

Improving the informal recycling sector through segregation of waste in the household - The case of Dhaka Bangladesh

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Abstract

The city corporation of Dhaka (DCC), Bangladesh, currently only collects less than half of the solid waste produced in the municipality, an area of 360 km² with a population of 7 million. Uncollected waste is dumped indiscriminately by inhabitants into water bodies or floodplains or else burnt, thus contaminating water, land and air of the city area and beyond. Rather than searching for solutions to improve collection and disposal services, this paper presents research which focuses on the production of waste at household level, and explores how household waste segregation can preserve the value of recyclable materials, enhance their accessibility to informal workers of the

recycling sector and reduce the overall waste flows. The analysis of the informal recycling industry and its stakeholders as well as waste generation and composition shows that there is still a large untapped potential. However any initiative aiming to increase source segregation and access to more recyclables needs to carefully consider all “integrated” aspects of the waste management system which influence and determine sustainability and success of the envisaged improvement. Practicality of segregation at the household level as well as regularity of collection or purchase of recyclables by the informal sector need to be addressed as priority.

1. Introduction

Management of municipal solid waste is a substantial challenge in developing countries, in particular in the larger urban centres (Scheinberg, Wilson, & Rodic, 2010). Rapid and unplanned urbanization leaves municipalities largely overwhelmed when it comes to the collection and disposal of increasing amounts of waste (Medina, 2005). Also, a transfer of engineering solutions for collection and disposal successfully used in industrialized countries is hardly feasible as enabling conditions differ significantly. Typically waste composition (e.g. higher fraction of organic waste), accessibility to the waste source (e.g. road quality), climate, management capacity, or even the technical skills and capacity of the people in charge of municipal solid waste management differ widely from an industrialized country situation. Therefore municipalities need to develop their own “localised” solutions and approaches to tackle the waste management challenge. Municipal solid waste management in developing countries is also characterized by the existence of a well-established informal sector active in collection and recycling of valuable materials (Gunsilius, Chaturvedi, & Scheinberg, 2011; Wilson, Araba, Chinwah, & Cheeseman, 2009). With high formal unemployment rates and a large number of urban poor, informal recycling is driven by the opportunity to provide a livelihood. As labour costs are low, collection and processing costs of recyclables

also remain low and thus make this source of material attractive for the informal cottage industry or the formal industrial sector. Recycling contributes to municipal solid waste management by diverting materials which have an economic value from the main waste flow, thus reducing quantities of waste to be collected and disposed. Nevertheless the informal recycling sector is seldom acknowledged for its contribution to municipal solid waste management. Informal actors (in particular waste pickers) are often perceived as unclean people, creating a mess in public spaces while sorting and dumping the refuse indiscriminately, and are thus hindered in their activities (Wilson, et al., 2009).

The tangible value of recycled products in developing countries shows that the generally negatively connoted term “waste” is subjective: for some a used plastic bag has no value, for others it is a resource. Also, organic refuse from the kitchen can either be a “filthy” component if mixed with other materials, or a valuable organic fertilizer if separated at the source and composted. In comparison, recycling activities in industrialized countries are rarely profitable but are subsidized and rather driven by environmental consciousness, environmental policy and regulations such as the polluter-pays principle (Scheinberg, et al., 2010).

For users of waste services, municipal solid waste management is mostly perceived as an issue of waste collection, and then “out of sight – out of mind” (as also in the case of Dhaka, described below). This perspective unfortunately overlooks the potential of recycling to reduce amounts of waste, and also the roles of the different actors from generation of waste to recovery and final safe disposal or treatment. In this regard, households can play a predominant role, as they have the capacity to substantially reduce the amounts of unwanted waste at household level by segregating clean materials which have a recyclable value - such as plastic or paper - instead of mixing them with other fractions such as kitchen waste, and thus diminishing their potential recycling value (Enayetullah, Sinha, Khan, et al., 2006).

Segregation at the household level is one of the measures for reducing amounts of discarded materials at the source (Figueroa, 1998). Another measure is the better organization at community level for the collection of recyclables. It is important to note that only increasing segregation does not provide the complete solution: the other “downstream” components of the waste management system (reliable collection of recyclables, recycling capacities) must also be in place and functional so that long-term incentives for households can be ensured.

This paper presents research which was initiated by the Bangladeshi office of the Swiss Foundation for Technical Cooperation Swisscontact with the idea to develop a project concept on pro-poor market development with a positive environmental impact. Field research took place from July to September 2011 in the city of Dhaka, Bangladesh, a city where rapid urbanisation and waste management is highly relevant and challenging.

A first research phase involved a comprehensive baseline study of the waste management situation in Dhaka. Experience from existing and past projects in Bangladesh, information from stakeholders, technical experts, the civil society and the government were compiled and analysed. In addition business opportunities and potential incentive schemes were explored as part of the research. Finally also main barriers were identified which hinder a more sustainable resource recovery in the existing system of Dhaka. In this context “sustainable resource recovery” means safer in terms of human and environmental health, with an improved social impact and economically feasible. Based on this analysis, the research was then narrowed down to the aspect of segregation of solid waste at the household level, which was identified as the most promising approach in the current context. Incentive models that could sustainably increase volumes of waste separated at source and recycled were characterized and subjected to local expert and stakeholder judgement.

2. Research materials and methods

Two documented studies had previously been realized in Dhaka for Swisscontact-Katalyst (Katalyst, 2012) by Waste Concern Consultants in 2005-2006: the first one in a specific neighbourhood of Dhaka (Uttara) and the second one more broadly on the topic of plastic recycling industry in Dhaka. Waste Concern Consultants is a branch of Waste Concern Group, a Bangladeshi enterprise specializing in waste management, focusing their work primarily on composting of organic waste from markets and carbon certificate trading (Waste Concern, 2012).

The Uttara neighbourhood study used household questionnaire surveys in randomly selected 100 households, collection point surveys (assessing amounts of waste generated, collected, composition of the waste collected, and waste density for 5 consecutive days), and an institutional survey of the private company in charge of waste collection, determining their operational system and capacity. An outcome of this study, which was also documented, was a one-year pilot project with the objective to increase waste segregation in households of Uttara.

The plastic recycling study had a broader scope, conducting randomised household surveys in 384 households clustered in low (211), lower middle (77), middle (77) and high (19) income groups. The overall physical characterization of waste at household level was analysed, as well as the types of plastic used, amounts sold to door-to-door buyers and prices obtained, amounts reused, and amounts disposed. Also, municipal collection point surveys were realized according to income groups of residents (amounts of waste generated by income groups, collected, composition of the waste collected, waste density, selling prices of plastic, amounts of plastic disposed). Stakeholder questionnaire surveys, targeting 30 individuals from each stakeholders group, as well as surveys at the final waste disposal sites which included assessing the number of people involved in waste picking at the disposal site, quantities of plastic collected and selling prices per category, finally completed the study.

The Katalyst / Waste Concern baseline surveys were used as a reference regarding waste composition and other technical aspects.

To complete or confirm available secondary data, qualitative primary data was also collected from July to September 2011. Field research, which consisted of observations, questionnaires, focus group discussions and semi-structured interviews was done on five levels: (a) in meetings with the societies in charge of waste collection in the neighbourhoods of Baridhara and Gulshan, (b) with visits to Dhaka City Corporation (DCC) collection points where separation takes place and semi-structured

interviews with primary waste collectors (Gariwallas) and waste pickers (Tokais), (c) with field visits to recyclables shops (Vangaris) in Baridhara where semi-structured interviews with shop owners and recyclables collectors (Feriwallas) were conducted, (d) in a visit of a plastic recycling factory and a semi-structured interview conducted with its owners, and (e) through questionnaires on individual perception of the municipal solid waste situation in Dhaka which were completed by 30 Bangladeshis from a medium to high social background, living in different neighbourhoods of the city.

Another important source of information was the 3R (Reduce, Reuse, Recycle) strategy issued in 2011 by the Bangladesh Government, developed with technical support of Waste Concern. In this 3R strategy, segregation at household level is outlined as one of the guiding principles of the government's strategy. The Katalyst/Waste Concern pilot project in Uttara is quoted as a good practice (MoEF, 2010).

Challenges and solutions for solid waste management in the context of low income countries and urban centres is not a new issue and a lot of documented scientific research is available on other cities and countries. Thus a comprehensive literature search and analysis accompanied this research. A similar context to Dhaka was identified in a pilot project in the Indian city of Bangalore (Shah, 1999). Literature research also shows that most experts find obtaining systematic and precise research data and evidence on source segregation a permanent challenge. This is due mainly to the informal nature of the municipal solid waste sector, social judgements and stigma around activities involving waste picking and handling, and also individual interests of different stakeholders which may bias their answers to researchers.

3. Results and discussion

The waste collection challenge in Dhaka

In Bangladesh, the solid waste management challenge is obvious to any observer, in particular in Dhaka, the capital and largest city. The Dhaka City Corporation (DCC) supervises municipal solid waste management in an area of 360 km² with a population of 7 million estimated to generate 3000 to 4000 tons of waste per day (Dhaka City Corporation, 2011). The DCC is responsible for gathering the waste from municipal collection points in the city's 90 wards (i.e. neighbourhood administrative units) and for the disposal of waste in designated dumpsites. These figures relate only to the areas under supervision of the DCC and do not include the "wider Dhaka metropolitan area", which is constantly growing.

The DCC openly states that its collection system cannot cope with the task of handling the large volumes of refuse produced by the ever-growing numbers of city dwellers, and that only 40-50% of the solid waste produced is being collected (Dhaka City Corporation, 2011). Where and whenever the collection service is inexistent or dysfunctional, the accumulating waste is dumped by the residents in the city's streets, open stormwater and wastewater drains or open water bodies. In particular, slum or periphery areas, which are not covered by the DCC, are affected by such a situation. Furthermore during the annual monsoon rains wastewater and stormwater drains which are clogged by solid waste overflow, creating an acute sanitary and hygienic threat, particularly in low-lying slum areas.

Inhabitants suffer from the deficiencies in solid waste management at different levels, expressing concerns that decaying waste is an eyesore, smells strongly, pollutes land and water bodies and attracts undesirable insects and rodents. The situation is perceived by the general public as a deficient service of the municipality in which collection and transport needs to be improved; a typical end of pipe viewpoint. Bangladesh's national 3R strategy acknowledges this same fact as: "Most of the cities' current approach to waste management system is conventional i.e. end of pipe solution. Its stress is on collection and disposal and not on reuse and reduction. 'We dump – They collect' is the general attitude that had been cultivated among the residents, institutions as well as industries by this approach over a long period. Waste management is not their concern. It is a municipal responsibility." (MoEF, 2010)

However since the 1990s, in some neighbourhoods, inhabitants have organized themselves to form private societies or welfare organizations who hire cycle-van drivers (Gariwallas) for door-to door collection of their waste (Ahmed & Ali, 2006). Households pay for waste collection, and the willingness to pay is directly linked with the quality of the services provided. This leads to less littering and thus cleaner roads in the neighbourhoods, but does not tackle nor solve the problem at the respective municipal collection points which are not serviced frequently enough by the DCC due to their lacking capacity, and thus overflow.

The role of the informal sector in recycling municipal solid waste

An informal waste separation and recycling sector has established and developed itself in reaction to a demand for recyclable materials by the industrial sector due to rising prices of imported materials such as plastic resin, glass or paper. Separation and recycling contribute to the collection challenge by reducing amounts of refuse to be collected. However despite the demand for recyclables,

large volumes of materials which could be of value to the recycling industry are still mixed with other refuse and thus damaged or soiled, and lose part of their initial value. Recycling such materials entails a time consuming sorting and cleaning process whereby the material quality remains low-grade, obtaining a lower price. This is the reason why a lot of materials are not recycled and a large volume ends up discarded in dumpsites or landfills.

The flows of recyclables and mixed waste produced by households are depicted in Fig. 1:

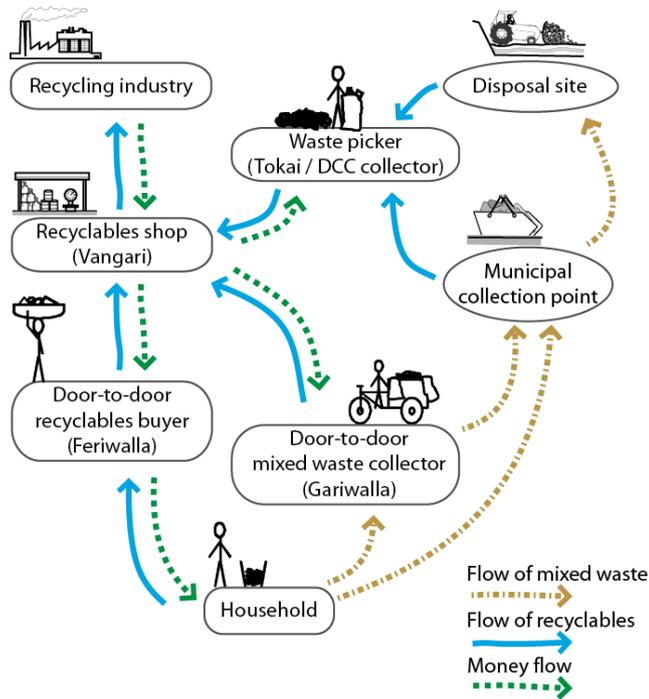


Fig. 1: Schematic overview of the waste management system for households in Dhaka.

Some households separate recyclables which they sell to recyclables buyers (Feriwallas), others only produce mixed waste. This mixed waste is either picked up by cycle-van drivers (Gariwallas), or the household members bring them to municipal collection points themselves. Another option which is not depicted here is that if the collection point is too far away or too full already, inhabitants dump the waste in streets or water bodies, where it will eventually be picked up by municipal cleaners, if at all.

Cycle-van drivers (Gariwallas) collect the mixed waste, and separate some recyclables which they can then sell in recyclables shops (Vangari Dokans, or Vangaris), thus earning some additional income to the salaries they are paid by the municipality or community for their collection services. They bring the remaining waste to a transfer point, from where it is transported to the city's landfills.

Waste pickers (Tokai) separate some recyclables from the mixed waste at transfer points or on the landfills. Also DCC collectors, in charge of loading the waste from municipal collection points onto the DCC trucks, separate some recyclables from the mixed waste. The recyclables are then sold by the Tokai or DCC collectors to recyclables shops (Vangaris). Finally the Vangaris sell the waste to the recycling industry in Dhaka, i.e. brokers, who in turn sell to wholesalers or directly to recycled products manufacturers.

Gariwallas, Feriwallas and Tokais contribute largely to solid waste management in the city. The government states in its 3R strategy that: "It is estimated (...) that every year Tk. 10,706 million is being saved through recycling. 120,000 urban poor from the informal sector are involved in the recycling trade chain of Dhaka City. 15% of the total generated waste in Dhaka (mainly inorganic) amounting to 475 tons/day are recycled daily" (MoEF, 2010). Although this is stated in a governmental strategy document, de facto the importance of this informal sector is hardly ever acknowledged by the municipality and residents, and Tokais in particular are often looked down upon as illegally scavenging through waste which is not their property.

Interviewed Vangari Dokan keepers unanimously claimed that they are facing a high demand for recyclables from brokers and wholesalers, and they are willing to buy much more than they already do. Thus there does not seem to be much constraint on the demand side. The specific case of plastic as explained further below indicates this as well.

Dumpsites for municipal solid waste are situated on low-lying, flood-prone land. They are not managed as sanitary landfills, apart from efforts by JICA (JICA, 2012) and Waste Concern (Waste Concern, 2012) at Matuail site (Scheinberg, et al., 2010). Thus commonly air pollution, spreading of vermin and leaching of polluting substances into the subsurface and ground water are not prevented.

Segregating recyclables at the household level, and thus ensuring their cleanliness and quality, can provide an interesting opportunity to enhance waste recycling, provide more resources to the recycling industry and augment incomes of the recyclables dealers and waste collectors (Feriwallas and Gariwallas) (MoEF, 2010). Furthermore, considering that informal recyclers are most often urban poor, improving incomes of such informal workers can help to improve and strengthen their livelihoods. On the other hand a strengthened recycling sector may also increase demand for unskilled labour which is easily met by the large number of rural migrants. In such cases the impact of higher recycling rates may not impact on individual income but rather increase the number of employment opportunities.

In the current household waste management system of Dhaka, such an increase of segregated recyclables

quantities from the households would increase the flow of goods sold to Feriwallas and can result in new material flows which are “given” to Gariwallas (Fig. 2).

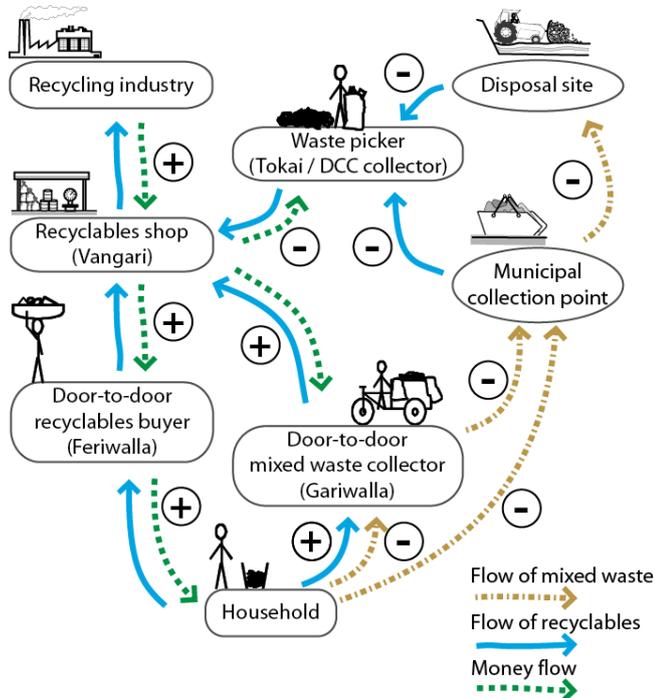


Fig. 2: Schematic overview of the waste management system for households in Dhaka assuming increased household segregation.

A scenario to reduce amounts of mixed waste while improving Gariwallas' livelihoods involves the household segregating waste and then “giving” the recyclable materials to the Gariwallas without any payment. The motivation of the household to segregate would thus primarily be driven by the interest to improve the waste management situation and not by economic incentives. Feasibility of such an approach will depend significantly on households' environmental awareness and understanding of the benefit of segregation for their immediate environment. In Bangalore, a similar initiative shows that households make such an effort without an underlying financial interest. Nevertheless a precondition for continuing motivation and commitment by households is a recyclables collection system which works properly and reliably (Shah, 1999).

Source segregation of plastic waste - economic incentives at work

Plastic waste and its recycling is a good example of how economic incentives drive segregation / separation in Bangladesh. In their assessment of the plastic recycling industry, Enayetullah et al. (2006) found that due to very

low labour costs Bangladesh can produce recycled plastic pellets for a price 2-3 times lower than the price of imported virgin resin. Products made of recycled plastic resin sell for 60 Tk/kg, while plastic products made from virgin resin are sold for 150 Tk/kg, the cost of imported virgin resin being 100 Tk/kg. Plastic products made from recycled plastic pellets are used for lower quality products, for example poultry feeding jars. Although the quality of products using recycled plastic is lower, consumers buy them because they are cheaper. As for plastic products which are typically discarded before the end of their “technical useful life” (e.g. packaging), customers assign little value to quality as it is unimportant if it is a recycled product with a shorter “technical useful life” or a virgin resin product with a longer “technical useful life”.

The plastic recycling factory visited in September 2011 in Uttara is a concrete example for cost-effectiveness of plastic recycling: a garment producer supported the building of the factory, and now supplies it with used plastic packaging for recycling. The used packaging is separated by hand from any other materials still sticking to it, and then melted to produce plastic pellets. The pellets are subsequently re-processed in the same location to produce new, thinner plastic bags, which are then conveyed back to the garment factory. The owners of the recycling factory, now that they already have the technology and know-how, are keen to extend their business to bigger volumes and a larger range of products.

Accordingly, recycled plastic materials are very competitive and meet a high demand on the industrial market. Also at the level of international trading, clean shreds or pellets of recycled plastic are in high demand at the prices at which Bangladesh can currently offer them. Using a scenario of a 100% plastic recycling rate (instead of 51% as estimated in 2006 by Enayetullah et al.), with a thus significant increase in production of recycled pellets, estimates of potential foreign currency income are at USD 29.42 Million per year (Enayetullah, Sinha, Hossain, et al., 2006). Such an increase of plastic recycling rates can however only be achieved through source segregation.

The largest waste fraction and the most difficult to exploit: organic waste

The largest fraction by weight of mixed municipal solid waste consists of organic biodegradable refuse (60 to 75%) (Dhaka City Corporation, 2011; Enayetullah, Sinha, Khan, et al., 2006). Reducing this organic content by means of composting, or any other organic waste treatment technology, would have a strong impact on reducing the volume of waste to be collected and disposed. It would also reduce the sources of attraction for vermin and rodents, as well as air pollution in terms of smell and greenhouse gas emissions caused by decomposition in transfer points and

on uncontrolled dumpsites. Composting, as one treatment option, allows a rapid aerobic decomposition, under controlled hygienic conditions with fewer environmental emissions. Controlled composting however demands some infrastructure and space. The reduction of greenhouse gas emissions can provide economic incentives as part of a carbon credits trading scheme. As mentioned above, Waste Concern Group is already making use of this opportunity. More recently the Government of Bangladesh has recognized this possibility too and has announced that it will launch composting projects in four of the country's 64 districts, with initial financing from existing international climate change funds (BDnews24, 2012).

Organic waste treated to produce compost has an economic potential as organic fertilizer and soil amendment. However if mixed and contaminated with non-organic substances (glass, plastic, etc.) or pollutants (solvents, heavy metals, etc.), organic refuse loses its value as compost. Bangladesh's National 3R Strategy for Waste Management states that "The quality and efficiency of the recycling plants highly depend on the quality of the segregated wastes. Especially the composting of organic wastes purely depends on the quality of waste separation." (MoEF, 2010). In urban areas such as Dhaka, organic waste is rarely segregated from the non-organic waste at household level as there is usually no perceived value for it, except in the framework of small-scale urban agriculture (food for goats or chicken, and compost for plants).

Also, organic waste composting is most effective and viable if a significant market demand for compost can be established and maintained.

Current initiatives of Waste Concern, the main producer of compost from organic waste in Bangladesh, set focus on organic waste from markets, where quantities of organic waste are large and it is easier to ensure control measures so that the organic material is not contaminated. For household solid waste, the effort and therefore cost of ensuring that organic waste is not contaminated is still very high, allowing only a very limited margin of profit, if not losses. However, encouraging households to segregate organics from waste, in other words separation of "dry" inorganic and "wet" organic waste, will be a further step to not only increase viability of composting as a treatment option, but also impact on reducing volumes of waste as well as environmental pollution. One additional aspect which can be challenging is that households also produce refuse which is neither organic nor a clean dry recyclable material. It is waste that has no recycling value, and needs to be separated from both "wet" and "dry" recyclables categories in order not to reduce their value. The terms dry and wet waste are frequently used in the South Asian context distinguishing between "wet" organic

biodegradable waste (mostly food and garden waste) and "dry" non-biodegradable waste (plastic, metal, glass, etc.).

Stakeholders' interests and incentives

Experience in developing countries shows that government-led top-down approaches striving to replicate existing models of waste management as used in industrialized countries, focussing on engineered solutions and mechanized technology, or else strict enforcement of policies and regulations, are seldom suitable nor sustainable in low income urban areas (Wilson, et al., 2009). Failures of such initiatives impact negatively on the willingness of the population to participate in and contribute to future solid waste management ventures. Projects and implementation approaches must therefore be chosen carefully and adapted according to the specific local context. Particular attention must be given to ascertain the interest and willingness of stakeholders to increase source segregation, as this plays a crucial role for enhancing the recycling sector.

Clearly, stakeholders have reasons for acting as they do, and therefore these reasons and underlying interests need to be well understood and taken into account as main priority when evaluating pathways of improvement. An envisaged scenario aiming at increasing segregation at household level will affect stakeholders in many ways. Furthermore, different neighbourhoods will present a variety of baselines differing in average household incomes (Afroz, Hanaki, & Tudin, 2011), presence and efficiency of door-to-door recyclables buyers, door-to-door garbage collection service and availability of well serviced municipal collection points. All these variables are crucial elements which need to be taken into account when designing improvement plans to promote household source segregation.

Households

Households are the main target group of any initiative aiming to increase source segregation at household level. Study results in the neighbourhood of Uttara in Dhaka, which can be described as a middle-to-higher income neighbourhood, showed that usually the maid (77% of households) or the caretaker (11%) are in charge of waste management at household level (Enayetullah, Sinha, Khan, et al., 2006). Maids and caretakers collect and store waste and if required interact with the waste collectors at a given time or else bring the waste to a collection point. Maids and caretakers, contrary to other family members with higher income, are likely to be receptive to any possibility of earning extra income. Furthermore household family members also accept and understand the typical practice

to allow maids or caretakers to earn additional income by recycling waste.

Such an economic incentive however is not sufficient to stimulate the majority of households to segregate recyclables. In Uttara, it was found that only 8% of households separate recyclables for sale (Enayetullah, Sinha, Khan, et al., 2006). Main reasons identified are:

- Segregating and storing of recyclable materials requires an additional effort and needs time which may not be available. Carrying several baskets of segregated materials up and down the stairs takes time and effort too, and maids and/or caretakers report that it is easier to put everything in one bin for transportation (Shah, 1999).
- Segregating involves separate storage of these materials, which requires space. Also, if organic material is separated and stored, it quickly starts smelling and easily attracts rodents and insects, thus creating a nuisance.

When asked about their willingness to participate in source segregation projects, a majority of households in Uttara replied positively. Results from the survey in 2011 also show that awareness and concern about the waste issue is evident, and interestingly a majority of the respondents expressed readiness to do something about the solid waste issue if a way to do it is shown to them. However when analysing already implemented projects, results show that actual participation was found to be low, in Uttara (Enayetullah, Sinha, Khan, et al., 2006) as well as in Bangalore (Shah, 1999). In Bangalore residents complained that waste collectors (comparable to the Gariwallas of Dhaka) would mix the already segregated waste again, leading to a frustration of those that had previously segregated waste. Explanation for this practice by waste collectors is that often waste is not separated the way the collectors want so they prefer to do it again (Shah, 1999). Results further show that residents do not recognize a direct link between waste segregation and their life quality. What bothers them are rather issues where they feel they have no influence, such as the littering in their streets, clogged drains or if a collection system at their doorstep is not sufficiently frequent and reliable.

The survey of 2011 also confirms that most individuals consider the priority issues to be in the hands of the City Corporation and they do not feel that they are part of the solution. Interventions to raise awareness on the role of the households as an important link in the chain of solid waste management is therefore relevant, but must be accompanied by plans to ensure a more frequent and reliable service of waste collection and purchase of recyclables, which again necessitates some equipment or

infrastructure facilities for enhancing segregation as well as storage, collection and transport of recyclables.

Authorities (Dhaka City Corporation, local private societies and welfare organizations)

Any integrated approach which takes into account all stakeholders and their roles and responsibilities obviously must also involve the local governmental authorities. Previous experiences in Bolivia (Swisscontact, 2012) have shown that even interventions at household level benefit from involving local authorities, the overall entity which has the responsibility for solid waste and represents the public interests, to enhance legitimacy, support and acceptance, or for up-scaling of initiatives. The fundamental question however is if authorities have the motivation and commitment to change the status quo.

In Dhaka, based on research results, project ideas for improving solid waste management were discussed directly with a private society in charge of the administration of one neighbourhood (Baridhara), who showed interest in improving the overall segregation and recycling rate in order to improve their solid waste situation and increase their image of a modern, "green" neighbourhood. One ward office of the Dhaka City Corporation (Gulshan) was also approached with project ideas, however here little interest was shown, and business as usual seemed to be the preferred method. DCC's major concern is with "secondary" collection, which involves emptying of municipal collection points and transport to the nearest landfills. Less concern is with the "primary" collection, involving waste management from households to municipal collection points. This shows that the country's 3R Strategy, which entails source segregation as a guiding principle and states that the city corporations should take initiatives to raise public awareness on this issue and to direct households, shops and institutions to segregate their waste (MoEF, 2010), is far from being mainstreamed yet.

Middle dealers (Vangaris) and door-to-door recyclables buyers (Feriwallas)

Vangaris and Feriwallas would benefit economically from an improved recycling scheme involving source segregation. But it is questionable whether these informal actors would appreciate any involvement of the municipality that affects their established informal trading system. In Bangalore, Shah (1999) reports that middle dealers were reluctant to see the authorities get more involved out of fear of having to pay more bribes in order to be able to continue with their informal trading. In Dhaka, middle dealers (Vangaris) often do not own the land their shop is built on, and any involvement with formal entities is considered a risk that this practice may be officially

identified and rectified, which is another reason for them to prefer less intervention by governmental authorities. On the other hand they would welcome larger amounts of clean recyclables as a result from increased source segregation and they declare that capacity and capital are not restricting issues. Also Feriwallas, the itinerant buyers, obviously would prefer more clean recyclables to increase their trade volume and income.

Cycle van drivers (Gariwallas)

Gariwallas collect mixed waste from buildings, and are not set up to pay for recyclables. Even if they were organized to conduct financial transactions, they are not allowed to access the private space of the household area as they are considered unhygienic due to their mixed refuse collection and separation activity. Feriwallas on the other hand only handle clean recyclables and are careful to have a relationship of trust with some household members. Thus it is more difficult to ensure that Gariwallas can obtain space and contact with any household members for trading of recyclables. Allowing easy and free access to recyclables by Gariwallas could comprise a specified bin used by maids or caretakers for "dry waste" with no need for financial transaction. In order to ensure that this segregated waste can be collected separately, cycle vans need to be equipped with separate compartments. However, any initiative to increase "free" access to clean recyclables for Gariwallas would directly compete with the current recyclables trading of the Feriwallas. The potential conflicts of interest would need to be assessed more in detail through pilot studies and focus group meetings to assess reactions of the stakeholders and to identify an optimal solution.

Waste pickers (Tokai)

Tokai are generally not on good terms with officials and the police, as they retrieve recyclables from dumps and municipal collection points without official permission. Their contribution to waste reduction is hardly acknowledged. Increasing source segregation at household level and better access to recyclables for Gariwallas and Feriwallas would tend to negatively affect Tokais as there would be less valuable recyclables in the residual waste at collection points or dumpsites. In this regard, a study on the livelihoods of waste pickers of Dhaka concluded that: "The [sustainable livelihoods] approach cannot ignore (or discourage) interventions working towards better solid waste management in a city with such [waste management] problems. Therefore, assuming such interventions will take place and that access to waste would be disrupted, the livelihoods of waste pickers as they stand cannot be viewed in any way as sustainable" (Rouse & Ali, 2001). A constructive and sustainable approach

would thus be alternative employment. With a scenario of actively increasing segregation at source through communitarian initiative, Tokais could potentially be employed in recycling centres where further separation or composting takes place. Such a change in working conditions would reduce their current health risks. Experience in Bangalore (Shah, 1999) shows that although the income of a former waste picker now working in a recycling centre is lower than before, the additional benefits cannot be neglected. No police harassment, increased social recognition, and security of a regular monthly salary outweigh the lower income.

4. Conclusion

Solid waste is a priority issue in Dhaka. Residents are aware and unhappy about the current situation. National authorities are looking for ways to improve the overall situation also by increasing recycling rates (MoEF, 2010).

Recycling already takes place at several levels via different stakeholders: at household level by waste producers, with trading by Feriwallas or during collection by Gariwallas, at municipal collection points, and on dumpsites by Tokai or municipal employees of the collection service. The system is however not optimized to secure a maximal value creation. In the current existing informal waste management system there is much scope for improvement at micro-level which can better exploit the value of recyclables. Source segregation at household level improves the quality of recyclables, and thus increases their value.

The presented results help understand why despite the demand for more recyclables the informal recycling sector is not able to expand and improve their activities. One major barrier is the access to clean recyclables of higher value. Furthermore negative preconceptions about informal recycling workers play an important inhibiting role. Valuing their work starts by including them in policies and planning processes. Other processes to improve their working conditions can be to engage them as "official" employees of local neighbourhood societies and welfare organizations.

A significant aspect of all improvement processes is to focus on the integration of a large diversity of stakeholders, to understand their needs and perceptions and then target the interventions to create ownership and commitment by all concerned. Increasing awareness on the benefits of waste segregation for improving life quality in the city and the wider environment needs to go hand in hand with a support to the functionality of the whole system, which includes facilitating behaviour change through better facilities, equipment but also improvements of service reliability.

Further studies and pilot projects are required which address interventions to facilitate household segregation and the collection or purchase of recyclables. Such initiatives will allow insights on feasible technical options which are most appealing to households and informal workers, but also explore the social interactions between different informal groups and find appropriate solutions which fit their livelihoods needs.

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