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ABSTRACT

This study extends the understanding of global production network (GPN) analysis by considering the post-consumption activities of the product in question, namely mobile phones. The authors examine the production networks involved in mobile waste treatment and the employment conditions in these networks. Also, in a context where e-waste management raises questions on environmental pollution and health, they examine how far Extended Producer Responsibility (EPR) operates in India. They find the post-consumption activities of mobile phones to be highly dynamic. This point is illustrated by the existence of a vibrant secondary market for mobile phones refurbished from the discarded ones, the recent trend of recycling of mobile waste, the discovery of the high value of its components, and the growing trade of mobile waste, though it is still a small component of the entire e-waste. At the same time, several issues plague these production networks—horrid working conditions, working without protection, the prevalence of child or adolescent labour to some extent, and male domination within the two profitable segments. Even in the formal sector, the work of recycling is mostly done by casual or contractual labourers, and many of the informal working conditions continue to prevail here. Again, the study shows that though the corporate sector has started responding to the concerns of civil society on the environment with regard to e-waste by taking up EPR, it is still falling short in its measures, as the waste manages to reach the hands of informal players, with the consequent implications for health and the environment. The way forward, should not entail curbing the informal sector, which offers livelihoods to many people, but it should be about extending EPR further to support entrepreneurs and workers in the informal sector and encouraging them to adopt environment-friendly and health-protecting production practices.

I. INTRODUCTION

As the world gets increasingly integrated through production networks, a lot of research is being done on global production networks (GPNs) and global value networks (GVCs), which investigates the following questions: How does the advent of private sector GPNs change the dynamics of trade, production and employment in developing countries? And

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what is the impact of these on the well-being of workers and small producers in GPNs? The need for studying post-consumption activities in the GPN and GVC literature has been pointed out by some scholars (Lepawsky and Billah, 2011). While taking into account an understanding of GPNs as including post-consumption activities, this study examines the production networks involved in mobile waste treatment and the employment conditions of workers in these networks in India. Two states, namely Delhi and Tamil Nadu, have been considered for the study.

E-waste, of which mobile waste is a component, is different from other waste. The manner in which e-waste is managed quite often has serious implications for the environment and health. This, in turn, has led to several measures aimed at addressing these issues. A prominent measure is that of extended producer responsibility (EPR) in e-waste management. The operation of EPR in the mobile production networks of India has been examined in this paper.

After setting out the context of post-consumption value chains, the paper deals with issues of mobile waste and ways to deal with them. This is followed by an analysis of the chain of travel of mobile waste once a mobile has been discarded, and the actors involved in the chain, that is, whether they were formal or informal, large or small, and so on. The next section deals with the nature of employment, including working conditions, in mobile waste chains. After this there is a brief description of EPR in India. Section VIII concludes.

As mentioned earlier, the states of Delhi and Tamil Nadu have been considered in the investigation and analysis in this paper. While Delhi is a major trading hub of e-waste in India, the state of Tamil Nadu has been considered because some formal recycling firms are operating in the state. Both secondary and primary sources of data have been used for the analysis. The secondary information was collected from existing reports, newspaper articles and published scientific papers. The primary data, on the other hand, consists of both structured and unstructured interviews, with representatives of formal and informal sectors. Both entrepreneurs and employees of 6-8 units were interviewed in each of the places (Old Seelampur, Mundka, Moradabad) belonging to the production chain. The study has, however, considered only a few sample units and the findings are limited to that extent.

II. GLOBAL PRODUCTION NETWORKS AND POST-CONSUMPTION VALUE CHAINS

Global production networks, wherein the lead firms outsource several production and service activities to developing economies, have increasingly become an important means whereby production is organised during the globalisation period. Post-2008, there has been a shift from North–South production flows to South–South. Capturing the Gains (CtG) is a research programme, which essentially examines the question of the employment and well-being of workers and small producers in these production networks. It assesses how far economic upgrading in GPNs/GVCs is followed by social upgrading in the same. The major kinds of economic upgrading identified in GPN literature are those of product, process, and functional and chain upgrading, leading to higher productivity and profit-making. The social upgrading

of workers and small producers refers to an increase in employment and improvement in working conditions, which includes increase in wages, compliance with minimum labour standards, enabling workers with labour rights, and freedom of association. It also includes the abolition of child labour and a movement towards equality in working conditions across gender and other social groups.

Within the Capturing the Gains (CtG) research programme, some studies have examined the value chains of mobile telecommunications devices. Bernhardt and Milberg (2011), for instance, have examined the economic and social upgrading of this industry, and find that there is considerable economic upgrading within mobile phone value chains but without much social upgrading. While examining mobile phone value chains, Lee and Gereffi (2013) found that increased GVC concentration has limited employment growth to just a few countries and firms. Another study traced coltan, the raw material for tantalum, an essential mineral in the manufacture of mobile phones, computers and other electronic equipment. It pointed out the violent sources involved in mobile phone manufacturing, as the demand for coltan has led to deadly conflicts between armies of Central African Governments and private militias (Nathan and Sarkar, 2011).

This study on mobile waste is part of the CtG research on mobile telecommunication devices. The linking of 'waste' as an integral part of GPNs is pointed out by Lepawsky and Billah in their interesting study on e-waste industry in Bangladesh (Lepawsky and Billah, 2011). This study takes cues from literature to track the transience and continuity of commodities, as in the case of the ship-breaking industry, wherein scrap materials are transformed to build another buoyant industry of furniture (Gregson, *et al.*, 2010). Lepawsky and Billah show how e-waste is not just about toxic dumping, but is something around which an entire industry has emerged, creating value and generating employment for many. Roughly 1.5–2 per cent of Dhaka's entire population is estimated to be directly earning a livelihood from e-waste, and an estimated 1000 tons of rubbish value material are put back into production every day. Given this scale of economic activity emerging from e-waste, the authors point out how an omission of post-consumption activities from the GPN/GVC literature would be highly inadequate. They argue that what GPN/GVCs generally take as the final point, that is, the purchase of a commodity by the buyer, should be conceptualised in the form of provisional moments in the "ongoingness of economic action and material transformation" (p. 135). These post-production value chains also exhibit the characteristics that GPN research typically engages with, namely, upgrading, skill and knowledge transfer, innovation and creativity, and even patenting and intellectual property protection. They conclude that "instead of the dead certainty of where we will end up in a GVC or GPN, we find a protean liveliness when we study the actions that make, unmake, and remake rubbish electronics" (p. 13).

III. ISSUES OF E-WASTE MANAGEMENT AND ATTEMPTS TO ADDRESS THEM

The post-consumption activities of a commodity may form an industry in itself, as noted above. As regards electronic goods, it, however, raises contentious issues of environmental

and health hazards. E-waste harbours over 50 toxic elements, including mercury, arsenic, lead, chromium, chemicals like brominated flame-retardants, polychlorinated biphenyls (PCBs) and the ozone-depleting chlorofluorocarbons (CFCs). When handled without adequate safeguards, they pollute the environment and enter human bodies. Exposure to these chemicals can cause long-term, even inter-generational, health problems, including neurological and endocrinal disorders or cancer (Agarwal, 2012). Many countries have banned or restricted the use of many of these toxics. Also, many others have banned the disposal of Waste Electrical and Electronic Equipment (WEEE) along with other municipal waste, either in landfills or through incineration.

There have been a lot of concerted campaigns globally by civil society to address issues on e-waste, which have, in turn, led to the formation of international conventions and forums aimed towards the same. Some of these include the Basel Convention on Hazardous Waste, the European Union directives and regulations related to e-waste and environmental protection, the creation of a Hazardous Task Force by the North American Commission on Environmental Co-operation, and the adoption of a recommendation on the environmentally sound management of waste by the Organisation for Economic Co-Operation and Development (OECD). By and large, these forums and treaties have three objectives, viz., the conservation of natural resources, consideration of issues of human health, and reduction of environmental pollution related to e-waste management.

One of the prominent measures envisaged for addressing e-waste management is extended producer responsibility or EPR, which entails making the producer the primary actor accountable for the entire life-cycle of the product, including its post-consumption phase, with the objective of reducing the adverse environmental impact of the product concerned. EPR includes the take-back, recycling and final disposal of the product in environment-friendly ways, following the 'polluter pay principle'. EPR also implies that producers should be responsible for the product, even in its designing stage, which would eventually facilitate its environment-friendly re-use or recycling. EPR is exercised in different ways in different countries. For example, in California in the US, producers pay recycling fees to a designated governmental fund used to operate the programme. Their counterparts in Japan have an obligation to recycle the WEEE collected, but partially receive financial compensation from the last owners of household appliances. In South Korea, the Government allocates the amount of WEEE to each producer to collect and recycle every year (Manomaivibool, 2009).

IV. RESEARCH QUESTION, DESIGN, METHODOLOGY AND LIMITATIONS

In view of the increasing attention being given to post-consumption activities in GPNs/GVCs, the post-consumption networks of mobile telecommunication devices, which constitute an important industry studied by the CtG research network, have been examined in this article. As mentioned earlier, the study explores the production networks of mobile waste and the employment conditions of workers in these networks. It also examines the problematic issues characterising the mobile waste industry and the operation of EPR in the mobile production networks of India.

The study has been undertaken in India, a country which has seen an unprecedented growth of mobile phones, with over 919 million subscribers by the end of 2012, and where the Indian mobile devices business is currently at its lucrative best (Mehta, 2013). Growth in the mobile industry also inevitably leads to a growth in its waste. The total annual e-waste generated in India during the year 2007 was 3,82,979 metric tonnes (MTs), including 50,000 MTs of imports in India. Of this, the mobile phone constituted 1655 MT.[1] However, mobile recycling is still at a nascent stage.[2]

V. THE MOBILE WASTE CHAIN

Travel of Mobile Waste Discards: Findings from Tamil Nadu and Delhi

As indicated earlier, there is little awareness among people regarding the value creation possibility of discarded mobile phones. Consequently, a large part of the mobile waste discards are not being used. Among the mobile waste discards that are used further, four forms of value-capturing can be identified. One pertains to the refurbishing of mobile phones in the secondary markets, while the second concerns the recovery of important components from old phones for repairing other phones. The third form is the data destruction from Sim cards, and the fourth is to do with the recovery and recycling of precious components derived from mobile phones. The next section discusses the first three forms of value capture, which is followed by a detailed discussion of the recovery and recycling of precious components, as these activities constitute a more elaborate production network in itself.

Forms of Value Capture from Discarded Phones

The refurbishing of discarded mobile phones comprises one major form of value-capturing. In Chennai, the capital city of Tamil Nadu, for instance, one can find small shops dealing with mobile phones. They first procure phones that are in working condition to some extent; they then repair and resell these in the market. Cell-phone chain stores like Univercell also procure used mobile phones and sell them to smaller shops, which service and resell them. The profits accruing from second-hand phones do not exceed Rs. 500 ($ 8),[3] on an average, with some exceptions. The second form of income generation emanates from the dismantling of the usable parts of phones that cannot be sold. These usable parts include integrated chips (ICs), speakers, and liquid crystal display (LCDs), among other things, which are recovered for use in the servicing of other phones. The third form of value generation emerges from the data destruction of sim cards. In Tamil Nadu, a formal company, Global E-waste Management Services, is involved in this form of value generation, which is the main source of revenue for it.[4] The company also has official tie-ups with Vodafone and Samsung.

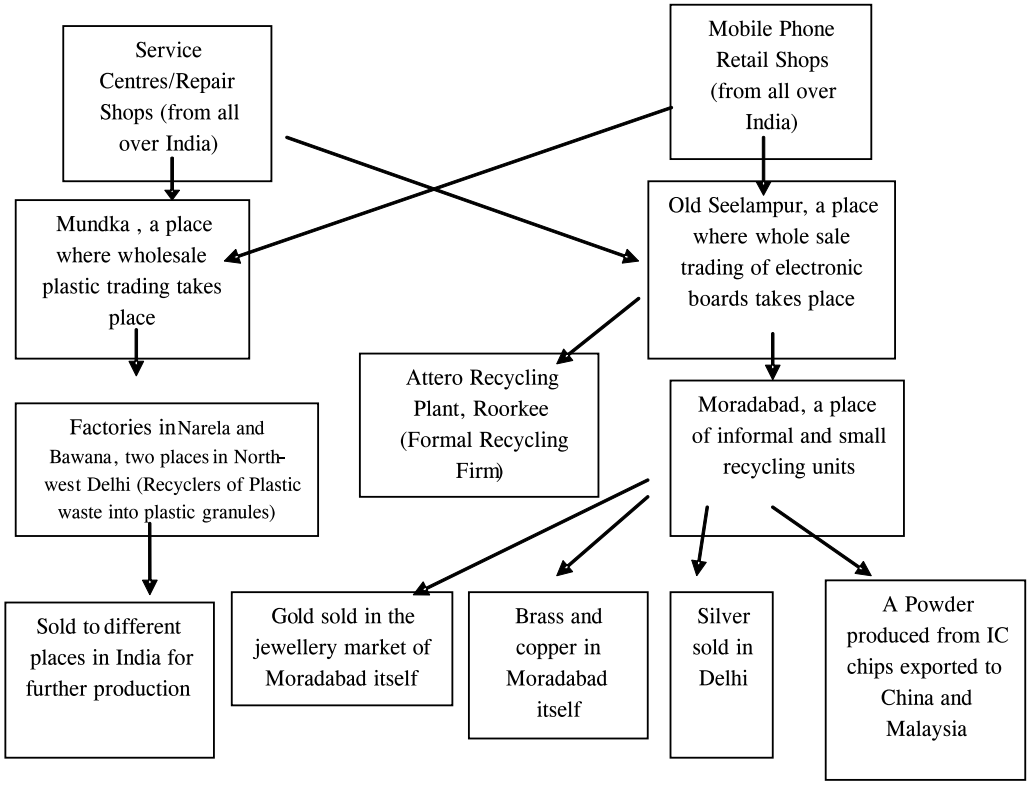
Value Generation through Recycling of Discarded Phones

Informal players assume a larger role in the recycling of mobile phones. In the informal market, the recycling of mobile phone discards goes through a series of production networks or chain of economic activities. The following discussion traces the segments involved in the production networks in the informal recycling markets (see Figure 1). There are two

major components that enter into the chain of recycling. These include printed circuit boards and plastic panels.

Figure 1

Chain of Travel of Mobile Waste with Delhi as the Centre



Component 1 of the Mobile Waste Chain—Circuit/Electronic Boards:

The chain of mobile waste starts from municipal bins, and small retail, service and repair shops. These discards are collected by either *kabadiwala*s or local suppliers linked to the wholesale markets of boards, which constitute the next link of the chain. However, since metal recovery from electronic boards does not take place in the informal sector in Tamil Nadu, the discarded metal parts are sent to North India for recycling in the informal market.

Delhi is a major informal trading hub of e-waste in India. Mobile waste arrives here from all over India. Within Delhi, Old Seelampur in the Trans-Yamuna region in North-east Delhi is the largest wholesale market for e-waste.[5] Although there are several other regions dealing with e-waste in general, Old Seelampur is the only place wherein a considerable amount of mobile waste is traded. In Old Seelampur, traders have their regular suppliers, who procure boards for them from all over India. The largest amount of e-waste reportedly comes from South India, which is its biggest producer.

The Seelampur centre consists of around 370[6] small trading units spread across several *gali*s (narrow streets). However, only around 35[7] from a total of around 370 trading units here deal with mobile waste. According to some traders, mobile waste is even today a

small component of the waste, accounting for just about 2-5 per cent of the total waste. However the value of per unit of mobile boards [Rs. 2000–2300/kg ($ 32.1–36.9)] is higher than that of any other waste. Further, the trading of mobile waste has increased by 20–30 per cent over the last few years. The boards go from Old Seelampur to the recycling units in Moradabad. A few traders sell the boards to a formal recycling firm called the Attero Recycling Company.

The third link in the chain of recycling activities in Delhi is Moradabad,[8] which is an important place in the journey of mobile boards—a place where waste is transformed into valuable metals and other components.[9] Here, IC chips and metals are extracted from these boards and then segregated. Some units specialise in dismantling activities while some others engage in the recycling of IC chips and plates. Various metals including gold, silver, copper, brass, white gold, platinum and plato emerge from the chips. The IC chips inside the mobile board cost around Rs. 12,000 ($ 192.6)/kg. Gold is generally sold in the jewellery market within Moradabad at a price slightly lower than the market price. Brass, which is sold for around Rs. 270 ($ 4.3)/kg, goes to the famous brass industry in Moradabad. Silver, sold for Rs. 45,000–50,000 ($ 722.3–802.6), is also sold in Delhi and other places. Copper is sold for Rs. 350 ($ 5.6)/kg in Moradabad again. The plastic part of the boards is taken to a place on the outskirts of Moradabad, where it is burnt and silver wires are extracted from it. Another important component, a powder (possibly a residue of rare earth materials), which results from the crushing of a particular set of IC chips, is exported to countries like China and Malaysia, wherein it is extracted further.

In Moradabad, the e-waste recycling units have started functioning only since the last ten years or so. Around 500–600 small unregistered units here work on e-waste, using minimum technology and machinery. Almost all units reportedly deal with mobile waste.[10] Mobile waste has entered the e-waste category only during the last 4-5 years. It constitutes only 10–15 per cent of the entire market. Earlier, as mentioned by an entrepreneur, no one knew that gold and silver could be extracted from these boards. Although only a new entrant, mobile waste thus constitutes a valuable form of e-waste in view of the precious metals that it can be transformed into. The trade in mobile waste has also shown an increase of around 20–30 per cent during the last few years. While no upgradation in technology was observed, there has been a significant expansion of the industry in terms of the advent of more units in other areas of the city.

Component 2 of the Mobile Waste Chain—Plastic:

As mentioned at the outset, plastic is the next important component of mobile waste that is recovered and recycled. The plastic casings from the mobile phones are of different grades, including polycarbonate, and Acrylonitrile Butadiene Styrene (ABS), among others. Delhi is one of the largest wholesale trading markets of not only electronic waste, but also plastic waste. Mundka, situated in West Delhi, accounts for large-scale wholesale trading of different types of plastics, which are brought from all over India. There are around 4000 units dealing in plastic in Mundka, employing around 12,000 people. Around 500 of

these units deal with mobile waste. The main activity undertaken in these units is sorting of different types of plastics. Some dismantling work such as the removal of copper wires attached to the plastic is also performed here. After sorting, the plastic is sent to factories in Narela, the *tehsil* lying at the border of North-west Delhi and Haryana and Bawana, also located in North-west Delhi. In these factories, the plastic is recycled into granules and sheets, which are then sold in the domestic market for further production. Mobile waste purportedly comprises a small component of the total plastic waste, accounting for roughly 8–10 per cent of the total plastic waste. The price of mobile plastic ranges from Rs. 5.50 to Rs. 8 ($ 0.088–0.13)/kg. It was pointed out that there has been an increase of about 20–30 per cent in the trade in mobile waste over the last few years.

The fieldwork for this study in Tamil Nadu also presented a similar picture. The plastic component of mobile waste moves from the local neighbourhood waste goods trader to a slightly bigger local plastic waste dealer. From there, it goes to a big plastic stockist, who recycles it or sends it further ahead for recycling. Here again, the cell phone panels do not constitute a constant flow, but form a small part of the collection of plastic.

Formal Sector Firms

The recycling of e-waste by formal players is still in a nascent stage in India, with some of the firms having obtained the sanction to operate only recently. For instance, in Tamil Nadu, there are a total of 19 e-waste recyclers in the state, out of which 6 have just been granted the 'Consent to Establish' while 13 have been granted the 'Consent to Operate' by the Tamil Nadu Pollution Control Board.

An interview with a firm in the formal sector, TES-AMM, a Singaporean company based in Tamil Nadu, showed that like in the informal sector, mobile phones/accessories discards comprise a very small proportion of the larger e-waste stream coming to the facility, that is, a few tonnes a month. The mobile phone discards are stored in the facility till an optimum quantity viable for recovery and recycling is achieved.

The components extracted in this company's facility are similar to those obtained in the informal sector, viz. copper, iron, aluminium, gold and plastic. Plastic is sent to a specific plastic recycler for further processing. Some components are also sent abroad for recycling. For instance, the batteries of mobile phones are sent by TES-AMM to its facility in Singapore for recycling. The waste left from PCB after metal recovery is crushed into a fine powder and sent to a Waste-to-Energy facility in Singapore.

The supply of mobile phone discards in TES-AMM comes from the manufacturers themselves, who have take-back programmes. The understanding they enter into with the companies supplying discards varies. For instance, for some of the waste/discards, the recyclers pay the manufacturers for procuring it while for others, the manufacturers pay the recyclers for recovery/recycling. The biggest challenge with regard to mobile waste, according to a TES-AMM representative, is the task of procuring enough waste to recycle. While consumers may change their phones and accessories often, they do not necessarily discard or return them to the manufacturers.

VI. LABOUR AND EMPLOYMENT CONDITIONS

While Part IV tracked the enterprises involved in the mobile waste production networks, this section discusses the composition of labour and employment conditions in these different segments. The refurbishing of phones and extracting the useful parts and accessories from them for repairing other phones comprise two forms of value generation. For small service shops and small dealers of mobile phones, the activities of mobile discards generate more income than their sale of cell-phones (as was claimed by the units interviewed during the fieldwork for this study in Tamil Nadu).

Mobile waste becomes an even more lucrative input once it enters the recycling stream. As discussed in Part A, in Delhi, the informal chain of recycling signifies a major economic activity that gives employment to several people. This necessitates a more elaborate discussion of employment conditions in the mobile waste chain in Delhi. However, a caveat here is that one cannot talk exclusively about the composition of labour and employment in the mobile waste chain, as its trade and recycling takes place conjointly with other e-waste.

The trading and recycling of electronic boards appears to be quite remunerative for both entrepreneurs and workers. For instance, workers in the trading units of Old Seelampur, on an average, work for eight hours and earn a monthly average income of Rs. 8,235 ($ 132.2). The range of earnings of the 15 workers is Rs. 5500 ($ 88.3) to Rs. 12,000 ($ 192.6). The per-day wage in the sample is around Rs. 274 ($ 4.39).[11] This is much higher than the all-India wage for casual labourers,[12] which is around Rs. 107 ($ 1.7) (NSSO, 2009-10). While details about the income and working hours of the entrepreneurs could not be obtained, one could, on the basis of the flow and scale of activity and business, infer that it is a highly lucrative business. This is also substantiated by the response given by a trader to the questions on income and working hours, which was 'no limit' for both the questions!

The remunerative possibilities in the trade thus lead the current traders to guard against the entry of others into the trade. This was endorsed by the comment of one youngster, who said that none of the traders would give any details for fear of any possible competition from the interviewers themselves. Such comments were also heard elsewhere. The fact that the traders belong to the Muslim community and generally consist of Maliks, lends some support to this observation. The survey of six units undertaken during this study showed all the entrepreneurs and workers are Muslims. Family or kith and kin ties or acquaintances seem to be the dominant basis of recruitment into the trade. Among the workers, 8 out of 15 workers were found to be related to the employers. The proportion of migrants in the trade was also small. The six entrepreneurs interviewed were all locals and the ratio of the migrant–local population among the 15 workers interviewed was 5:10. Even these migrants came from Uttar Pradesh, a state that many of these traders originally belong to. In general, it was pointed out that migrants formed only 2–5 per cent of the total employed population.

One could see that a lot of youngsters were actively involved in these trading activities, which is a reflection of the dynamism of the trade. The average age of the entrepreneur in the study sample is 38 years, while that of the workers is 26 years in a sample of 6 units. The youngest entrepreneur was 28 years old and the youngest worker was 19 years old.

The employment pattern in Moradabad also shows a very similar story. The survey of entrepreneurs and workers in eight units showed that the workers, on an average, were earning Rs. 9,200 ($ 147.7) per month.[13] They are paid extra for overtime work. None of the entrepreneurs revealed their earnings. As was seen in Old Seelampur, the entry of an outsider into the industry is difficult. The employers do not generally employ migrant labour due to the fear of details of their work and trade practices leaking out. Only 2 out of the 23 workers were migrants in the sample, and these two migrants came not from other states but from Aligarh in Uttar Pradesh itself. Besides, the entrepreneurs and workers in Moradabad predominantly belong to the Muslim community.[14] All the 8 entrepreneurs and 21 out of 23 workers were Muslims. Many labourers (12 out of 23) were also related to the entrepreneur. They had been recruited and employed on the basis of an understanding between them and the employer rather than on the basis of any written contract. Here again, youngsters were actively involved in the trade. On an average, the workers were of 26.8 years of age and were found to be working for 2.7 years in this trade. The average age of the entrepreneurs was 37.5, and on an average, they had 6.6 years of experience in this work.

The plastic component of the chain of mobile waste, however, did not show a remunerative scenario. The survey of six units in Mundka, the major trading hub of plastic waste, showed that workers, on an average, earned only around Rs. 4,000 ($ 64.2) per month. The earnings differed for different workers with some earnings being as low as Rs. 2,000 ($ 32.1) while others were earning Rs. 6,000 ($ 96.3). There were also adolescent workers who are paid the lesser amount of Rs. 2,000–2,500 ($ 32.1–40.1). Unlike in Old Seelampur and Moradabad, the activity of trading in plastic is not confined to any one community, and people of all religions are engaged in it. Out of the 25 workers surveyed, 17 were Hindus and 9 were Muslims. Also, the phenomenon of migration was highly prevalent. All the 25 workers in the six units were migrants. The proportion of the migrant–local population is 90: 10. Many of the workers were migrants from Bihar, West Bengal, Uttar Pradesh and Assam. There were also migrants among the entrepreneurs.

Gender Composition and Prevalence of Child Labour

In Old Seelampur, only men were involved in the disassembling and trading activities, while in Moradabad, very few women were engaged in these activities. The interviewers could not find any women workers in the units they visited. Even in Mundka, they were told that the general women–men ratio is 15: 85. Out of the 25 workers interviewed, only four were women. These findings reveal that the mobile-waste production networks are largely male-dominated. The rough nature of the work which entails no fixed timings, the performance of operations and transactions out in the street, the large scale of business activities, and the zeal with which the business is protected show characteristics of a typical male domain. These ‘naturalisation’ barriers could be preventing women from entering into these lucrative production networks.[15]

The problem of child labour is also prevalent, though not so rampant in many segments of the production networks. In Old Seelampur, the incidence of child labour was reported

to be rare. In the more hazardous industry of recycling in Moradabad, child labourers aged 'above 12' and adolescent labourers were found during the pilot survey. Children were also seen to be performing the task of fire heating of the mobile boards. However, no child labourers were found during the survey. In the least remunerative segment of plastic disassembly and trading in Mundka, however, there was a high incidence of child labour. In the study sample of 25 workers, 4 were adolescents aged below 18 years, with one of the boys being only 14 years old.

Working Conditions

The working hours, on an average, were within the decent limit of eight hours in Old Seelampur and Moradabad. In Mundka, however, they extended beyond eight hours, ranging between eight and ten hours even for children. Although in two segments, the earnings of workers were found to be reasonably good, the nature of work and working conditions ranged from tough to horrid. In Old Seelampur, the disassembling and trading activities were performed in crowded and dusty buildings, which extended to the streets. The nature of the work itself entailed dealing with electronic waste and constant exposure to hazardous materials, which could lead to illnesses. A doctor practising in the area was asked whether people working and living in the dusty, crowded *gali*s that were dumped with e-waste, complained of asthma. The doctor agreed, but he said that the number of stomach ailments arising from the poor quality of water in the area was higher than those attributed to other causes.

In Moradabad, the working conditions were found to be horrid and more hazardous than in other places, as it involved the melting of metals, a process which produces toxic smoke and heat. The workers work within such surroundings without any protective clothes. However, none of the interviewee mentioned about any diseases associated with work as such. The workers nurtured habits of smoking and taking tobacco and *gutka* (an intoxicant), as they seek relief from work in these tough surroundings. Even in Mundka, the workers have to work in difficult conditions, while sitting on the open ground under the blazing sun, with just a plastic sheet acting as a roof for shade, amidst dust, plastic and metal particles. The workers use some basic tools like hammer and tongs.

In all the three segments, it was found that the workers were not using any protection at work. Nor did they report any health problems. None of them were members of any workers' union or association.

Overall Scenario in the Formal Sector

No detailed information of workers could be obtained from the formal plants. But a few questions were discussed with 2–3 workers while they were returning from the plant at the end of their shift of work from the Attero Recycling Plant in Roorkee, situated in the state of Uttarakhand. A total of around 600 workers were employed in all the departments of the plant. There were three types of workers: permanent, contractual and daily labourers. The daily labourers were paid Rs. 155 per day and were not given any medical facility or bonus. They were brought in for work for a few days and were paid at the end of the period.

Contractual workers, on the other hand, were appointed for around three months and were paid Rs. 4,200–4,500 ($ 67.4–72.2) per month. Only permanent workers were entitled to medical insurance, bonus and paid holidays. The plant currently had only male workers who came from within Roorkee and the nearby Muzaffarnagar area. No child labourers were employed in the plant. The workers were mostly Muslims, while the supervisors and managers were Hindus. The permanent and contractual workers were given some training before being employed on the job. The workers worked for eight hours and used protection like mask and gloves. However, there was news of an accident wherein a worker's fingers got cut in the machinery and yet no compensation was paid to him as he was a daily labourer.

There does not appear to be much of a difference between non-permanent workers in the formal sector and workers in the informal sector. In fact, the wages are better in the informal sector. However, some positives of the formal sector are that there is a possibility of the workers becoming permanent, some protection is used by the workers while at work, and no child labourers are employed in the units.

VII. EXTENDED PRODUCER RESPONSIBILITY (EPR) IN INDIA

India is one of the few countries that now have a law in place on e-waste management. On 1 May 2012, the new e-waste rules stipulated by the Union Ministry of Environment and Forests, Government of India, came into force. One major mandate of these rules is that of Extended Producer Responsibility (EPR). Nokia is one of the mobile firms operating on the principle of EPR. It launched a Take-Back and Recycling Programme in January 2009. It placed over 1400 bins at the Nokia Care Centres (service centres) and branded retail shops (known as Nokia Priority Dealers) in four cities to collect dead mobile phones and accessories of any brand. Nokia vouches "to work with carefully selected companies who recycle the phone and accessories we pass on to them. These companies are assessed on a regular basis to make sure they're doing things properly and that anything handed to them is recycled responsibly[16]" .

The fieldwork revealed that though the corporate sector has started responding to the concerns of civil society on the environment with regard to e-waste, it is still falling short in terms of the implementation of the requisite measures. Even when Nokia takes back its product for the purpose of disposing its waste, it does not attempt further production on its own from its waste, rather it simply passes on the waste to recyclers in the formal sector. It has, however, been reported that the formal recyclers sub-contract their work to informal recyclers (Agarwal, 2012). Therefore, even when Nokia may give the collected waste to formal players, the waste could end up in the informal sector. Again, as seen in the discussion of employment conditions in the formal sector, much of the labour comprises casual labourers whose working conditions are different from those of informal workers only in terms of the use of protection clothes (the effectiveness of which still remains to be seen). Besides, there was callous neglect of their plight when met with mishaps. As such, at the moment, EPR of even the firm which has taken it up seem very incomplete.

VIII. CONCLUSION

Within the GPN literature, Lepawsky and Billah (2011) made a case for considering post-consumption activities of a commodity, as they could form a huge industry in itself. The study on mobile waste discussed in this article lends further support to this argument. It is not just that post-consumption activities form a huge industry employing several people, but also that it is a highly dynamic industry. This is illustrated by several factors such as the existence of a vibrant secondary market for refurbished mobile phones created from the discarded ones, the recent entry of mobile waste for recycling, the discovery of the high value of its components and the growing trade of mobile waste though it is still a small component of the entire e-waste. It was seen that two major segments of the mobile waste chain signified profitable economic activity for many young entrepreneurs, due to which they were guarding against the entry of others. The profitability of these two segments, in turn, led to reasonably good earnings for its workers.

The dynamism and new enthusiasm of value recovery from mobile waste, however, should not obliterate the several issues plaguing these production networks, including the horrid working conditions, workers working without protection, the prevalence of child or adolescent labor, male domination and environmental hazards. Even in the formal sector, the work is mostly being done by casual or contractual labours. Also, insecure working conditions that are often attributed to the formal sector seem to continue in formal firms, as indicated by the fact that a firm in the formal sector had not given the compensation to a worker who had met with an accident.

The findings in this study of labour conditions during the post-consumption phase of mobile telecommunication services are similar to those of the CtG project in other sectors (such as horticulture, apparel and tourism). While there have been increases in employment and wages, the employment in these sectors has been characterised by increasing casualisation of labour based on the dictum of flexibility of labour. There has not been much improvement in terms of the security of employment, conditions of work or of securing of rights such as the right to freedom of association (Barrientos, *et al*., 2010). Research has also shown the need for cleaning up the production networks (as in the case of apparel) from the issue of child labour (Bhaskaran, *et al*., 2013).

Again, the study shows that though the corporate sector has started responding to the concerns of civil society on the environment with regard to e-waste by taking up EPR, it is still falling short in terms of implementing the right measures. Even when Nokia takes back its product for disposal of its waste, the waste somehow reaches the hands of informal players. However, curbing of the informal sector is not the way forward. Workers in all the investigated segments categorically denied having any health problems, which it may be believed, has to do with their fear of intervention by others, which may clash against their even more immediate concern of survival and mobility. Interventions which would hamper these basic needs of a large number of people employed in the chain of e-waste are not desirable. What could probably be done is to extend the corporate responsibility beyond merely taking back the used phones, to support the entrepreneurs and workers in the informal

sector towards the adoption of environment-friendly production practices, and the provision of efficient working equipment and protective clothing to workers.

Finally, it would be fruitful if the GPN literature now extending to include the post-consumption phase of a product explicitly engages with conceptualisations like EPR (belonging largely to the terrain of hazardous waste management literature) as both the conceptualisations have common goals like the provision of decent work and working conditions to workers in the production chain.

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2. http://www.nokia.com/global/about-nokia/people-and-planet/sustainable-devices/recycling/recycling/ as accessed on November 6, 2013
3. Calculated by using the dollar–rupee conversion of $1=Rs. 62.3 as on 19 August 2013.
4. This information is based on an interview with a representative of GEMS.
5. It is reputedly the largest electronics dismantling–recycling–selling market in the country.
6. A total of six units were interviewed in Old Seelampur. Each of the respondents presented the number of units in a range. The average has been calculated by averaging the middle points of the range values presented by the respondents. The range of values given by the total respondents is 300–450.
7. The range is 25–45. The average calculated from the range of figures given by the respondents.
8. Moradabad is located in the state of Uttar Pradesh, situated at a distance of 167 km from the national capital, New Delhi.
9. Moradabad is renowned for its brass work and has carved a niche for itself in the handicraft industry throughout the world. It is probably the easy availability of craftsmen, tools and technique dealing with metals that has given the place a historical advantage, making it a hub for recycling units of e-waste.
10. The entrepreneurs and workers of eight units were interviewed in Moradabad.
11. The monthly income has been divided by 30 days.
12. Casual wage labour: A person casually engaged in other's farm or non-farm enterprises (both household and non-household) and getting in return wage according to the terms of the daily or periodic work contract (Available at: http://mospi.nic.in/mospi_new/upload/nsso/concepts_64R.pdf as accessed on November 6, 2013).

13. This information is based on the report provided by five workers.
14. Muslims have historically been largely involved in metal work, as in the case of the Moradabad brass industry. It is in such context that their dominance in the e-waste industry may be understood.
15. Gender stereotyping of work holds in most cases of trade and businesses.
16. http://www.nokia.com/global/about-nokia/people-and-planet/sustainable-devices/recycling/recycling/ as accessed on 6th November 2013.

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