



**Reduce, reuse and recycle are less effective when faced with growing levels of urban waste. There is a clear need to promote locally feasible, formal practices and replication of success stories.**

**By Tenzin Norbu and C. Visvanathan**



# 3R practice in east and south-east Asia

What is happening and what needs to happen?

**T**he enormity of the challenges facing Asian countries in developing a 3R (reduce, reuse and recycle) society is revealed by the extraordinary consumption statistics emerging from the region as it rapidly industrializes – especially China and India. Unfortunately, but not unsurprisingly, this growth is accompanied by a corresponding rise in the generation of solid waste and the degradation of natural resources.

The Asian Development Bank (ADB) estimates that urban authorities in Asia spend 50%–70% of their total revenues on waste management.<sup>1</sup> In a separate study by the World Bank,<sup>2</sup> neglect of the environment is calculated to cost an average of 5% of gross domestic product (GDP), while government spending on environmental protection amounts to less than 1% of GDP!

In addition, a recent fact sheet on China's Environmental Health Project released in February 2007<sup>3</sup>, the experts predict that Beijing alone will produce (in 2006) domestic electrical and electronic waste (e-waste) at an alarming 115,000 tonnes/year, made up of 3.6 million televisions, fridges, washing machines, computers and air-conditioning units, plus 2.3 million mobile phones. This figure is also expected to exceed 158,000 tonnes by 2012.

India, on the other hand, is equally 'playing' hard. Analysis for 2004/2005 presented by Amit Jain during 3R South Asia Expert Workshop Kathmandu, Nepal, from 30 August to 1 September 2006

estimated the annual market size of personal computers in India as 15.4 million, with volumes of television sets totalling 11.7 million, refrigerators 4.8 million and washing machines 1.7 million. The analysis also estimates a 25% annual growth rate in computers and 15%–20% of other items. Taking account of the obsolescence rate and the e-waste inventory, domestic e-waste in India is estimated to be around 146,000 tonnes/year and is expected to exceed 1.6 million tonnes by 2012.

Sadly, for both China and India, these figures do not include those e-wastes that are shipped (often illegally) from developed countries. The current pace of urbanization, the consumerist society and its waste generation will lead us to a point of no return – let alone global sustainability and poverty reduction.

The ecological footprint per person of the Asia-Pacific region has risen by more than 130% since 1961 and now requires 1.3 global hectares of biologically productive area per person. This emerging consumer society has added the enormous challenge of managing modern waste and developing a 3R society to the municipal authorities already troubled with issues regarding waste management and sanitation.

Although some governments in this part of the world have recently formulated and incorporated 3R measures and cleaner production options to tackle the waste crisis, most of them have been implemented only in capital cities. In rural and peri-urban areas,

**Urban authorities in Asia spend 50%–70% of their total revenues on waste management**





Urban residuals or shifting cultures? SOURCE: WWW.3RKH.NET

urban municipal wastes generate a steady income – despite the risks involved in treating and recycling them to produce other consumer products.

Asian societies, especially in the villages, have historically led a 3R-oriented lifestyle. Traditional know-how on resource conservation has been passed down from father to son. However, these techniques are now useless when confronted with urban waste (see photo above). These sudden shifts in the culture have brought various challenges and chaos in solid waste management. It is also clear that the business-as-usual scenario cannot continue in Asian countries as long as current waste disposal and treatment methods prevail.

These compounding problems are a grim reminder to all stakeholders to adopt and implement 3R initiatives at both ends – upstream production and downstream consumption. Executable and feasible technology frameworks should be developed. Before then, studies should be conducted to assess the gaps and prevailing treatment situations.

This article attempts to give a broader picture of the ongoing 3R implementation in some Asian countries, including key players such as China and India. Wastes from three major sources (urban municipal waste, hospital waste and e-waste) are considered.

In most of the countries studied, informal activities dominate due to lack of funding, government initiation, policy lapses and public ignorance on waste management issues. Weak activities (for livelihood purposes) adopting primitive technologies and operating in a haphazard manner at the micro and meso scale are common. Unlike developed countries, optimized processing/treatment technologies are non-existent and, in most cases, insignificant due to the level of technology and the maintenance budget involved. In some countries, waste composition alone determines the need for such technologies. Judging by the prevailing technology barriers, it also remains unclear whether technology leapfrogging could enhance 3R initiatives in developing countries.

### 3R initiation in Asia

Junichiro Koizumi, the former Prime Minister of Japan, proposed the 3R Initiative at the G8 Summit held at Sea Island, Georgia, US, in 2004, and it was formally endorsed by the G8 leaders. As a follow-up activity, the Ministerial Conference to launch the 3R concept was held in Tokyo from 28 to 30 April 2005. The launch was considered the first step in changing global consumption and production patterns, and building a sound material-cycle society.

Since then, there have been significant developments and awareness on 3R initiatives in most Asian countries. Many

non-governmental organizations (NGOs), community-based organizations and the private sector have been actively working in these countries to promote 3R in various forms. Interestingly, some private sector companies such as Tetra Pak have set good examples by recycling used milk and juice cartons in some countries (see Box 1). The company has also promoted other recycling activities involving schools and community members.

### 3R endeavours in managing municipal waste

Managing municipal waste in urban centres is a challenging task, especially when the waste streams are heterogeneous with no or little collection fee. There are significant differences across Asia in the generation and composition of municipal waste due to varying geographical and climatic conditions, and living styles. At times, waste generation patterns differ even within the same municipality.

Table 2 shows the composition, especially the recyclable content, of the municipal solid waste generated in some Asian

#### Box 1. Tetra Pak recycling initiatives

In Vietnam, Tetra Pak – a global company providing food processing and packaging solutions – recycled over 18 tonnes of used cartons in 2006 and nearly 40 tonnes in 2007. This exemplifies a range of activities the company undertakes in this sector (Table 1).

TABLE 1. Tetra Pak recycling activities in selected Asian countries

Country	Paper mill	Product
India	Daman Ganga	Core board
Indonesia	BBPK Research Institute	Market pulp
Malaysia	Pascorp Paper Mill	Box board
Philippines	Container Corporation	Box board
Thailand	Fiber Pattana	Market pulp
Vietnam	Thuan An Paper Mill	Kraft paper



Low-cost roofing sheets and other recycled products. SOURCE: TETRA PAK



TABLE 2. MSW composition in selected Asian countries

Country	Waste composition (%)					
	Organic waste	Paper/ cardboard	Plastic	Glass	Metal	Others
Bangladesh	71	9	5	1.5		13.5
China <sup>a</sup>	65	9	13	2	1	10
China <sup>b</sup>	41	5	4	2	1	47
India	45	7	4	2	2	40
Japan	17	40	20	10	6	7
Korea	31	27	6	6	7	23
Malaysia	45	7	24	3	6	15
Philippines	41	19	14	3	5	18
Singapore	44	28	12	4	5	7
Thailand	48	15	14	5	4	14
Vietnam (Hanoi)	49	2	16	7	6	20

<sup>a</sup> People using coal    <sup>b</sup> People using gas

### Box 2. Organic waste management in Bangladesh: decentralized composting

The average waste collection efficiency of 50% in Bangladesh and the dominance of organic materials (>70%) in MSW have seriously crippled the local authorities in managing it.

A research-based organization, Waste Concern, initiated a pilot project on community-based resource recovery in Dhaka city in 1995. With further support from the government and international organizations, Waste Concern implemented community-based decentralized composting projects in Dhaka. Activities included door-to-door waste collection, composting of the collected waste in a decentralized manner (employing barrel, aerator and box types of composting) and marketing of compost and recyclables.

So far, these concepts have been replicated in 20 cities and towns in Bangladesh. Waste Concern has installed a large-scale 700 tonnes/day composting plant in Dhaka city producing 50,000 tonnes of organic fertilizer. With this project, the organization seeks to reduce greenhouse gas emissions by around one million tonnes over a period of 8 years under the Clean Development Mechanism of the Kyoto Protocol.



Decentralized composting in Bangladesh. PHOTOS: WASTE CONCERN

countries. The waste components are, in most cases, discarded or dumped without any treatment or recycling. Such practices have prompted some private sectors and NGOs to initiate recycling and proper waste management strategies. For instance, Waste Concern, an NGO based in Dhaka, Bangladesh, has been actively involved in promoting 3R initiatives and good practices in that country (see Box 2).

Technology applications for thermal recovery (direct combustion of waste to recover heat) and fuel recovery (production of refuse-derived fuel (RDF) and packaging-derived fuel (PDF) from waste) are not found in most Asian countries. These technologies are applied only in the most developed Asian countries.

In China and Thailand, these technologies do exist, but there is an uncertainty over their efficiency both in terms of cost and environmental factors. Material recovery from, and sorting of, MSW remains largely unexplored in many Asian countries. Although some pilot models have proved successful in developed countries, further research is needed before they can be implemented.

In the more developed countries of this region, a chain of informal recyclers – from waste scavengers to the waste dealers – perform the task of material recovery and sorting. It is justifiable to state that their livelihood could be at stake if the technologies described above become operational and commercially successful. In practice, this is not likely to happen – at least in the coming years.

But given the health risks and the need for resource conservation, the provision of these technologies – or at least some formal registration and support from governments about the need for them – is vital. Major attention should be paid to the 3R technologies associated with MSW sorting, pulverization and composting. Composting has proved to be one of the best affordable solutions for developing countries to manage their municipal waste. Bangladesh has set an ideal example by successfully setting up decentralized composting systems throughout the country. Similar formal approaches are also seen in China, India and Thailand, but they lack the fundamental support to make decentralized composting strong and successful.

### 3R endeavours in managing electronic waste

According to *The Financial Express* (2005),<sup>4</sup> about 80% of the e-waste generated in the US is exported to India, China and Pakistan. The recent ban on importing e-waste to China has diverted much of it to Bangladesh and other neighbouring countries due to the presence of cheap labour and recycling businesses. In Delhi alone, there are about 25,000 workers employed at scrapyards, where 10,000–20,000 tonnes of e-waste are handled every year, with obsolete personal computers accounting for 25%.

In China, and with similarities to the practice of ship breaking, the e-waste imports are generally made possible by certain intermediaries. The wastes are shipped to Hong Kong in containers labelled 'For recycling' and then smuggled to a number of recycling towns in China. Neighbouring countries such as Sri Lanka, Nepal and Bangladesh have not been spared from this overflow of e-waste. It is a crisis not only of quantity but also of toxic ingredients such as lead, beryllium, mercury, cadmium, and brominated flame retardants, which pose both occupational and environmental health threats. But industry, government and consumers have, to date, taken only small steps to deal with this looming problem. In developing





countries especially, e-waste is highly sought after by scavengers and local recyclers.

Most of the developing Asian countries are at an early stage when it comes to implementing 3R technologies related to electrical and electronic waste (WEEE). The whole market is driven by chains of informal recyclers. Manual dismantling of electronic components is the most common method of recovering valuable materials. To recover copper and other metals, the electrical components (including electrical wires) are burnt, releasing deadly cocktails of toxins. Other e-waste items are dismantled and sorted manually to recover fractions, including printed circuit boards (PCBs), cathode ray tubes (CRTs), cables, plastics, metals, condensers and other materials such as batteries.

In Cambodia, as in any other developing country, e-waste management is also a major issue. However, its economic status attracts more imports/dumped materials than locally originated e-waste. Cambodia is starved of electricity supplies, hence people in rural areas thrive on batteries as a way of producing electricity. In this context, lead-acid batteries play an important role in powering the economy. Various measures have been taken at the local and national levels for the appropriate treatment of used lead-acid batteries. As the name implies, these batteries consist of hazardous materials that often end up as wastes that demand environmentally safe recycling and disposal.

This growing concern over e-waste (domestic and imported) in the developing Asian countries has prompted many NGOs to initiate their own campaigns to promote the safe handling and reduction of

e-waste. Current efforts in managing e-waste could be further enhanced if the policymakers and the industries joined together in implementing cleaner production mechanisms and Extended Producer Responsibility.

### 3R endeavours in managing healthcare waste

As mentioned in a World Bank report in 2000, management of medical/healthcare waste in developing countries in Asia is less than satisfactory, even in government hospitals. Uncontrolled burning, reuse of disposable items and unintentional injuries from improperly discarded sharps are common and lead to life-threatening infections such as hepatitis B and C, and HIV.

Even today, medical/healthcare waste management and its potential threats in most developing countries remains a subject that is not well defined or understood by the general public nor policymakers. As a result, medical and healthcare waste is often disposed of with general waste streams or, in some cases, collected separately and burned in locally made or poorly maintained hospital waste incinerators.

It is a mystery as to who is responsible for managing such waste once it reaches the dumpsite or municipal collection point. Proper source separation would prove effective in answering such questions. It would also greatly reduce the amount and the toxicity of the medical waste requiring treatment and disposal.

For instance, the single bin collection and storage system employed means that any waste generated within a medical facility is

Optimized  
processing/treatment  
technologies are  
non-existent

## Big in making recyclables small

Balers  
Sorting Systems  
Conveyors  
Starscreens  
Shredders  
Paper Spikes

Advice  
Design  
Development  
Manufacture  
Installation  
Service



**Bollegraaf**  
RECYCLING MACHINERY

[www.bollegraaf.com](http://www.bollegraaf.com)

## Making the most out of waste

Starscreen Units  
Water Bath Separator  
Glass Cleaning Units  
Composting Reactor  
Mobile Neptunus  
Autoclave

Advice  
Design  
Development  
Manufacture  
Installation  
Service



**Lubo Systems**  
SCREENING & RECYCLING

[www.lubo.nl](http://www.lubo.nl)

Members of Bollegraaf Holding

Bollegraaf Recycling Machinery  
P.O. Box 321, 9900 AH Appingedam, The Netherlands  
Tel +31 (0)596 65 43 33, Fax +31 (0)596 62 53 90, [info@bollegraaf.com](mailto:info@bollegraaf.com)

Lubo Screening & Recycling Systems b.v.  
P.O. Box 2222, 7801 CE Emmen, The Netherlands  
Tel +31 (0)591 66 80 80, Fax +31 (0)591 66 80 88, [info@lubo.nl](mailto:info@lubo.nl)





Box 3. E-waste in Thailand

Private-sector enterprises play a huge role in managing e-waste in Thailand. The Wongpanit Recycling Plant is an icon of 3R business in Thailand. The company recently sought new types of waste capable of being recycled, such as polystyrene foam and e-waste. The company began as a small junk shop in 1974 in the province of Phitsanulok in northern Thailand. The business now covers the purchase of non-toxic industrial waste from local suppliers and its transformation into usable raw materials for further manufacturing as well as products.



E-waste recycling at the Wongpanit plant in Thailand. PHOTO: WONGPANIT

According to the Pollution Control Department, the generation of e-waste in Thailand is increasing at the rate of 12% per year. Table 3 shows the breakdown of e-waste for 2003.

TABLE 3. E-waste generated in Thailand in 2003 <sup>5</sup>			
Item	WEEE (tonnes)	Recyclable (tonnes)	Non-recyclable (tonnes)
Televisions	8201	2542	5659
Refrigerators	17,763	16,342	1421
Washing machines	11,370	8073	3297
Air conditioning units	17,407	17,407	-
Computers	2105	2105	-
Total	57,934 (100%)	47,577 (82.1%)	10,377 (17.9%)

considered as infectious. 3R initiatives could play a major role in reducing the amount of medical waste generated in developing countries and in diverting such waste from municipal dumpsites (NB: open dumping at dumpsites is more prevalent in developing countries than waste disposal to landfills, even though the former is a designated area for waste disposal managed by municipalities).

To boost such initiatives and to solve the medical waste management dilemma, the current system needs a 'medical waste supervisor' as suggested by Dr Satoshi Imamura from the Japan Medical Association during the Asia 3R conference held in Tokyo between 30 October and 1 November 2006. Such people could play a significant role in managing medical waste and could

TABLE 4. Estimated quantities of healthcare waste generated in Metro Manila<sup>6</sup>

Type of facility	Infectious waste (kg/day)	Non-infectious waste (kg/day)	Total (kg/day)
Accredited hospitals			
Government	5971	6850	12,821
Private	3996	4584	8580
Health centres	802	1203	2005
Medical clinics	2580	3870	6450
Dental clinics	5880	1960	7840
Veterinary clinics	372	93	465
Pharmaceutical laboratories	5772	1443	7215
Blood banks	204	51	255
Funeral parlours	1176	196	1372
Medical schools	132	33	165
Research institutions	48	12	60
Total	26,933	20,294	47,228

bring a significant change to its handling and safe disposal in developing countries.

In Thailand, medical wastes are collected separately and incinerated at designated incinerators. There are discrepancies between departments in the estimated waste generation rate, which ranges from 0.11–0.65 kg/bed/day. According to the Department of Environmental Health, about 750 incinerators are installed in various hospitals across the country. These incinerators, which date from around 1995, are mostly locally designed with a capacity of 50 kg/hour, have two chambers and operate with excess air.

In the Philippines, most of the government and private hospitals segregate waste and employ microwave units for treating the infectious waste. But due to a lack of financial support, most of these wastes often end up in municipal dumpsites. A recent survey by the ADB found that there are about 3670 healthcare facilities in Metro Manila (the greater metropolitan area of the city of Manila). It is estimated that they generate over 47 tonnes/day of waste of which more than 55% is infectious waste (Table 4).

At present, there are two privately owned incineration facilities. The operating companies also provide collection, treatment and disposal services to both private and public healthcare facilities in Metro Manila. Neither incineration facility has air pollution control equipment. Ash collected from the combustion process is disposed of on-site in a cement vault. On the other hand, the company providing disinfection by means of microwaves has received formal complaints from neighbours living near the site about odours.

The major fraction (75%–90%) of the waste generated by healthcare facilities in the developing countries of Asia is generally non-medical waste with low risk, similar to domestic waste. The remaining fraction (10%–25%) is hazardous and may pose a variety of health risks. Therefore there is a need to promote the concept of source separation or recycling as a priority action. For example, Hospital Lam Wah EE in Malaysia has successfully initiated a source separation and recycling activity from the waste collected within its facilities (see Box 4).

The volume of medical waste generated in most of the countries is small compared with municipal waste, making it difficult to operate an economically viable treatment plant. But once such waste enters the municipal sewers or dumpsites, the consequences could be alarming.

Conclusion

The current pace of urbanization and waste generation in east and south-east Asia demands the development of a regional approach in





#### Box 4. Recycling project at Hospital Lam Wah EE

At Hospital Lam Wah EE in Malaysia, wastes are segregated at source and bagged separately following specific guidelines outlined in the hospital's *Infection Control Manual*. Clinical wastes are both autoclaved and incinerated. General wastes are collected by the local authority and taken to the designated landfill, while recyclable wastes are recovered and the revenue is used to help hospital staff in need or to respond to emergency situations. The Recycling Project Committee was set up in June 2002 with 19 committee members who sort out the recyclable items, categorize them and weigh them before selling. A fine of RM30 (US\$8.71) is levied on those members who fail to perform their duties.

Items such as old newspapers, books, magazines, loose papers, cardboard, clear and coloured plastic bottles, drip bottles, glass bottles, cooking oil bottles, aluminium cans, plastic bags, old clothes (wearable), and old car batteries are collected and sorted. Some of these recyclables are also brought in by staff members from their houses. Numerous awareness campaigns and promotions have been held to boost recycling activities. Up until the end of June 2006, the hospital had managed to recycle almost 300 tonnes and generate a revenue of about RM70,000 (\$20,320) (see table).

**TABLE 5. Amount of waste recycled since the project's inception**

Date	Total weight (kg)	Sales (RM) <sup>a</sup>
July–December 2002	21,000	3600
January–December 2003	56,900	13,500
January–December 2004	82,500	19,100
January–December 2005	84,100	22,100
January–June 2006	52,500	13,100
<b>Total</b>	<b>244,500</b>	<b>71,400</b>

<sup>a</sup> 1 Ringgit Malaysia (RM) = \$0.294

terms of waste colour-coding, source segregation and transboundary movement of wastes for treatment. In terms of 3R implementation, there is a need to promote locally feasible and formal practices and the replication of success stories.

Wherever possible, e-waste and medical waste should be treated separately using the best available and affordable technology. As a minimum, e-wastes should be sorted before they reach municipal sewers and dumpsites. For medical waste, there is a need to promote microwave and autoclave treatment technologies and to upgrade existing incinerators. However, a detailed technical review and potential technology development are necessary.

More should be copied from developed countries in the region in terms of their policy frameworks and good practices rather than producing knock-out products that flood the market and end up in landfills or dumpsites.

#### Acknowledgements

The authors would like to thank the ADB and the 3R Knowledge Hub (3RKH) team for making this article possible. We are also grateful to all of the individuals, companies and organizations quoted in this article. For more information and references please contact the authors.

**Tenzin Norbu** is a Senior Research Associate on the 3RKH Project at the Asian Institute of Technology, Thailand.

e-mail: [norbu@ait.ac.th](mailto:norbu@ait.ac.th)

web: [www.3rkh.net](http://www.3rkh.net)

**C. Visvanathan** is a Professor at the Asian Institute of Technology, Thailand.

e-mail: [visu@ait.ac.th](mailto:visu@ait.ac.th)

web: [www.faculty.ait.ac.th/visu](http://www.faculty.ait.ac.th/visu)

#### References

1. Asian Development Bank, *Sustainable Development in Asia*, 2000 ([www.adb.org/documents/books/sustainable\\_dev/default.asp](http://www.adb.org/documents/books/sustainable_dev/default.asp))
2. Global Policy Forum, *Environmental Cost Of Asia's Development*, Alan Boyd ([www.globalpolicy.org/soecon/develop/2002/1126adbenvt.htm](http://www.globalpolicy.org/soecon/develop/2002/1126adbenvt.htm))
3. Samantha L. Jones, Project Fact Sheet, China as E-waste Dumping Ground: A growing Challenge to Ecological and Human Health, February, 2007. See web page ([www.wilsoncenter.org/topics/docs/ewaste\\_feb1.pdf](http://www.wilsoncenter.org/topics/docs/ewaste_feb1.pdf))
4. *The Financial Express*, 2005. A wiser approach to e-Waste ([www.financialexpress.com/fe\\_full\\_story.php?content\\_id=108565](http://www.financialexpress.com/fe_full_story.php?content_id=108565))
5. Policy and Practices on E-waste Management in Thailand, presented by Teeraporn Wiriwutikorn, Pollution Control Department, Ministry of Natural Resources and Environment (Thailand) during Hanoi 3RKH Inception Workshop, 25–27 April 2007.
6. Asian Development Bank, Consultant's Report *Metro Manila Solid Waste Management*, Manila, 2004.

■ This article is on-line. Please visit [www.waste-management-world.com](http://www.waste-management-world.com)



presents crushers and crunchers for

# WASTE Recycling

- Bulky refuse
- Domestic waste
- Industrial waste
- Mattress
- Carpets



Mobile



Stationary



Crusher



Cruncher

**FORUS GmbH**  
Ernst-Alban-Straße 6 · 17192 Waren (Müritze) · Germany  
phone: +49 (0)39 91 12 11 55 · fax: +49 (0)39 91 12 11 52  
e-mail: [forus@t-online.de](mailto:forus@t-online.de) · [www.forus.de](http://www.forus.de)