing unpleasant odors and flies or fungi that were a local public concern.

To date, over 18,000 Takakura bins have been freely distributed to about 40,000 households in 8,800 sub-districts across the city (2006-2010) *(Chart 2).* On the local market, one Takakura bin set costs the equivalent of 1,000 yen. So far about 400 city environmental facilitators and 28,000 environmental personnel have been involved not only in the distribution of the bins and training, but also in educating households citywide about organic waste reduction through the THC method. The ULI Peduli, an NGO-wing of Unilever (Surabaya), played a major role in providing financial support for both activities.

In Surabaya, the implementation of the THC method has attained a steady 30% reduction of organic waste, as compared to that of the CBSWM alone (collection of recyclable, not organic waste), according to the Institute for Global Environmental Strategies (IGES, *Clean Asian Initiative Newsletter*, Vol. 10, March 2013). This indicates that 3,421 metric tons of  $CO_2$  equivalent emissions could be reduced annually and its emissions were avoided from the Benowo landfill in Surabaya. The net  $CO_2$  reduction suggests a notable achievement by the THC method in cutting greenhouse gas emissions with respect to environmental benefits.

Due to its remarkable achievements, Surabaya won a number of govern-

the municipality were also internationally recognized by a variety of international organizations. The city won the 2007 Urban Environment Improvement Award from the United Nations Economic and Social Commission for Asia and the Pacific (UNESCP) and the 2008 Best Practices Award for Improving the Residential Environment from the UN-HABITAT (United Nations Human Settlements Program). In 2011, Surabaya was selected by the Association of Southeast Asian Nations (ASEAN) as one of the most Environmentally Sustainable Cities in the region. Just recently, the city has received the United Europe award from the Europe Business Assembly (EBA) in the "Innovative City of the Future" category.

The success story of the THC method in Surabaya clearly indicates that Japan's technology could be applied in other parts of the developing world, as long as the innovation considers factors of climate, local features and customs, while respecting local identity and culture by using locally available resources. As reflected by the novelty of the THC method in its implementation, it is not always necessary to promote cutting-edge technology in developing countries; rather, efficient energy consumption, and inexpensive and convenient devices are more suitable and preferable for this purpose. What is common in Japan is really novel and seminal in Indonesia. The Takakura device might not work if the Takakura technologies were adopted in another region with a different climate. The annual temperature in Indonesia varies from 27°C to 35°C. With an annual average temperature of 31°C, it is an ideal condition for composting activities. Therefore, it is important to adapt Takakura technology based on local climate conditions. It is also necessary to transfer know-how about the technology to local people to enable them to use Takakura bins themselves, thus assisting its diffusion into local policy assimilation.

For this purpose, local community leaders were trained by the KITA's experts on how to convert garbage into compost using the THC method. A number of top rank officers, who were responsible for the city's MSW management, have visited Kitakyushu to attend capacity building training programs that last for two weeks. In return, over five experts from the KITA have travelled to Surabaya for site visits and inspections. The officers, who previously participated in this training, have now been promoted to occupy key positions with leadership responsibilities for transferring best environmental practices from Kitakyushu to Surabaya.

Resulting from the KITA's training, the local municipality established banks of garbage by separating and recycling non-organic waste, thus promoting waste segregation at its source and connecting unofficial recycling industries into the city's new waste management system. After intensive training for 10 months and public campaigns by local NGOs financially

supported by a private sector company (Unilever) on the benefits of applying the THC method, the public's mindset gradually changed. This led to a higher degree of their participation and environmental awareness, thus promoting a cleaner neighborhood throughout the citv through annual Green and Clean (G&C) competitions. As a part of the G&C public campaign promoted by the municipality, a variety of trees have been planted around the city's green spaces in recent vears.

### Compost from THC method for urban farming



#### CHART 3 Relationship among stakeholders in THC implementation



Source: Kurniawan et al. (2013)

To gradually transform MSW management in the city, Surabaya municipality has established various garbage banks for separating and recycling non-organic waste in recent years, thus promoting waste segregation at source and connecting unofficial recycling industries into the city's MSW management system. Furthermore, the municipality established about 16 compost centers across the city with a total monthly production capacity of 600 tons of compost. The compost generated may be used not only for urban farming, but also for beautifying the local environment and gardening. In addition, the use of compost has increased green spaces by 10% in residential and urban areas.

Based on the results of the demonstration projects in Surabaya in recent years, it is evident that the THC method has benefited the local people in terms of time efficiency and reduction of final waste quantitatively. This innovation offers novel solutions to local environmental problems by improving the outcomes of composting activities. In this regard, the seminal device could efficiently transform garbage into good quality compost within 72 hours, thus improving local environmental protection and the quality of people's lives. By turning the organic waste into a valuable resource like compost, solid waste could be decoupled from economic growth. With the increasing use of Takakura bins for organic waste composting, this suggests that city-to-city cooperation can eventually lead to direct experiences at ground-level, as people from both cities closely work to achieve the same goal of waste reduction.

#### Conclusion

After almost a decade (2005-2014), the implementation of city-to-city cooperation between Kitakyushu and Surabaya has had positive impacts on the local environment through the adaptation and assimilation of the THC method. This case study has demonstrated that a substantial improvement in MSW management can result from a simple and low-cost technology such as the Takakura bin. The KITA has effectively engaged with the local government not only to facilitate technological transfer of the THC technology and to promote international cooperation, but also to effectively provide a wide range of assistance for the municipality, with the support of the JICA. The Surabaya municipality, local communities and other stakeholders such as NGOs also followed up this cooperation by creating the required organizational capacity to make a viable MSW management system, starting from the household level *(Chart 3)*.

In addition, support from local institutions, both governmental and nongovernmental players, is essential to facilitate the adoption of new best available techniques (BAT) in the waste sector like Japan's THC method. Like other BATs, composting technology using the THC method has minimum impacts on the environment and lower costs without compromising public health. The international cooperation between the two cities did not terminate with the provision of the THC equipment by the KITA to the Surabaya municipality. Substantial improvement in MSW management in Surabaya was possible, as people followed up and the local government spread and applied the new system widely. The Surabaya municipality has the knowledge and communication skills to engage local communities and promote the need to improve the local capacity to provide such services.

It goes without saying that city-to-city cooperation can promote larger processes in other developing cities or at national level towards environmental sustainability. The successful implementation of the THC method in Surabaya has inspired its replication in other cities nationwide and in other developing countries. In fact, the Takakura-based composting model has been included as one of the most important features in the Indonesian Solid Waste Management Legislation since 2008 ("Development of waste management practices in Indonesia" by Christia Meidiana and Nurdan Gamze Turan, *European Journal of Scientific Research*, 40, 2010). The law also positioned Surabaya as a role model for others cities in implementing the transformation of MSW management in the country.

In partnership with the JICA, the Takakura bins are now widely promoted and tested in other parts of the world, such as Nepal, Burkina Faso, the Dominican Republic, Sri Lanka, Djibouti, Tanzania, Benin, and Jordan. The use of the THC technology for organic waste reduction has enabled cities in the developing world to ease growing environmental concerns in their cities partly due to MSW problems. In addition, this innovation will help their governments attain the win-win goal of economic growth and environmental protection without sacrificing either in the battle against MSW. For Japan, environmental protection is regarded not as an obstacle but a tangible contribution to promoting sustainable development.

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Tonni Kurniawan is a postdoctoral fellow at the United Nations University-Institute of Advanced Studies of Sustainability (Tokyo). His research focuses on solid waste management.