E-Waste Recycling In India – Bridging The Gap Between The Informal And Formal Sector

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EXECUTIVE SUMMARY

In this paper the authors will present options for bridging the gap between the formal and informal divide in e-waste management in India. These options are being developed, implemented and evaluated in the framework of different Indian, European, and bilaterally financed studies and projects focusing on Delhi, Bangalore, Pune and Kolkata.

Electrical and electronic waste (e-waste) is one of the fastest growing waste streams in the world. According to a recent study carried out by MAIT and GTZ in 2007 about 380,000 tons of e-waste are generated annually in India and the generation of e-waste is expected to touch 470,000 tons by 2011. The study also reveals that only about 6 percent of the e-waste is recycled, of which 95 percent is recycled through the informal sector. E-waste recycling in the informal sector provides jobs to thousands of people and supports the formal waste management agencies like municipalities. Investigations of the authors showed that the existence of an informal but entrepreneurial SME based infrastructure permits a profitable e-waste management business. At the same time, the informal sector is lacking skills and technologies, and manages hazardous material without any regard to occupational health and safety (OH&S) requirements and in an environmental harmful manner. It is observed that with rising e-waste quantities the recycling scenario is changing, with the formal recyclers increasingly entering the e-waste recycling sector. There is a widespread expectation that these formal sector recyclers would be able to manage e-waste in an environmentally sound manner by using Best Available Technologies (BAT) leading to better environment management and enhanced resource recovery. However, it is not clear whether the advent of formal recycling would come at the expense of informal sector recyclers or would complement their activities.

In this paper, we present a model which allows the integration of the informal and the formal sectors in India. The broad building blocks of this model are a) federating disparate informal sector workers into collectives; b) capacity building at various stages of the e-waste value chain; c) development of appropriate framework conditions in support of the informal sector; d) elaboration of applicable business structures taking into account the

constraints and resources of the informal and formal sectors, and e) implementation, monitoring and evaluation of the model in different baseline situations. We show that there are mutual gains to be obtained from an increased cooperation between the formal and informal sector because of their competitive advantages. Social welfare is enhanced through this interaction. It furthermore leads to reduced pollution, better resource management and creation of green jobs in the recycling sector. The outcomes of the investigation suggest that the collection, segregation and primary dismantling of non-hazardous fractions of e-waste should be focused in the informal sector while the other higher order recycling processes may be concentrated in the formal sector. We further illustrate elements of the model with several initiatives implemented in India.

INTRODUCTION

The increased use of electrical and electronic equipments and the high rate of obsolescence of this equipment leads to an increased generation of e-waste. The alarming rate of electrical and electronic waste (e-waste) generation has become a major global concern and e-waste recycling is now an important economic activity. It is a well known fact that e-waste also contains hazardous constituents that are potentially harmful to the environment and human health if they are not handled properly. The presence of valuable resources such as copper, silver, gold and platinum make it attractive to recycle e-waste. Recycling activities have invariably been associated with small backyard operators involving a large work force and located mostly in the developing nations. The major activity in e-waste recycling is dismantling which is labour intensive and requires manual operations which are available in abundance in poor nations.

In India a number of studies have been carried out since 2004 on e-waste generation and its recycling in different geographical locations. According to recent studies carried out by Manufacturer's Association of Information Technology (MAIT) and the Gesellschaft für Technische Zusammenarbeit (GTZ) in 2007 about 380,000 tons of e-waste are generated annually in India and taking into account the sales of PC and consumer electronics the generation of e-waste is expected to touch 470,000 tons by 2011. The study also reveals that only about 19,000 tons of e-waste are recycled and large amounts of e-waste are refurbished and sold in the secondary market.

With rising quantities, awareness and interest from policy makers regarding the issue, the recycling scenario is changing with the formal recyclers entering the e-waste recycling sector. There is widespread expectation that these formal sector recyclers would be able to manage e-waste in an environmentally sound manner by using Best Available Technologies (BAT) leading to better environment management and enhanced resource recovery. However, it is still not clear whether the advent of formal recycling would come at the expense of informal sector recycler or would complement their activities.

In this paper, we present a model, which allows the integration of the informal and the formal sectors in India. The broad building blocks include a) federating the informal sector workers into collectives; b) capacity building at various stages of the e-waste value chain; c) development of appropriate framework conditions in support of the informal sector; d) elaboration of applicable business structures taking into account the constraints and resources of the informal and formal sectors, and e) implementation, monitoring and evaluation of the model in different baseline situations. The expected mutual gains from an increased cooperation between the formal and informal sector is brought out. The other benefits highlighted include social welfare, reduced pollution, better resource management and creation of green jobs in the recycling sector. These options have been developed,

implemented and evaluated in the framework of different India-European Union (EC) bilaterally financed studies and projects focusing on Delhi, Bangalore, Pune and Kolkata.

E-WASTE SCENARIO IN INDIA

The electronics industry has emerged as the fastest growing segment of Indian industry both in terms of production and exports. The share of software services in the electronics and IT sector has gone up from 38.7 percent in 1998-99 to 61.8 percent in 2003-04. The liberalization, and the opening up of Indian markets together with the change in India's import policies vis-à-vis hardware leading to substitution of domestically produced hardware by imports has facilitated an IT penetration in the Indian market at an accelerated pace. The IT industry is the prime mover with an annual growth rate of 42.4 percent between 1995 and 2000. By the end of financial year 2005-06, India had an installed base of 4,640,000 desktops, about 431,000 notebooks and 89,000 servers. According to the estimates made by MAIT the Indian PC industry is growing at 25 percent annually. During 2007-08 ICT PC sales grew at 16 percent annually and consumer electronics sales grew at 13-15 percent annually while the cellular phone subscribers reached a growth rate of 96.8 percent in 2008. With the increased use of electrical and electronic equipments the e-waste generation also increased but the assessment shows that only about 5.7 percent of this e-waste is being recycled. The fate of the rest of the waste is still unknown.

According to the assessments made, 60-70 percent of the total e-waste generated is from ten states and sixty-five cities in India. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab in the list of e-waste generating states in India. Among the top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur. There are a number of e-waste dismantling facilities that are operating in almost all of these cities. At these facilities the e-waste is usually dismantled and exported, and sometimes even processed locally to extract precious metals. Some large scale organized e-waste recycling facilities are being set up in India of which one is currently ready for full operation.

UNDERSTANDING THE EXISTING SYSTEM

Informal Recycling

The informal sector has a historic role in waste management and recycling in India and it is well known that e-waste recycling is no exception to this with an estimated 95 percent of e-waste being recycled through the informal sector (GTZ-MAIT study, 2007). The informal e-waste recycling sector provides jobs to thousands of people in urban and peri-urban areas, and supports the formal waste management agencies like municipalities.

Investigations of the authors showed that a widespread and active network and considerable manual skills enable the existence of an informal but entrepreneurial SME based infrastructure that permits a profitable e-waste management business. Most of these informal SMEs concentrate on one or two recycling stages with well established relationships to other informal e-waste recycling SMEs up or down the recycling chain. Value is added at each stage creating employment at different levels, thereby sustaining the system.

The e-waste recycling in the informal sector essentially involves collection, segregation, dismantling. Additionally, various investigations have shown that there are extensive repair and refurbishment activities resulting in an extended life of the products and a large

second hand market, in particular for IT products. To a large extend the informal sector in India is also involved in extraction of precious metals. These generally small units exercise little or no control over their activities and use highly-polluting process - in many cases without being aware of the risks of these (see picture below).

Environmental concerns regarding the operations in the informal sector occur at different stages of the e-waste recycling chain. Most severely the illegal extraction of precious metals is causing highly dangerous and toxic emissions such as dioxins, heavy metals, lead, cadmium, mercury etc. Additionally, the discharges and the smudges from e-waste processing leads to contamination of water bodies and soil due to residues e.g. acids, spent fluids/chemicals, traces of polychlorinated biphenyl (PCB), brominated flame retardants (BFRs), etc. This leads to considerable occupational health and safety concerns and environmental hazards. The contact with the chemicals used during the operations, improper ventilation and working without use of personal protection equipments lead to direct exposure to hazardous chemicals. Apart from this, workers are also exposed to other hazards leading to physical injuries and chronic ailments such as asthma, malnutrition, skin diseases, eye irritations etc. and in some cases even to long term and incurable diseases.

However, the economics of recycling and the prevailing scales of operations are some of the factors that keep the informal sector going. An additional important factor is the social bondage between recyclers in the informal sector, which could be used as a cohesion factor to bring them closer and provide a platform for them to share their thoughts. The differences among the informal recyclers need to be ironed out to bring about an attitudinal change, to build a strong bondage within their community. The intention behind this process would be to provide an identity to the cluster/group and facilitate an exchange of their experiences and knowledge. Organized socio-cultural gatherings and entertainment should become an important social activity.

Formal E-Waste Recyclers
With now rising e-waste quantities on one hand, and with new regulatory requirement entering into force soon on the other hand, formal recyclers increasingly enter the e-waste recycling sector. There is a widespread expectation that these formal sector recyclers would be able to manage e-waste in an environmentally sound manner by using Best Available Technologies (BAT) leading to better environmental management and enhanced resource recovery. However, it is not clear whether the advent of formal recycling would come at the expense of informal sector recyclers or would complement their activities. Additionally, investment in machinery and increased working standards are more cost-intensive and competition with informal sector recyclers is tough.

Legal Framework for E-waste recycling in India

The National Environment Policy (NEP) published by the Ministry of Environment and Forests in 2006 mandates encouraging reuse and recycling of waste with the aim to conserve the natural resources and at the same time reducing the waste destined for disposal, thus encouraging the use of waste as a resource. The provision to establish a system for collection of recyclable materials has also been provided in the NEP. Additionally, the NEP emphasizes strengthening the informal sector and providing them with a legal status so that they can be involved in the mainstream activity of the recycling industry. In view of the inadequacy of some of the legislative and regulatory measures, NEP provides for the formulation of new legislations and regulations to protect and safeguard the environment and human health.

However, in India, up to date, there are no specific environmental laws or regulations for e-waste management. However several provisions under different regulatory regimes may apply to various aspects of e-wastes. Since e-waste or its residues fall under the category of both 'hazardous" and "non-hazardous waste", they shall be covered under the purview of both the hazardous waste regulations as well as the municipal solid waste regulations. The existing policies and regulatory regime do not distinguish between the informal and formal recyclers which may cause certain impediments in the recycling activities in complying with these regulations.

Considering the need for specific e-waste regulation the Government of India, Ministry of Environment and Forests has submitted a draft "E-waste (Management and Handling) Rules, 2010" in mid 2010. This draft legislation is currently being reviewed, and objections and suggestions from the public are being obtained. The Indian Government announced on 4 October 2010 that the new E-waste legislation shall enter into force on 1.1.2012. The proposed draft rules provide for the regulation of e-waste which is a post-consumer waste, generated at the end of life of a product. These rules call for the registration of all of those dealing with e-waste such as collection, dismantling, refurbishing and recycling activities irrespective of being located in the informal or formal sector. These rules also impose the Extended Producer Responsibility (EPR) and the Reduction of Hazardous Substances (based on the EU RoHS Directive) provisions.

These E-waste rules will provide the basis for further legislation and guidelines that are currently being developed to further specify the legal framework. The existence of an adequate legal framework is fundamental precondition to enable the establishment of a sound e-waste management system for India. It particularly requires further elaboration of distribution of responsibilities, definition of means for implementation and institutional set-up and for enforcement measures. Furthermore, specification of an implementation mechanism for producer responsibility either collectively through a Producer Responsible Organization (PRO) or individually is being required. The authors are involved in supporting the development of some of these guidelines. The Rules also mandates the deposition of the WEEE at the collection centre or with the recycler specifying the collection and channelization of e-waste. Thus the enabling regulatory framework will need effective participation and adequate investments by the responsible actors.

THE WAY FORWARD?

As outlined, in India most of the recycling takes place in the informal sector with some formal recyclers, waste management companies and investors now entering the market. Recycling per se is considered as a secondary enterprise. For the Indian government the

role of the informal sector in the value chain of e-waste continues to remain important due to its potential to generate employment. There is a need being seen to integrate the activities of the informal sector into the mainstream recycling of e-waste by dovetailing the activities of informal and formal sector. The creation of associations that comprise different informal e-waste recyclers is one possibility towards achieving a formalisation of the informal sector stakeholders. These associations would function similar to cooperatives with each having an individual institutional set-up depending on their members. The creation of an association would e.g. allow to receive formal registration and certification as e-waste recycler. Additionally, combined activities and incentives could be undertaken such as focused marketing initiatives etc.

The process of integrating the informal sector with the formal sector, however, is a challenging one. On one hand, too little is still being known on the diversity of networking amongst informal recyclers, and their distribution of tasks and financial mechanisms amongst the various stakeholders. On the other hand, the informal sector is very diverse and comprises multiple stakeholders, and hence, requires a multi-level approach to develop a path forward to their inclusion in the formal recycling market. There have been a number of reports on the identification of the clusters and the evaluation of the processes used, which reveal the need to formalize the activities, and provided a baseline understanding of how the informal sector functions in this segment. But these studies have still been sporadic and locally focused, and not yet enabled to receive a comprehensive understanding. However, they provide information on specific E-waste hubs and indicate to focusing on specific pilot regions. The EU Switch Network project on E-waste Channels, which is currently being conducted by GTZ in cooperation with MAIT, Toxics Link and adelphi, for instance, now focuses on the E-waste recycling in Delhi, Bangalore, Pune and Kolkata.

The path to formalization of these informal recycling units requires a number of stages with different levels of involvement to integrate these informal stakeholders in the formal recycling scheme (that itself is - as additional challenge or chance - still in development). Once informal E-waste recycling clusters are identified the next stage is to create groups of stakeholders within the cluster and to identify their core processes within the group. The formalisation process itself requires the members of this group (and supporting stakeholders) to design an institutional and financial set.-up that will allow this group to function as one business entity in future. Considering that at this stage the group still consists of various individuals who are each used to act as SME-like enterprises once can imagine that new mechanisms are required to integrate the different needs and priorities of these individual stakeholders on the way to formalisation as a group. Experiences and lessons learned throughout India from other formalisation processes with informal sector groups can be useful in this to some extent e.g. for the development of an adequate internal decision making structure, internal distribution and contribution of financial resources etc. This process requires considerable efforts to create awareness among the group through extensive awareness campaigns on the formalization process highlighting its advantages.

In line with the NEP (and the future E-waste rules), the group then has to identify and register its core activities, and to get officially legally registered (e.g. as association).
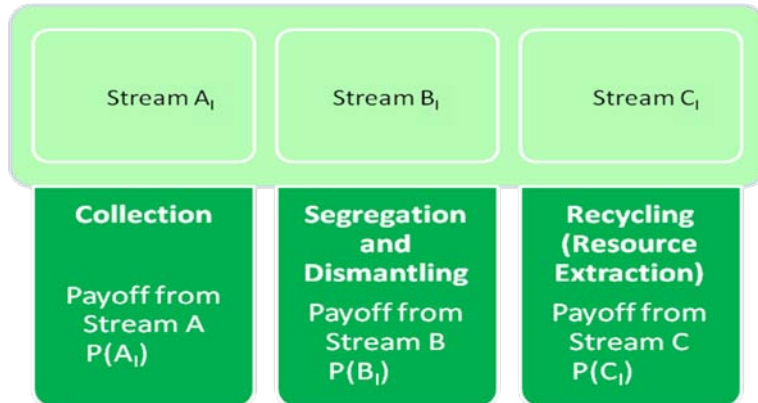
The Proposed Architecture
The way forward hence, involves formalising the informal sector e-waste recyclers through means of forming associations, register these and professionalise their businesses. It is obvious that the formalisation process, which the informal sector can undergo within the
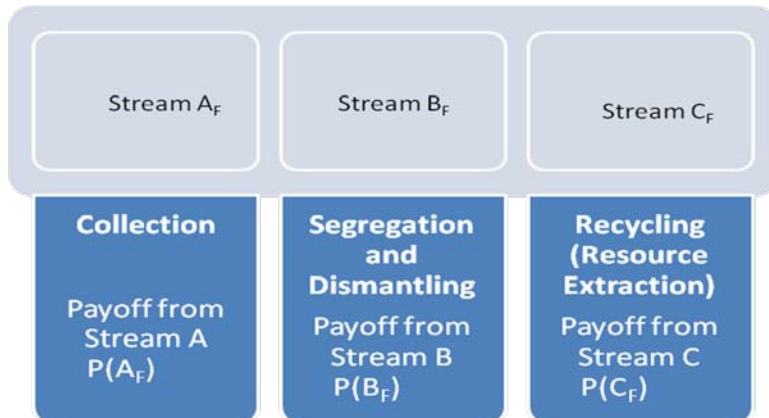
envisaged time horizon is limited. Restricted human as well as particularly financial resources as well as legal obligations will most likely restrict this formalisation process to those e-waste recycling activities that take place at the beginning of the recycling chain e.g. collection, dismantling, dissembling for re-use, preparation for recycling (e.g. shredding). Additionally, the current nature of the informal sector and its predominance use of manual instead of mechanical recycling methods favour the informal sector to keep those manually focused activities.

The following two graphics show a simplified architecture of the existing e-waste recycling system and the distribution of activities between the formal and informal sector.

Current Scenario – Informal Sector

Stream A_I	Stream B_I	Stream C_I
Collection Payoff from Stream A $P(A_I)$	**Segregation and Dismantling** Payoff from Stream B $P(B_I)$	**Recycling (Resource Extraction)** Payoff from Stream C $P(C_I)$

Current Scenario – Formal Sector

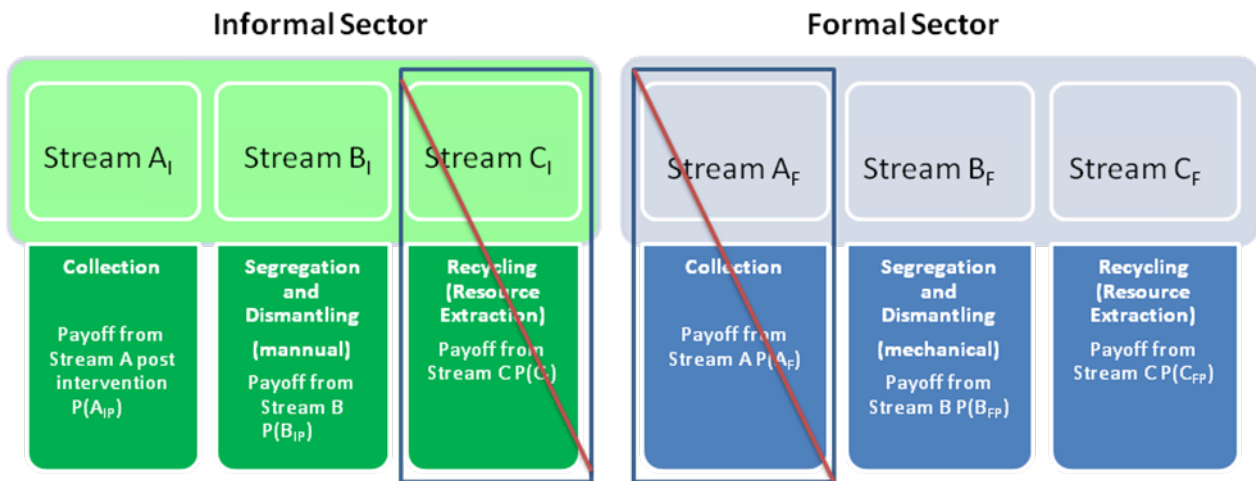| Stream A_F	Stream B_F	Stream C_F
Collection Payoff from Stream A $P(A_F)$	**Segregation and Dismantling** Payoff from Stream B $P(B_F)$	**Recycling (Resource Extraction)** Payoff from Stream C $P(C_F)$

The scenario is changing at a faster pace now with the formal recyclers entering the scene and high-end recycling envisaging complete environmental compliance and efficiency in the processing of waste and the recovery of a high quality product. But such units are unable to access the materials due to the informal collectors, scrap dealers and recyclers in the informal sector who are able to reach for the door-to-door collection and are able to pay a good price for the e-waste in comparison to the formal recyclers. The formal recycling units have high investments and high overheads to meet the environmental compliance requirements. As a result they are not able to meet the price demanded by the vendors or the consumers and are thus unable to access e-waste.
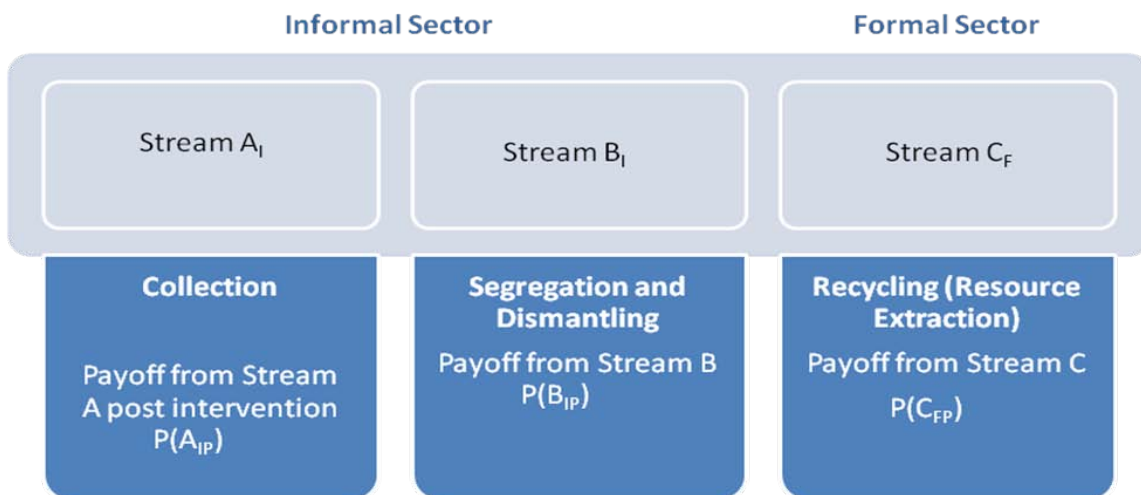
A mutual support system that could be provided by the operations in the informal and formal recycling units as reflected is ideal for developing economies. The system will provide a balance between the cheap labour intensive operations in the informal sector and the sophisticated mechanized operations in the formal recycling units. The following

two graphics show first, the intervention scenario and second, the proposed future scenario.

Intervention Scenario

Proposed future Scenario

The optimization of resource flows is required to obtain quality products and has to be set as a goal while providing the model for integrating informal and formal e-waste recyclers. As a first step in the process all elements of the value chain need to be identified and all stakeholders have to be involved. The mechanism of transfer of e-waste needs to be planned in such a way that the material reaches its destination in the shortest time possible and avoids any pilferage during handling and transit. A system of collection and transportation using third party or involving multi-stakeholder system would be a viable solution. Saving time and energy in the operations should become an integral part of the system.

The model provides the interaction between the formal and informal sector taking the interests of both into account in a rational choice framework. The model shows that there are mutual gains to be obtained from the trade of material from the informal and formal sectors because of their comparative advantages. We also show that the social welfare is enhanced by this interaction between the formal and informal sector and results in reduced pollution, better resource management and creation of green jobs in the recycling

sector. The model recommends that the collection, segregation and primary dismantling of non-hazardous fractions of e-waste be focused in the informal sector while the other higher order processes can be concentrated in the formal sector.

Producer responsibility

An important role in the process of enhancing the e-waste recycling system in India will play the waste generators and in particular the large branches. The above mentioned MAIT-GTZ e-waste assessment study revealed that 94 percent of large enterprises / organisations included in the study did not have an IT disposal policy for the obsolete and end-of-use IT products or e-waste and were not aware of the required practices. Therefore, most of the e-waste is being disposed off to those that pay the highest price. Environmental and health and safety standards and registration requirements are not considered. It is crucial to motivate the large e-waste generators to apply minimum standards for their e-waste disposal. The new legal framework will help implementing this. Awareness measures need to provide accompanying guidance to enhance enforcement.

Governmental support and financial incentives

The economics of recycling have been the only criteria for the thriving of the informal sector. This needs to be changed in order to understand the environmental health issues associated with the activities. Due to the limited access of the informal sector to financial resources (e.g. loans) it has to be discussed if financial incentives need to be provided to the informal sector stakeholder to allow i) its formalisation process and ii) the improvement of its processes towards compliance with environmental, health and safety standards. E.g. specific allocation of funds for environmental surveillance and evolving Public Private Partnership (PPP) model based systems could be introduced. Additionally, financial aid/access to credit/ incentives/ subsidies and insurance scheme are further measures that may need to be made available. One of the best methods to improve the practices is to offer incentives to those complying with environment and health norms and also promote marketing of such products through a certification mechanism. This would then likewise benefit the formal recyclers, who in return should not be left out since their motivation to invest in this sector are also crucial basis for development of a sound e-waste recycling system. Hence, competitive aspects between the formal and informal sector require attention, and should not be neglected during the supporting process of the informal sector.

CONCLUSION

Some of the major issues and challenges faced in the implementation process can be attributed to the gaps and overlaps in the system. First and foremost the gaps in the legal framework need to be closed. The current framework does not specify the role of different stakeholders. No mandatory requirements are provided for the specific activities that are likely to cause direct or indirect impact on environment or health. These actions are not justified as there is no difference between those who comply and those who do not comply. In other words there is no reward for compliance and no punitive action against the erring units.

There is a lack of viable working models to suite the Indian conditions. One of the important issues is the conflict arising among the groups which have their origin in the formal business, administrative and financial models. The business ventures have not been made attractive and investments are not sufficient to meet the high level operations. One of the important links in the informal-formal integration is an efficient collection

operation, which has not been put in place. In many cases of recycling post-consumer waste, the reason for the failure of formal recycling operations is the lack of a collection and take back system. Though there are millions of scrap or junk dealers collecting all sorts of wastes that have recycling potential, these are not organized and they operate purely on economic basis. They do not contribute effectively to the system and focus only on the individual survival and sustenance. The most important factor that influences the Indian system is the prevailing political scenario.

The integration of activities in the informal and formal sectors is essential to establish a viable recycling model for e-waste recycling. There is a need to dovetail the activities of the informal sector with those of the formal recycling units in order to achieve optimal solutions for the recycling practices without compromising environment and health. The combined effort would also meet the requirements under the NEP to organize the informal sector and bring them into the mainstream activity and facilitating them to overcome the problems related the pollution and health hazardous. The streamlined system will operate efficiently only if these are supported by cooperation between the various stakeholders in the value chain.

ACKNOWLEDGEMENTS

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