"Surabaya Green & Clean": genesis of a community-based, semi-decentralized waste management model

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Introduction

With a population recorded in 2015 at 2,975,358 inhabitants, Surabaya is Indonesia's second-most populous city after Jakarta. The capital of East Java, Surabaya is a large coastal city oriented towards trade and industry. Surabaya is today a very horizontal city, covering 375 km². The seaside (north and east) is sparsely urbanized. The coast, covered with marshes and mangroves (on 300 ha), is largely unbuildable. The density of housing is nevertheless high: 8,300 inhabitants/km² on average. Beyond its municipal perimeter, Surabaya, together with Gresik and Sidoarjo, forms a conurbation of almost 6.5 million inhabitants.

The urban structure of Surabaya is characterized by large avenues and boulevards where car traffic is dense, even very crowded at peak times. These main roads, not very welcoming for pedestrians, delimit residential areas that are streaked with narrow alleys where vehicles are much less present: the kampungs. The kampungs are the traditional living quarters of Javanese cities. These are dense and compact blocks, forming a mosaic of small individual houses built with durable materials. Very often, Javanese people live and work in these neighborhoods. In most cases, the streets are paved and traffic is reduced: cars

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can park, two-wheelers can circulate, and frequent speed bumps impose very limited speeds.

Covering only 7% of the area of the municipality, the kampungs house approximately 60% of the population of Surabaya. Mostly inhabited by lower-middle-class homes, the kampungs are neither affluent residential areas nor slums. Traditionally placed under the management of a chief, they constitute spatial and social units of organization. While kampungs generally have a derogatory connotation (evoking a mode of rural life unsuited to the modernity of cities) and tend to be eradicated, the authorities of Surabaya distinguished themselves through a political will to include them in urban planning and to stop despising them in favor of modern real estate projects.

Based on this vernacular urban structure, the case of Surabaya serves as an excellent example of the social, community-based, multi-scale, and multi-technology ecological innovations that cities in the Global South could seek to develop. After a waste crisis in the early 2000s, a huge community mobilization led to a solid waste management system that is inspiring other cities from all over the world.

The most interesting innovation comes in the form of community waste banks for recyclables, which are widespread at the kampung scale (cf. Chapter 2). The neighborhood is not simply the technically defined perimeter for waste collection, but also the level at which some aspects of the service are managed and decided. In the case of Surabaya, neighborhood organizations decide on the local policy to be implemented. The kampungs, however, take responsibility for the cleanliness of their area, for collecting and sorting the waste, maintaining green spaces, and managing the community composting platform, etc. While this policy produces very different results across the kampungs, it promotes the deep involvement of residents (especially women's associations), in circumstances where the municipal public service lacks the capacity to directly offer these facilities on a massive scale.

The data presented here stems mainly from a field survey conducted under the ORVA2D research project,[1] in cooperation with the Environmental Engineering Department of the Institut Teknologi Sepuluh Nopember (ITS). Accessing data proved to be complicated for several reasons: the absence of technical and financial monitoring of service activities managed by the municipality, the

[1] Research Program "*Organisation de la Valorisation des Déchets dans les pays en Développement*" (ORVA2D), AFD, 2015-2017: http://eso-lemans.cnrs.fr/fr/recherche/programmes-en-cours/projet-afd.html

performance of services by companies reluctant to show their accounts, and the lack of transparency in public accounts. Despite these difficulties, primary data was collected through surveys in several *kampungs*, and, additionally, reliable secondary data were obtained from the Cleansing and Environmental Protection Agencies of the City of Surabaya (Durand et al., 2019).

The "Surabaya Green & Clean" program

2001: a waste crisis that served as a collective awareness

In 2001, the city experienced a major crisis. Keputih, the only disposal site in the city, was closed by the court following a complaint from nearby residents. However, the future landfill was not yet ready; therefore, there was no longer an outlet for the city's waste. For more than three weeks, household waste piled up in every neighborhood. The start of the rainy season accentuated the crisis. In no time, the city and its waterways were strewn with enormous "floods of waste", as the local press put it.

The new Benowo landfill was hurriedly opened three weeks later and gradually brought up to standard. However, that event was crucial in raising collective awareness regarding the waste issue. It had a strong impact on public opinion and laid the ground for a highly proactive and participatory waste management policy.

An initiative fostered by a corporate social responsibility program

The Surabaya Green & Clean project began through a collaboration between the Unilever Foundation, a local NGO (Pusdakota), and UNESA University. This ambitious program was triggered by the crisis sparked by the sudden closure of the Keputih disposal site in 2001, the long-term field experiments run by NGOs in liaison with the residents, and Unilever's determination to implement a CSR policy. As a major producer of palm oil, the company needed to improve its image, which is why it invested in this project. It provided annual grant-based support for a large annual city-wide contest organized to reward the cleanest neighborhoods.

The stated objective, based on a first eco-friendly kampung launched in the early 2000s, is to reduce waste at the source through neighborhood organizations by mobilizing recycling and composting activities. In partnership with the

City of Surabaya, Unilever identified community "leaders" within each *Rukun Warga* (RW, neighborhood units) and *Rukun Tetangga* (RT, community units) on whom they could rely to raise awareness among the population, and funded their training. The program was also promoted by 420 voluntary "facilitators" (with expenses paid and officially recognized) together with 28,000 community "leaders" trained in waste sorting and composting.

The overall amount of Unilever's CSR (corporate social responsibility) program is confidential, but it is known that the foundation contributed some IDR 400 million (about €27,000) in 2014 and IDR 300 million (about €20,000) in 2016 to the Surabaya Green & Clean program (Cavé & Nugroho, 2016).

Jointly organized by a corporate foundation, local NGOs, women's associations, and the media, the operation was subsequently taken over by the municipality to be mainstreamed as public policy. In 2016, the program was taken over by the Surabaya municipality, and 60% of neighborhoods participated in it, with 118 prizes awarded each year (Cavé & Nugroho, 2016). As a result, and while it was earlier described as "a dirty city full of pretensions and greed" (Hollander 2008, p.15), Surabaya now has the reputation of a clean city, both literally and figuratively (in terms of corruption).

Ibu Risma, a mayor committed to environmental issues

The transformation of Surabaya, from a dirty and dry city into a clean and green city, is today commonly attributed to its current mayor: Tri Rismaharini, nicknamed "Ibu Risma". A graduate in Architecture with a specialty in urban planning from ITS, Ibu Risma worked for twenty years in municipal services. From 2005 to 2008, she headed the Cleanliness and Landscaping Department (DKP), in charge of green spaces and cleanliness.

She was elected Mayor in 2010 with 38% of the vote on a campaign slogan: "make Surabaya a smart, humane & ecological city". In a few years, and despite a relatively limited municipal budget of IDR 2,971 billion in 2015 (EUR 198 million)—i.e., less than IDR 1 million/inhabitant (approx. €67/inhabitant)—her administration notably:

- developed the city's port activities (200% increase in traffic);
- imposed free education and health services for the poorest households (around 35% of the municipal budget is spent on education);

- permanently closed 'Dolly', the largest prostitution district in Asia. Brothels have been transformed into daycare centers and abandoned petrol stations into children's play areas;
- repurposed urban wasteland by developing 11 municipal parks, so that Surabaya now has more than 20% green space;
- provided rainwater absorption spaces (e.g., cemeteries) to reduce the city's chronic flooding;
- protected mangrove areas and supported urban agriculture;
- developed a participatory mode of government, which includes communities in decision-making and the implementation of public policies.

In 2011, the city won the national Adipura competition, which rewards cities that make the most environmental effort. In 2012, Surabaya received the ASEAN Environmentally Sustainable City Award. This award recognized the development of green spaces, as well as the marked improvement in the cleanliness of the city. The city was clean, parks were built, trees were planted along the avenues, and collection points were created in each district to store the waste collected from homes.

In 2013, Ibu Risma was named one of the ten most influential women in the country by Forbes Indonesia. The magazine notably recognized her for having blocked a government toll road project through the city in favor of a future tram system. In 2014, Ibu Risma was nominated for the World Mayor Prize, awarded by the World Mayors Foundation.

In 2015, the city, which had won the national Adipura competition five times in a row since 2011, received the Adipura Kencana, the highest environmental award in Indonesia. Not surprisingly, in November 2015, Ibu Risma was largely re-elected as mayor of the city, with 86% of the vote.

Surabaya's waste management system today

The City of Surabaya became one of the cities in Indonesia with the largest volume of solid waste. The volume of solid waste production in Surabaya in 2018 was 9,594 m^3/day. The amount of solid waste handled in the landfill was 5,237 m^3/day, or 55%. The remaining waste is mostly handled at the source, through household composting, decentralized composting centers, waste banks, and informal recovery. However, around 25% of municipal solid waste still lacks proper management and is thrown into the drainage system or

burned in the open air. The city also has a significant issue related to its landfill because the land area of Benowo Landfill is not well equipped to handle the entire solid waste of Surabaya, the potential for pollution could be large, and solid waste is the second leading cause of greenhouse gas emissions in Surabaya (after transportation).

Primary waste collection at kampung level

Surabaya has made the policy choice to entrust all collection to a municipal enterprise, meaning that it is performed directly by the municipal service with a fleet of 285 trucks. The purchase of compactor-trucks is planned in order to reduce the number of collection rounds. To make this solution viable, the city went through a period of modernizing all its municipal management and consolidating its budgets. Today, the collection rate is close to 90%.

In Surabaya, primary collection is highly organized, albeit not officially authorized. It is deployed by neighborhood organizations (Rukun Warga or RW) and carried out by the neighborhood's poorer residents or by waste collectors. They collect the waste using handcarts and take it to one of the city's transfer points (TPS – Temporary Shelter Facilities). These primary collectors, or tenaga penambil as they are called, are paid by the RWs, and their level of remuneration varies from one neighborhood to another. The RW administration levies a corresponding user charge on the households. As a result, the Surabaya municipality has no data on the organization of primary collection. What enables this primary collection system to function is actually the strong local sociability that has its historical roots in the operation of several public services. The Surabaya municipality then takes responsibility for transporting the waste from the TPSs to the city's new sanitary landfill.

In Surabaya, there are 173 official transfer points (TPSs). These are no longer places where waste is simply deposited, but real sorting centers at the disposal of the neighborhood's primary collectors. With a surface area of 100 to 300 m², they can house the waste of around 10,000 people. Neighborhood associations (rukun warga) enjoy strong incentives to sort waste (both financially and in terms of social recognition). Recyclables may account for up to 36% of household waste.

In light of this example, the neighborhood appears to be a favorable scale for sorting and reducing the streams of waste to be transported to the centralized sanitary landfill. What's more, collecting the service charge from residents

for primary collection proves relatively easy. As the service is decentralized, this also means that vulnerable citizens can be given work.

Decentralized composting plants

After the "flood of waste" caused by the premature closure of the polluting municipal disposal site at Keputih in 2001, the Surabaya municipality launched an organic waste recovery policy based on the creation of decentralized composting platforms and the promotion of household composting.

In 2016, 23 municipal decentralized composting units were operating across the city with an average capacity of 2 tonnes/day for each platform, equivalent to 19,000 tonnes/year for all platforms combined (around 2% of the waste generated by the city) (Cavé & Nugroho, 2016). The treated waste comes from the city's green spaces, the municipal plant nursery, and markets. As the waste streams are homogeneous, the compost is of good quality and used for urban green spaces or given to schools and communities.

Green waste composting costs €16.35 per tonne (Cavé & Nugroho, 2016). If the cost of sorting is factored in, the cost of treating the organic fraction of mixed household waste would rise to €36 per tonne of raw waste. Composting represents 3% of municipal expenditure in Surabaya, while the volumes of composted waste are 5%. This operation appears to be particularly well-run in Surabaya, where it costs little compared to the quantities composted. This is mainly due to the large number of solutions that Surabaya proposes for composting waste at several scales.

Neighborhood composting: community-led management of domestic bio-waste

Alongside the municipal composting platforms, the Surabaya municipality has distributed a vast number of community compost bins for organic household waste. Between 2005 and 2010, considerable community efforts were made to promote this practice: nearly 20,000 household composting bins were distributed, mainly thanks to the involvement of women's community associations.

The combination of the two approaches in the City of Surabaya (decentralized composting of green waste and household composting at the community scale) shows the municipality's real commitment to reducing the amount of waste sent to landfill. Several factors appear to be positive: the composition of the waste (a large number of green spaces and a significant share of organics

in household waste) and Surabaya's urban sprawl. By increasing the number of small, decentralized composting units (500 m²), the city makes good use of vacant urban land and helps to reduce waste transport costs. The main limitation of this approach is the inability of the households involved in community composting to sell the compost. One of the composting units managed by a Japanese cooperation project is trying to sell its compost, but it is seen as too expensive by farmers located over 100 kilometers away.

Sanitary landfilling

From a financial point of view, what stands out is the significant financial burden of landfilling in Surabaya. Surabaya's sanitary landfill operates with impermeable cells, leachate collection and treatment, and the capture of biogas for conversion into electricity, at a cost of €8.4 per ton. This is due to the high cost of a sanitary landfill that complies with environmental standards—which makes the case for diverting waste flows towards recovery and recycling channels through composting practices and waste banks.

In Surabaya, a gasification project for landfill waste was under consideration in 2018, with a planned capacity of 100 tons/day to generate 8 MW/day of electricity. The choice of this process seems risky as it requires homogenized waste, which in turn demands heavy and costly preparation. This unit, which would be a first in Indonesia, is still under construction. It should be noted, however, that MSW gasification projects are currently very rare worldwide and only suited to very specific contexts.

Surabaya's waste banks: community waste sorting

In Surabaya, Indonesia, public policy turns a blind eye to the informal sector (unregulated activities) and encourages an official community-led waste management approach. This is the rationale behind the creation of waste banks designed to promote neighborhood recycling.

The initiative was driven by a national program, Adipura, set up to reward cities that had environmentally virtuous waste management practices. Adipura is a program launched by the Ministry of Environment in the mid-1990s, which rewards cities that make the most efforts in urban environment management. The evaluation criteria include three main areas: brown issues (waste management, water, and air pollution); green issues (green spaces and urban planning); and white issues (democratic participation). The contest is held every year, and

the participating cities are assessed by third parties (universities and NGOs). To win the award, cities now have to be equipped with a sanitary landfill and have set up waste banks (Ministry of Environment Regulation No. 6/2014).

Waste banks: creating ties between residents and recyclers

In 2016, there were 400 waste banks across the city, defined locally as a "social engineering tool to involve citizens in waste sorting" (Cavé & Nugroho, 2016, p.48). Solid waste from houses is brought to the waste bank by the community itself. Waste deposited at the banks has been pre-sorted and carried by households (generally housewives). The waste banks are managed at the community level by a women's association. Each waste bank pays out its profits to residents as it sees fit, but most only make one payment a year. Some waste banks manage to remunerate their managers, thereby transforming a voluntary community activity into a real job.

In Surabaya, it is an organized neighborhood community that finances or directly implements this service. Each neighborhood waste bank sets its own user tariffs. The users are not paid immediately: the revenue from their waste is kept in a savings account and only paid out to them once a year on the occasion of a religious holiday (and during the cleanliness contest organized city-wide). The idea behind the waste banks is that: "dry waste has value. This value is not huge. But if you save it and let it build up over a certain time, it becomes a worthwhile amount" (Ibu Maya, Unilever, 02/05).

Each waste bank then negotiates the rates for its materials with buyers; prices vary considerably depending on time and place. A waste bank sorts between 15 and 50 different types of waste materials to sell on directly to large buyers. Yet, these recyclable-waste banks, supported by the public authorities, are unable to function without recourse to informal dealers (who also get recyclable materials from waste pickers and large producers such as offices). Waste banks thus represent only a first step in the process of formalizing this sector.

To structure the chain, the municipality has encouraged the creation of a "parent" waste bank (Bina Mandiri waste bank) that buys waste from other waste banks. Managed by six "volunteers", this "parent" waste bank actually only purchases waste materials from about 200 waste banks (50% of the total). The others continue to sell to informal semi-wholesalers, who offer a better price, faster payment, and are often geographically closer. In reality, the "parent" bank finds it difficult to channel all of the recyclables captured by the community waste banks to its own site. The community banks are often tempted to sell their

materials to informal local dealers, who offer better purchase terms, including prices, frequency, payment terms, and the variety of materials accepted (Cavé & Nugroho, 2016).

One of the limits to multi-stakeholder integration lies in managing the entire recovery and recycling chain. This does not mean public management of the whole chain, but rather knowledge and coordination among stakeholders. Surabaya has tried to set up a "parent" waste bank to centralize all recycled waste streams, but this has met with relative failure as the networks of buyers and waste dealers continue to operate. As a result, a robust network of informal waste pickers persists when it comes to recovering the bulk of recyclable waste.

An innovative financing method for still limited tonnages

The city estimates the annual turnover of each waste bank at between €20 and €330 from the resale of recyclable waste, equivalent to a yearly income of around €3 or €4 for each participating household. While some waste banks pay out their receipts directly to the residents, others use them to finance other local public services. For instance, the receipts can be deducted from water or electricity bills (also managed at the community level). This can reduce bills by 20–25%. Other waste banks pay out in the form of discount coupons usable in local shops, thus helping to boost the local economy. In all cases, such schemes are implemented with the approval of local authorities (RW or RT); this is outside the purview of municipal authorities.

There are no centralized data on the flows transiting through waste banks. In Surabaya, estimates suggest the figure of 3.3 tons a day was captured in 2014, equivalent to 0.22% of the tonnage sent to landfill by the city, or 0.62% of all recyclable waste generated (Cavé & Nugroho, 2016, p.54). The volumes captured by these community structures thus remain limited compared to those of the informal waste pickers, who continue to capture the highest-value waste materials. Furthermore, although waste banks work very well in the kampungs—i.e., the traditional neighborhoods home to a small middle class—they are much less successful in recently built residential blocks and districts. The entire downstream portion of the chain remains outside the public authorities' jurisdiction, despite their attempt to set up a "parent" waste bank.

Conclusion

The SGC: a resounding success, yet largely overestimated

From the start, the Surabaya Green & Clean program was a great success: the physiognomy of the neighborhoods changed, public cleanliness improved, and the inhabitants of the kampungs were valued. In the mid-2000s, an exceptional popular mobilization took place around the issue of waste: no less than 28,000 citizens volunteered to serve as voluntary liaisons, relaying public policy to residents. Today, 60% of the districts participate.

As of 2008, one report stated that "the amount of waste transported to Benowo landfill […] has reduced by more than 10% from around 1,500 T/d in 2005 to 1,300 T/d in 2007". As of 2009, the observation is amplified: in the space of 4 years, between 2004 and 2008, the production of waste had dropped by 23% (Maeda 2009, p.2). In 2012, the effect was further amplified: the volume of waste to be buried had decreased by 36% in 7 years (Ginanjar 2012, p.13). The authors associate this exceptional reduction with the development of composting and Waste Banks, in particular. Since 2013, this assertion has been repeated in the academic literature (Tauran, Ma'ruf & Suyatno, 2015, p. 55; Wijayanti & Suryani, 2015, p. 176). In 2016, the municipality itself affirmed that its public upstream recovery policy allows a reduction in the waste to be collected by 350 T/d for 1,477 T/d of waste buried in Benowo.

Based on the analysis conducted for this paper, these balance sheets seem considerably overestimated. According to the figures from this study, in 2016, the 23 composting units processed 52 T/d, while the 400 Waste Banks recovered 3.3 T/d, a total diversion of 55 T/d. However, it is categorically unlikely that domestic composting (which is difficult to measure and is losing momentum) can treat 295 T/d of household waste.

An Asian model fostered through a CSR program

Nonetheless, many delegations came to take inspiration from the Surabaya waste management "model". The waste bank device and the composting part in particular were promoted in other metropolitan areas in the country (Medan, Semarang, Macassar, Jakarta) and in Asia (Philippines, Thailand, Nepal, Malaysia). As has been shown, in Surabaya, the neighborhood scale was always pivotal: it is the long-standing sociability that enabled the innovations in sorting and composting to be deployed.

As this example shows, companies, like NGOs, thus play an important role in launching new initiatives. CSR allows financial resources to be released outside the conventional modes of financing urban services. The key question regarding these financing methods is that of their longevity. If it is not feasible to base a municipal waste management policy on such short-lived partnerships, their participation could nonetheless serve as a springboard to launch innovative operations. Any scaling-up requires a longer-lasting financial mechanism and more direct involvement from public stakeholders. This is why, in Surabaya, the municipality subsequently took over from the Unilever Foundation. The next step will thus be to make the actual waste generators pay, particularly when the waste is produced by companies, yet very often managed by the public service.

Towards an incentive-based fee?

In Surabaya, 86% of waste management expenditure is covered by public authorities: 6% of municipal resources come from the central government, 34% from the provincial government, and 46% from the municipality's own resources. Waste management expenditure, however, represents only 7% of the municipal budget. When assessing the financial soundness of the service with respect to the share of expenditure covered by the taxes or fees paid by households, household participation is less than 15% in Surabaya.

In Surabaya, it is not through joint billing, but rather good waste management practices that help to finance other services. The sale of waste collected by a community waste bank provides a nest egg that residents can use to pay their other bills, such as water or electricity. Territorial solidarity has thus emerged within the neighborhood.

For closer integration of community waste recovery into Surabaya's MSW management service, it would nonetheless be more logical to allow citizens to pay part of the waste removal fee (*retribusi*) in the same way. This measure would help citizens to become fully aware of the synergies between waste recovery on the one hand, and the reduction of the cost (and price) of the MSW collection and disposal service on the other. In other words, it would introduce a type of incentive-based fee (an incentive to generate less waste). This seems quite possible, as even the poorest households manage to earn a monthly income of IDR 8,000 from the sale of sorted dry waste, whereas the *retribusi* amount fluctuates between IDR 500 and 19,000 per month.

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