Revitalising Economies of Disassembly

Informal Recyclers, Development Experts and E-Waste Reforms in Bangalore

RAJYASHREE N REDDY

In the last decade, reforms introduced by the Indo-German-Swiss e-Waste Initiative were meant to modernise and revitalise Bangalore's informal e-waste recycling sector. While the reforms rapidly transformed the circuits of e-waste recycling in the city, the outcomes have been less than ideal for informal recyclers. This article charts the changing role of informal e-waste recyclers in the wake of the introduction of reforms and shows how reforms disconnected a majority of informal recyclers – who have historically underwritten the costs of disposing the city's e-waste – from newly modernised circuits of e-waste recycling. In sum, it reveals that the reforms provided an impetus to "corporate privatisation" and undermined the extant network of "informal privatisation" of e-waste in Bangalore.

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Rajyashree N Reddy (*rreddy@utsc.utoronto.ca*) is with the Department of Geography, University of Toronto.

Under pressure from neo-liberal forces, urban local bodies (ULBs) across India have enacted an array of reforms that aim to make the country's notoriously underperforming and inefficient municipalities effective and financially sustainable service providers. As part of these reforms, which have gathered steam since the liberalisation of the Indian economy in the early 1990s, essential and obligatory functions performed by ULBs such as municipal solid waste (MSW) management services have either been fully or partially privatised. Typically, under the ULBs programme of privatisation, private actors (such as for-profit corporations, civil society groups and citizens) are enlisted to discharge duties that were formerly the responsibility of state institutions and actors. The precise role of these private actors varies. In Bangalore, for instance, the city municipality has entered into public-private partnerships (PPPs) with for-profit waste corporations to discharge a variety of tasks, including the collection and disposal of MSW in a cost-effective manner. Bangalore's city municipality has also partnered with civil society organisations and citizen volunteers with a view to bolster participatory approaches to waste management.

Such trends in privatisation of waste management have attracted academic scrutiny: A segment of academic scholarship is critical of this programme of privatisation for its failure to achieve several of its intended goals such as failure to ensure financial sustainability of ULBs, failure to achieve increased coverage of waste collection, failure to adopt environmentally sound technologies of collection and disposal, and, finally, failure to offer equitable terms of employment and ensure the occupational safety of waste workers (Post et al 2003; Srinivasan 2006). In addition, scholars contend that ULB-mandated privatisation of MSW management services – which they insist should properly be characterised as "corporate privatisation" – is infringing and dispossessing a disparate set of private actors, including ragpickers and petty recyclers, who have harnessed their entrepreneurial skills to offer private waste management services in cities across India, long before privatisation became the de rigueur best practice of ULBs (Chaturvedi and Gidwani 2010). This type of privatisation, which was not mandated by the ULBs but emerged organically, is variously termed "informal privatisation", "petty privatisation" or "privatisation-from-below" (ibid). Scholars contend that through informal privatisation the urban working poor not only create self-employment opportunities to sustain

themselves and their families but also ensure that large sections of India's urban population whose waste disposal needs were not serviced by limited capacities of overextended ULBs have some access to waste disposal infrastructure.

In Bangalore and other Indian cities, "informal privatisation" or "privatisation-from-below" has been crucial for the collection and disposal of Waste Electrical and Electronic Equipment (WEEE), more commonly referred to as electronic waste or simply e-waste. E-waste is a special category of waste and refers to end-of-life or obsolete electrical and electronic equipment. According to the United Nations Environmental Programme (UNEP), in many parts of the world e-waste is accumulating at a faster rate than MSW (UNEP 2007). Because e-waste contains quite extensive combinations of hazardous chemicals that are harmful to the environment, UNEP and other international environmental organisations insist upon the segregation of e-waste from the general waste stream. In India, at present, less than 1 kg per capita of e-waste is generated but this number is expected to grow at an exponential rate (ibid). While the per capita generation of e-waste is quite low, the total amount of e-waste generated in the country is already quite substantial. Development agencies and electronics industries' associations have recently attempted to compile accurate baseline data on the scale and rate of e-waste generation in India. According to one such study in 2007, about 3,80,000 tonnes of e-waste was generated in India with computer e-waste accounting for 56,000 tonnes of this waste (Khattar et al 2007). A mere 19,000 tonnes of the total e-waste generated in the country in 2007 was recycled. The remarkable fact that should be emphasised, however, is that the informal sector was responsible for recycling a phenomenal 95% of the 19,000 tonnes that was recycled. Arguably, based upon such evidence, a strong case can be made that informal recyclers have historically underwritten the costs of disposing the ever-growing quantities of e-waste accumulating in India.

In this paper, I chart – through a case study of Bangalore – the changing role of informal e-waste recyclers in India in the wake of the introduction of wide-ranging reforms that seek to overhaul the country's e-waste disposal practices. In India, the most far-ranging e-waste reforms were first introduced in the city of Bangalore. Therefore, examining the evolving role of informal recyclers from the vantage point of Bangalore can provide key insights into the process. The central argument of this paper is that e-waste reforms – aimed at revitalising the circuits of e-waste disposal – have provided an impetus to "corporate privatisation" and undermined the extant network of "informal privatisation" of e-waste in Bangalore. That is to say, emergent e-waste reforms have bolstered the position of corporate e-waste firms and marginalised informal e-waste recyclers who have historically underwritten the costs of disposing the city's e-waste.

This argument is developed over four sections. Section 1 lays out how a segment of Bangalore's informal recyclers came to pioneer e-waste recycling and create lively economies of disassembly that play a vital role in sustaining our urban economies and ecologies. In Section 2, I document how e-waste reforms introduced by German and Swiss development agencies to improve Bangalore's e-waste disposal practices are consolidating the position of corporate recyclers while marginalising informal recyclers. In Section 3, I critically evaluate development experts' attempts to scale up the e-waste reforms first introduced in Bangalore to other cities of India. I conclude in Section 4, by calling upon policymakers and experts to work with informal recyclers from the outset as valued partners and design new regulatory regimes along more equitable terms.

1 Bangalore's E-waste Recycling Pioneers

A report released by UNEP in 2007 identified the information technology (IT) sector as one of the largest producers of e-waste in India. This certainly appears to be the case in Bangalore where along with the growth of the IT sector there has been a steady rise in the quantities of hazardous e-waste generated by these industries (Saahas 2005). A key reason for the IT sector churning out large quantities of e-waste is that the obsolescence rate of computers used in Bangalore's IT sector is quite high with 30% becoming obsolete every year (*Deccan Herald* 2005). On the whole, according to 2005 estimates, around 8,000 tonnes of e-waste was generated in the city of Bangalore (ibid). In less than five years, this amount had risen substantially with industry experts approximating that in 2009 a little over 14,000 tonnes of e-waste was generated in the city (WEEE Recycle 2012c). In the early 2000s, due to the actions of groups such as Greenpeace, the media began to pay attention to e-waste (Greenpeace 2005). After taking stock of the dark underbelly of Bangalore's celebrated IT sector, and taking note of sharp increases in the rate of e-waste accumulation, some members of the media made apocalyptic projections suggesting that the cyber city of Bangalore would soon turn into a cyber wasteland.

Due to increased media coverage and the actions of Greenpeace, Bangalore's municipal authorities and the IT industry were forced to pay attention to this environmental catastrophe. But even as they slowly registered the magnitude of the problem, the city's municipal authorities and the IT industry remained ill-prepared to effectively manage this waste. In marked contrast to ULBs and the IT sector's oblivious attitude towards e-waste, the city's informal recyclers saw the economic opportunities embedded in e-waste and began, as far back as the early 1980s, to develop robust networks for not only collecting e-waste but also dismantling and processing it. In what follows, I describe briefly how a segment of the city's informal recyclers pioneered e-waste recycling in the city and show how informal e-waste recycling came to be embedded in a specific place in Bangalore.[1]

In the early 1980s, in a slum neighbourhood off the old city market area of Bangalore, a group of scrap collectors and recyclers belonging to the city's marginalised Muslim community, who had been engaged in the collection of an assorted variety of scrap material, discovered that a new kind of waste, namely, computer e-waste, was becoming a prominent part of the waste stream. A few of these recyclers focused their energies

on exclusively collecting and developing techniques for disassembling and processing computer e-waste. For early pioneers, informal e-waste collection and recycling proved to be a highly lucrative recycling niche: Many of them made handsome profits while a few made mini-fortunes from e-waste.[2] The early pioneers usually channelled the profits they made into buying small plots of land where some pioneers constructed homes for dwelling and others (incrementally) constructed rental units. With keen interest, unemployed Muslim youth of the neighbourhood observed the rising fortunes of e-waste recyclers and came to believe that e-waste was the means through which they too could earn money quickly. The lure of making fast money from e-waste and leveraging that profit to speculate upon and capture real estate surpluses was thus an important pull factor for many unemployed Muslim youth in the neighbourhood who began to set up makeshift e-waste dismantling businesses. The result of this frenzied effort to start e-waste recycling businesses was that this neighbourhood emerged as a hub of e-waste recycling in the city. It became embedded in uneven local and global circuits of e-waste flows and eventually became embroiled in passionate debates about urban ecology, appropriate recycling technologies and contested notions of socio-ecological justice and equality.

Before I discuss the uneven circuits of e-waste flows and value creation, it is important to position the aspirations of Muslim informal e-waste recyclers in a broader political economic context. The Muslim community, in spite of being more urbanised than other communities in India, is one of the poorest communities with less than 8% gainfully employed in the formal sector in urban India (Sachar et al 2006). In Karnataka, where the overall poverty rate of the state's urban population was pegged at 30%, the poverty rate of the urban Muslim population in the state was as high as 45% (ibid). These dire statistics are unlikely to change in the near future as low levels of educational attainment have left the Muslim community ill-prepared to take advantage of the opportunities created by Bangalore's new information economy. So, any hope of overcoming abject poverty and attaining a regular income is dependent upon their ability to carve out secure livelihoods in the informal sector. Many in the Muslim community in the slums off Bangalore's city market neighbourhood hoped that recovering value from e-waste would be their path out of poverty and open up lines of social and economic mobility.

The realisation of this promise hinged, however, upon a crucial factor, which is informal recyclers' ability to territorialise e-waste flows. To elaborate, according to many informal recyclers, the principal factor that determines their ability to earn a livelihood and turn a profit from e-waste is access to raw material, that is, *access to e-waste*. As such informal recyclers would spend a sizeable amount of their time in a determined effort to acquire e-waste. As they scoured for e-waste, informal recyclers primarily targeted Bangalore's two IT hubs, namely, Electronics City and International Technology Park, which had the reputation of generating the bulk of the city's computer e-waste. The secondary target of informal recyclers was neighbourhoods such as Bommanahalli Industrial Area, located off the elevated expressway leading to Electronics City that has a high concentration of IT firms. As informal recyclers embarked upon their hunt for e-waste in IT hubs of Bangalore, their strategy was to establish direct contact and develop personal relationships with the facility managers of IT companies in the hope that they would contact them to cart out e-waste as and when it piled up in their firms. The ultimate hope of recyclers is to establish – through face-to-face negotiation with key personnel in the facilities department – de facto territorial rights to waste generated in those IT firms. Through such territorialisation of e-waste, informal recyclers warded off their competitors and prevented them from acquiring e-waste. The profits that informal recyclers would make depended directly upon the amount of e-waste they could acquire through such territorialisation of e-waste.

Economies of Disassembly

The question that remains to be answered is precisely how do informal recyclers make profits from e-waste? In what follows, I elaborate an answer to this question. Informal recyclers deploy two primary methods to create new circuits of value that yield profits. The first method deployed by informal recyclers is to dismantle computer e-waste into its constituent parts that are then sold for a profit. More concretely, informal recyclers who dismantle e-waste first meticulously retrieve reusable working components (such as integrated circuit chips, functional hard drives) from computer e-waste. The recovered reusable parts are either sold to vendors of assembled computers in the city market or to computer repair shops and computer technicians. The vendors of assembled computers, in turn, reuse the parts retrieved by informal recyclers to build "new" non-branded computers, which are mainly aimed for household consumption. The computer repair shops and technicians use the working parts salvaged by dismantlers to repair broken computers. In addition to retrieving working components, dismantlers also strip and segregate the non-working parts of computer e-waste into recyclable materials such as plastic, glass and metal that are in turn sold to respective wholesalers of these recycled materials.

In contradistinction to dismantlers, a second method used by a small group of informal recyclers in the slum neighbourhoods off the city market is to chemically process certain parts of computer e-waste in order to recover precious metals such as copper, silver and gold embedded therein. Their narrow scope of activity meant that recovery of precious metals emerged as a sub-niche within the informal e-waste recycling sector of Bangalore with workers labouring in this sub-niche developing an intimate understanding of various chemical processes (such as processing printed circuit boards in nitric acid and mercury) needed to separate and extract precious metals embedded in e-waste. Whilst the focus and the scope of the activities undertaken by recyclers who recover precious metals is much narrower than that of dismantlers, their collective labours lead to the same end result which is the extension of the life of wasted computers and the creation of extensive secondary circuits of value from circuits of e-waste.

How should we understand these economies of disassembly? That is to ask, how should we understand informal recyclers' revaluation and re-commodification of e-waste through the creation of secondary circuits of value? One straightforward reading of informal recyclers fashioning new values from e-waste is to cast it in terms of ecological service and subsidy to the city. That is to say, we can argue that by extending the life of obsolete electronics through reuse, repair and recycling, informal recyclers exemplify best practices in sustainable waste management and offer important ecological services to the city.[3] Beyond providing ecological services, informal recyclers also offer important economic services to the urban economy. I list below what I consider to be three important economic contributions that informal e-waste recyclers make to the city.

The first and most obvious economic service that informal recyclers provide to the city is through salvaging recyclables from e-waste. They thus create employment opportunities for themselves and make significant contributions towards ameliorating livelihood insecurity in the city. Second, incessant recovery and creative deconstruction and reconstruction of obsolete electronic commodities allows them to use constituent parts of old computers to form the basis of new products such as assembled computers. By doing so, informal e-waste recyclers extend the global electronic value chain in multiple new directions thus ensuring that the death of a computer results in the reconfiguration of circuits of value that computers are embedded in rather than the ultimate demise of global value chains.[4]

The third economic service informal recyclers provide to the city is they play an instrumental role in the wider dissemination of digital technologies in the age of the "knowledge economy." For instance, assembled computers – which as I have demonstrated are built at least in part with the aid of recyclables recovered by informal recyclers – are within the purchasing power of the lower middle classes and are also extensively used in internet kiosks frequented by the lower middle class and the poor. These groups are typically termed as technological "have-nots" by scholars and policymakers who advance the notion of a "digital divide". The advocates of the digital divide posit that because there is a gap between the "haves" and "have-nots" access to digital hardware and software, the technological "have-nots" inhabit a time that is not contemporaneous with that of the digital elites (such as the elites who live and work in the IT enclaves of Bangalore). Informal e-waste recyclers, by facilitating increased access of underprivileged groups to computer hardware and technologies, render problematic any simplistic conceptions of the digital divide or contemporaneous experience of information modernity. In addition to playing an instrumental role in the production of low-cost digital hardware, informal e-waste recycling gives recyclers and their associates (such as the owners and workers of computer repair shops) many opportunities for practical learning: For instance, opportunities for practical learning are created as they tinker with e-waste in their quest to recover working components and repair broken parts of obsolete computers. Opportunities for practical learning are also created when informal recyclers and their associates attempt to fashion new digital products from electronic detritus. Informal e-waste recycling through creating opportunities for practical learning thus democratises and expands the ambit of digital knowledge.[5] In sum, this account of Bangalore's informal economies of disassembly reveals that informal recyclers provide a multiplicity of economic benefits and services to the city and underscores my contention that the informal sector subsidises the ecological costs of e-waste disposal in the city. Additionally, it also reveals that the economies of disassembly forged by informal recyclers are about more than bare life (that is, mere survival and creation of subsistence opportunities). I would assert that as e-waste recyclers salvaged things from digital detritus they are also fashioning themselves as creative individuals whose labours lead them to innovatively re-imagine, re-craft and recombine the constituent parts of end-of-life computers to produce new commodities and new uses for dying computers. To put it another way, using a phrase deployed by Jane Bennett, I am making the case that the forging of economies of disassembly has allowed informal recyclers to approach the world with a "sense of vitality". Bennett writes "sense of vitality, [is] the charged up feeling often generated in human bodies by the presence or promise of commodity consumption" (Bennett 2001: 114). During my fieldwork, many informal recyclers spoke of the giddy excitement with which they tinkered with e-waste and the pride they felt when they developed a knack for ingeniously extracting or recombining constituent parts of obsolete computers to fashion new digital and non-digital commodities. So I extend Bennett's assertion to suggest that a "charged up" feeling can be generated at the promise of commodity disassembly as well.

Neither development experts nor environmental non-governmental organisations (ENGOs) – both of who have the ambitious agenda of persuading governments and industries across the globe to develop and institute robust e-waste management systems – fully appreciate the ingenuity of informal recyclers and the remarkable heterogeneous circuitry of value that this ingenuity has engendered. As we will see in the next section, development experts partially valorise yet view the informal sector as an essentially disorderly and sickly sector that must be reformed in the interest of creating orderly metropolitan space and preserving the health and well-being of informal e-waste recyclers and their recycling operations.

2 Revitalising Informal Economies of Disassembly?

In this section I discuss how Bangalore was the ground zero in Swiss and German development agencies' efforts to overhaul and modernise e-waste disposal practices in India. The ultimate objective of reforms instituted by Swiss and German development agencies in partnership with government and non-governmental actors is to revitalise the informal sector and lay the foundation for a robust system of e-waste management in India. In this section, I also show that these well-intentioned reforms have opened up opportunities for corporate e-waste firms with large capital outlays to aggressively stake claim to

e-waste generated in the IT hubs of Bangalore. This development has undermined the territorial rights that informal e-waste workers had painstakingly established in the IT hubs of the city, which in concrete terms implies that the informal recyclers' ability to acquire e-waste – the crucial input necessary for their survival and success – has significantly shrunk and in many instances completely eliminated. Thus the perverse effect of reforms that were designed in part to revitalise the informal sector has been seen to sap the optimism (or the sense of vitality, if you will) of informal recyclers.

Indo-German Swiss e-Waste Initiative

The Indo-German Swiss e-Waste Initiative (hereafter IGS), launched in 2004, is a partnership between the German Society for Technical Cooperation (GTZ), the Swiss Federal Laboratories for Material Science and Technology (EMPA) and the Indian Ministry of Environment and Forestry (MoEF). While GTZ is working on a range of hazardous waste issues in Karnataka, EMPA's focus was solely on e-waste. EMPA took the lead in the project and their implementation unit chose the "cyber city" of Bangalore as the site for the development of a model, "Clean e-Waste Channel". Among the more influential ideas shaping the policy responses to e-waste today is the notion that a separate channel that can be properly monitored from beginning to end should be set up for collecting, transporting and subsequently processing e-waste. Pointing out that the extant informally privatised system of e-waste management in Bangalore was at best subject to lax oversight, IGS experts set out to create a separate e-waste channel that would be constituted by strong institutions and actors who would be subject to proper regulatory oversight. This channel was christened the Clean e-Waste Channel (CEWC) and IGS decided to roll out a model CEWC in Electronics City, Bangalore's premier IT park.

In order to establish the CEWC, IGS worked closely with the Electronics City Industries' Association (ELCIA), which, as the name suggests, represents the interests of industries located in Electronics City. As a first step towards the creation of CEWC, ELCIA, in partnership with IGS, formulated and formally adopted a "code of conduct" which specified "sound" e-waste recycling practices for IT companies located in Electronics City (ELCIA 2007). The code of conduct, among other things, urged IT companies in Electronics City to separate e-waste from other waste streams, and track the quantities of e-waste generated. But the most important "sound" environmental practice that the code of conduct urged IT companies to comply with is to put an end to their practice of selling e-waste to unauthorised scrap dealers and informal recyclers. This diktat had devastating consequences for informal e-waste recyclers hailing from the slum neighbourhood off the old city market area (discussed in detail ahead). Subsequent to the adoption of the code of conduct, ELCIA set up a central collection point for e-waste collection within Electronics City. With the setting up of the central collection point, the CEWC was fully operationalised. The central collection point would provide IT firms with a convenient location to dump their segregated e-waste. E-waste dumped at the central collection point would be collected by "authorised" e-waste recyclers for further processing.

In Bangalore, at the time of the creation of CEWC, two authorised e-waste recyclers existed.[6] An uneducated Muslim recycler whose company started out as a ragtag operation in the informal sector was the founder of one of the two authorised recycling companies. In marked contrast, the other authorised recycling company, called E-Parisara, was founded by a postgraduate of the elite Indian Institute of Technology (IIT) who had previous professional experience with global waste companies based out of Singapore. Based upon this biography, the founder of E-Parisara could be described as a member of the "new transnational capitalist class" that leverages the cultural capital of education and professional networks to build successful business (Upadhya 2004). The well-networked E-Parisara emerged as the preferred choice of development experts. E-waste collected at the central collection point was exclusively shipped to E-Parisara. Bangalore's second authorised recycling unit, started by an entrepreneur who does not possess the same kind of cultural and social capital as the founder of E-Parisara, was wilfully sidelined by the IGS experts. Development experts' preference for E-Parisara is also evident in the promotional brochure produced by ELCIA, with the aid of IGS, to publicise the establishment of CEWC (ELCIA 2007). In the promotional brochure not only was E-Parisara listed as the *sole* authorised e-waste recycler in Bangalore but it also featured an interview with the founder of E-Parisara who used this opportunity to extol the virtues of his company (ibid). Such preferential treatment and favourable publicity has helped E-Parisara gain a strong foothold in Electronics City and the company now has a roster of over 50 corporate clients, including prominent companies such as Infosys, Intel and IBM.[7]

As they conceptualised the city's e-waste policy framework and implemented the CEWC, development experts continually affirmed their commitment to carve out a role for informal recyclers in the CEWC. Yet, no role was assigned for informal recyclers in the CEWC. Indeed, as I have shown above, even the authorised e-waste facility founded by a former informal recycler was sidelined by IGS. The informal sector, I would argue, is subject to such punitive restrictions because of development experts' ambivalent attitude towards the informal sector. Development experts valorise certain attributes of the informal sector. For instance, IGS experts often highlight informal recyclers' ability to scour and collect e-waste from dispersed sources and they also speak with admiration about informal recyclers' capacity to manually disaggregate waste into minute parts. IGS experts propose to harness these skills and allow informal recyclers to eventually play a vital but supplementary role in the CEWC, which is that of acting as suppliers who feed meticulously sifted waste to large corporate firms such as E-Parisara.

In essence, what IGS experts are proposing is a circumscribed role for informal recyclers in the CEWC and justify this proposal, most importantly, on the grounds that it protects the health of informal recyclers and that it has the added advantage of making the most rational use of informal recyclers' skills. Most policy discussion around informal e-waste recycling

invariably highlights the grave health risks that informal recyclers inflict upon themselves through the use of rudimentary techniques of processing e-waste and emphasise the need to make urgent interventions to mitigate these health risks. Operating within this global discourse, IGS experts, too, underscore health risks that informal recyclers of Bangalore inflict upon their bodies and view the alleviation of these health risks as their most urgent duty (Rochat undated). At stake in these policy debates, I would argue, is a specific notion of what I have earlier – drawing upon the work of Jane Bennett – referred to as a sense of vitality. To elaborate policy discourses that highlight adverse health impact are in essence commenting on the "vitality" (or the lack thereof) of extant informal recycling systems. Pushing this argument further, I would suggest that IGS experts with their strong emphasis on self-inflicted health risks, in fact, view the existing informal e-waste recycling system of Bangalore as an ailing system that literally makes people sick. The next logical step for IGS experts is to revitalise the ailing system by targeting the source of sickness. This they attempt to do by forbidding informal recyclers from using risky techniques of processing e-waste and limiting them to the role of suppliers of finely sieved e-waste to large corporations.

In addition to making claims about improving health outcomes of informal recyclers, IGS experts view their re-envisioning of informal recyclers' role in CEWC as potentially revitalising Bangalore's extant e-waste recycling system in two additional senses. First, IGS experts argue that by circumscribing the role of informal recyclers they will improve the overall productivity of e-waste recycling. That is, they suggest that large-scale companies (such as E-Parisara) with the capacity to invest in sophisticated machinery can extract precious metals at a rate higher than what could ever be achieved by informal recyclers and thus for IGS experts it makes sense to proscribe informal recyclers from undertaking any form of processing beyond manual disaggregation of e-waste (Rochat et al 2008). Second, IGS experts claim that the circumscribed role they assign for informal recyclers will also improve environmental outcomes. How so? IGS experts who accuse informal e-waste recyclers of dumping non-commercial portions of e-waste in the open assert that by circumscribing the role of informal recyclers they can train informal recyclers to perform their limited role with exemplary diligence and thus become better environmental stewards (Rochat undated).

To sum up, in the estimation of IGS experts, by circumscribing the role of informal recyclers in CEWC they would revitalise the health of recyclers, improve environmental outcomes for the city and increase the productivity of e-waste recycling. IGS experts insist however that informal recyclers would be allowed to take up this circumscribed role in the CEWC only if they embarked upon a multi-step programme of improvement that culminates in informal recyclers converting their units into formal units. To put it pithily, informal recyclers' entry into CEWC was made conditional upon the formalisation of the informal recycling sector.

As I said, achieving formal status is a multi-step process. First, informal recyclers had to agree to participate in knowledge and skills training workshops conducted by IGS experts through its surrogate institutions. Once they were properly schooled in scientific recycling methods, informal recyclers were expected to apply these lessons and make (costly) investments towards relocating their business, which was now expected to be equipped with protective gear and pollution mitigating equipment, to an industrial zone. Finally, informal recyclers had to make sure that they complied with and obtained appropriate regulatory authorisations such as authorisation from pollution control boards.

Promise of Transition

IGS experts promised to help informal recyclers in this journey of transitioning from informal to formal status. Help, however, arrived at a sluggish pace and informal recyclers had to wait for considerable length of time to obtain formal status: That is, even though the CEWC was inaugurated in Electronics City in 2007, it was not until 2011 that a few informal recyclers, from the slum neighbourhood off the city market area, who had formed an association to collectively work towards attaining formal status were able to finally be authorised as a formal unit. As they struggled between 2007 and 2011 to meet the bureaucratic and financial burden of transitioning to a formal unit, informal recyclers' businesses suffered, they barely made any profits and the relationships they had painstakingly cultivated with facility managers in Electronics City were severed as a consequence of which they no longer had any territorial claims to e-waste generated in Electronics City. During this period, instead of approaching e-waste with a "sense of vitality" informal recyclers confronted it with a sense of dejection and uncertainty. This uncertainty continues to plague the reformed informal recyclers and they have to contend with IGS granting E-Parisara virtual monopoly over e-waste generated in Electronics City. Now they are still scrambling to source e-waste from bulk producers of e-waste. Thus, the net effect of IGS circumscribing the role of informal recyclers in the hope of revitalising them has been to actually undermine the viability of their businesses and bolster corporate e-waste firms such as E-Parisara.

IGS' interventions also amount to a neo-liberal re-regulation of e-waste and environment in the city. Critical geographical scholarship has highlighted that the neo-liberalisation of environmental governance, understood to be the articulation and constitution of neo-liberalism through environmental governance, often results in the enclosure of critical natural resources (Guthman 2007; Heynen and Robbins 2005; McCarthy and Prudham 2004). The roll-out of CEWC in Electronics City can be understood along these lines, that is, as a process that enclosed e-waste as a result of which e-waste, which was a source of "variegated form of social wealth" (Gidwani and Baviskar 2011: 42) to hundreds of informal recyclers, is now being made available exclusively to one authorised recycler. Furthermore, key gaps in IGS' institutionalisation of regulatory oversight for CEWC are also consistent with neo-liberal approaches to urban environmental governance. Let me illustrate: IGS experts asserted that authorised recyclers such as E-Parisara should be subject to regular audits in order to ensure that highest environmental and occupational health standards are maintained

but no such audits have been conducted. Authorised recyclers are free to voluntarily adopt self-regulating standards. The lack of mandatory regulatory standards combined with reposing faith in private firms' self-regulation can breed what Scott Prudham (2004) terms "organized irresponsibility" in environmental governance regimes. This, in turn, can help propagate the very environmental and health risks that IGS experts sought to mitigate through the institution of CEWC. Finally, revanchist neo-liberal logic manifests in CEWC through selective and punitive over-regulation of the informal sector. While capitalist firms such as E-Parisara were under regulated, informal recyclers, as I have shown, were required to comply with burdensome regulations and undertake mandatory improvements as the price of their admission to CEWC.

Even after meeting these burdensome requirements, informal recyclers have been at best unevenly incorporated into the CEWC. Far from being revitalised they continue to struggle to make any profit principally because they no longer have access to bulk e-waste. Furthermore, lack of mandatory audits means we have no way of knowing if workers employed by E-Parisara are protected against occupational health risks, nor do we know if E-Parisara properly disposes the non-commercial toxic residue that is left behind after the profitable portion of e-waste is extracted. Thus, IGS' support of corporate firms such as E-Parisara has produced at best dubious environmental and social outcomes and this in turn means that the vitality of the city's emergent e-waste system continues to be suspect. There is nothing uncertain, however, about one of the outcomes of IGS' reforms: IGS gave impetus to corporate privatisation of e-waste and bolstered the position of corporate firms such as E-Parisara at the cost of Bangalore's informal sector. Development experts who seem largely satisfied with the uneven outcomes they have engineered in the city (WEEE Recycle 2012c) are seeking to scale up Bangalore's reforms and institute them in other cities within India. In the next section I provide a brief, critical review of the effort to scale up e-waste reforms that were first rolled out in Bangalore.

3 Scaling Up Clean E-Waste Channels

In the previous section, I have shown that Bangalore was the place where ambitious and far-reaching e-waste reforms that aimed to modernise and revitalise India's ailing e-waste management systems were first introduced. A new project launched in 2010 seeks to extend the e-waste reforms first introduced in Bangalore to Delhi, Kolkata and Pune. These reforms are being extended to other cities under the aegis of a new environmental governance project called "WEEE Recycle". GTZ, a key member of the IGS initiative of Bangalore, which merged with two other German organisations to form the German Agency for International Cooperation (GIZ), is the leading partner of WEEE Recycle. The Indian partners of WEEE Recycle include Manufacturers' Association for Information Technology and the national ENGO, Toxics Link. The primary objective of WEEE Recycle is the creation of e-waste channels along the lines of Bangalore's CEWC in Delhi, Kolkata and Pune: This project is justified on the grounds that creation of separate e-waste channels will institutionalise the proper collection and disassembly of e-waste by disciplining the unruly informal recycling sectors of these cities (WEEE Recycle 2012a). To this end, WEEE Recycle has adopted the same disciplinary strategy as the IGS initiative in Bangalore, which is to insist upon the formalisation of the informal sector.

In the previous section I have shown that economic, environmental and health outcomes engendered by IGS were less than optimal and yet Bangalore's reforms have become worthy of emulation and replication. Why is this the case? For development experts, Bangalore's CEWC is worthy of emulation because it is viewed as a success story within policy discourse. Development experts point to the creation of two formalised informal units in Bangalore as evidence of this success. My contention is that development experts' emulation of Bangalore's reforms is not contingent upon the putative success of their reforms. To be precise, what I suggest is that the e-waste reforms and strategies first introduced in Bangalore are being seamlessly scaled up and replicated in other cities because the expert sanctioned "policy fix" that was rolled out in Bangalore is viewed as the only universal solution to the e-waste challenges faced by all cities in India.[8] Quite simply, then, Bangalore's CEWC is worthy of emulation because it is framed as the only rational policy fix to the e-waste problem in India.

The policy fix ignores realities such as the fact that Bangalore's informal recycling sector is much smaller than Delhi's. According to Saahas' field investigations, when e-waste reforms were first rolled out in Bangalore, the city's informal recycling sector comprised of a mere 250 scrap dealers and 150 recyclers (Rodrigues and Gantenbein 2008). In contrast, Delhi's informal e-waste recycling sector is vast: According to WEEE Recycle (2012b) estimates, nearly 25,000 workers are employed in Delhi's informal recycling sector. Given that IGS failed to fully integrate Bangalore's much smaller informal sector into the city's CEWC, it would be highly optimistic to expect that WEEE Recycle will constructively work with 25,000 workers to ensure that they create viable formalised informal associations that will be incorporated into an e-waste channel. Incorporation of 25,000 workers is also highly implausible because WEEE Recycle, like IGS, is also simultaneously promoting corporate e-waste firms to play a greater role in Delhi's e-waste management system. Furthermore, WEEE Recycle like all development projects is governed by the punctuated temporalities and project logics of the global development sector: It was designed as a project that would begin in 2010 and end in 2013 and this temporal framework of the project seems especially indifferent to the time required to enable informal recyclers to transition into viable and resilient formal institutions. Thus, apart from development experts' bias towards formal recyclers and against informal recyclers, the temporal logics of development interventions will also result in the uneven incorporation of informal recyclers into emergent circuits of e-waste management.

One of WEEE Recycle's key partners is the leading national ENGO, Toxics Link. On the national stage, Toxics Link played an early, invaluable role in highlighting the emergent threat of dangerous levels of e-waste accumulation in India. It was Toxics Link's early field investigations into the modus operandi

of e-waste dismantling units in Delhi that revealed for the first time the exploitative working conditions and health risks associated with informal recycling (Agarwal and Wankhade 2006). Subsequent Toxics Link field investigations in Chennai, Mumbai and Kolkata confirmed that the hazardscape of e-waste dismantling results in toxins bioaccumulating in bodies of informal recyclers and eventually contributing to chronic illness and long-term morbidity of workers (ibid; Toxics Link 2003; Toxics Link 2007). Since these extensive investigations, Toxics Link has worked tirelessly to draw policymakers, governments and civil society's attention towards the mitigation of the hazardous conditions of informal e-waste recycling. Even as it makes an urgent case for mitigation, Toxics Link has also taken the principled stance that mitigation cannot be at the cost of informal recyclers' livelihood.[9] It remains to be seen whether the involvement of Toxics Link will result in reflexive and deliberative rather than fast implementation of e-waste reforms in Delhi, Kolkata and Pune, and if that will, in turn, result in informal recyclers of these cities being better integrated into modern circuits of e-waste management than their counterparts in Bangalore were.

4 Conclusions

Indian cities are rapidly transforming and issues of governance, including environmental governance, are being posed with a renewed sense of urgency amidst widespread frustration about the dearth of innovative and resilient policies to address myriad environmental problems that cities are confronted with. Along with frustration about the seeming inability to contain the chaos of Indian cities there is also resurgent confidence among the urban elite that with civil-society participation and the judicious adoption of international "best practices" India can create clean and orderly world-class cities. The Swiss and German development agencies' roll-out of e-waste reforms must be situated within this larger context. Their intervention was welcomed by governments and civil society actors alike, who seem to be convinced that the creation and institutionalisation of separate channels for e-waste collection and disassembly, in keeping with international best practice, would eliminate health and environmental risks associated with informal recycling and modernise India's improvised e-waste recycling system whilst also ensuring that the revamped e-waste recycling system would not displace informal recyclers who depend upon e-waste for their livelihood.

This paper clearly shows that displacement and dualism were inter-braided logics in this project. It shows that the implementation of the IGS reforms were uneven with the corporate e-waste sector benefiting the most and the informal sector, which was cast out of the CEWC for a few years, being subject to punitive regulatory restrictions. Well-meaning experts' efforts to mitigate the occupational health risks of informal recyclers not only eliminated some of the health risks but also eliminated informal recyclers' occupation by making it difficult for informal recyclers to obtain raw material. Such perverse outcomes are partly attributable to the very nature and structure of international development projects such as the IGS project which are governed by the logic and temporalities of policy cycles: within the time constraints of policy cycles, IGS had to rapidly design and execute its Bangalore reforms and produce demonstrably "successful" results. IGS was "successful" in its goal of "formalising the informal sector" but formalisation, as I have shown, has not ensured the economic viability of informal recyclers. The perverse outcome is also the result of the present conjuncture in India where waste has emerged as a fiercely contested frontier of capital accumulation: both Indian and global waste corporations are vying to get lucrative waste contracts and e-waste in particular is seen as an undercapitalised but potentially hugely profitable niche sector. The inherent bias of policymakers and experts towards the modern waste corporations implies that large firms such as E-Parisara have leveraged their cultural and social capital to lobby development experts to create conditions of possibility for the growth of corporate firms.

Within this broader context, informal recyclers' ability to participate on more equitable terms in new regulatory regimes entails the rethinking of temporalities of project cycles, critically re-examining experts' bias towards the formal sector and the related stigmatisation of the informal sector. More broadly, policymakers and experts need to engage with informal recyclers in respectful, non-patronising terms and recognise informal recyclers as actors who do not simply desire protection against health risks rather they must see them as actors whose sophisticated economies of disassembly hints at their desire to fashion future-oriented life-worlds in the city.

NOTES

1 This account is based upon fieldwork that I conducted in Bangalore for a total of 12 months, between 2006 and 2008.

2 Bangalore's most prominent early pioneer of informal e-waste recycling does not hail from this slum neighbourhood but he is well known among recyclers here. Tall stories of his success were recited with a mix of awe and envy: this recycler now owns a house and a warehouse in the heart of Bangalore, a factory in a nearby town, and prime real estate in an adjacent district of Bangalore. Resolutely realistic, most informal recyclers of the slum neighbourhood off the old city market area did not entertain delusions of attaining such spectacular success; however, they do believe that with hard work it would be possible to emulate the moderate success attained by few of the early pioneers.

3 As ULBs have embarked upon the privatisation of municipal waste, scholars, activists and waste-pickers in many parts of the world advance a similar line of argument and assert that because they provide ecological services to the city their contributions should be recognised and the services of waste-pickers and other informal recyclers must be incorporated into ULBs' partially or fully privatised solid waste management systems (see Samson 2009 for an overview).

4 In making this argument, I build upon recent geographical scholarship on commodity afterlives that highlight how the capture of value during disassembly of wasted commodities extend global commodity chains in multiple and contingent ways (Crang et al 2012; Lepawsky and Billah 2011; Lepawsky and Mather 2011).

5 Ravi Sundaram (2010: 117) terms knowledge acquired through learning in an informal setting "the world of informal technological knowledge". More broadly, Sundaram deploys the term pirate modernity to capture the proliferation of informal production networks within which a substantial portion of software and hardware is produced in Indian cities.

6 The IGS e-Waste Initiative considered an e-waste facility/company to be an "authorised recycler" if that company had managed to obtain regulatory authorisations from pollution control boards such as Karnataka State Pollution Control Board or Central Pollution Control Board.

7 Despite this success in lining up corporate clients, the founder of E-Parisara often complains that

the formal sector is only able to capture 5% of the total e-waste generated in India (Acharya 2008). The suggestion here is that the informal sector is still running amok and that government and policy experts should do more to curtail the informal sector and foster the formal sector.

8 I develop these points about policy emulation by drawing on Peck and Theodore's (2010) overview of the key insights of recent geographical scholarship on policy mobilities and mutations.

9 More recently, even as Toxics Link insists on protecting the livelihoods of informal recyclers, it has also expressed concern that e-waste continues to leak into the informal sector and recommends vigilant monitoring to identify and plug such leaks (Agarwal 2012). Such sentiments give moral legitimacy to first depriving the informal sector of a crucial input necessary for their trade even before meaningful efforts have been made to integrate them into a clean e-waste channel.ll

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