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INNOVATIVE APPROACHES AND STRATEGIES FOR INTEGRATED WASTE MANAGEMENT

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Final Draft

This background paper was prepared with inputs from Mr. Prasad Modak, Executive President of the Environmental Management Centre (Mumbai, India) for the International Consultative Meeting on Expanding Waste Management Services in Developing Countries ahead of the eighteenth session of the Commission on Sustainable Development. The views expressed herein are those of the authors only and do not necessarily reflect the views of the United Nations.

1. Introduction

Waste originates from extraction and transportation of resources and during conversion into various products and services. When products and services are used, waste is generated at various stages and at multiple locations till the end of life of the product/service. Waste volumes and characteristics often indicate intensity of resource use and resource use efficiency. It makes a sense therefore to find mechanisms to reduce generation of waste at the source itself by careful use and management of resources, by designing and encouraging products/services that minimize wastes across the life cycle and by practicing Reduce, Reuse and Recycle (3R) to the extent possible.

Wastes, if not collected, treated and disposed in compliance with applicable regulations, contaminate land, water as well as air resources. Indiscriminate disposal of waste can pose serious risk to the security of limited resources that we have, wholesomeness of our ecosystems and the human health, especially that of the poor.

Issues related to resource and waste management are therefore intrinsically linked and <u>an integrated approach</u> is necessary. (see **Figure 1**).

The "resource-waste cycle" as shown in **Figure 1** is complex. It involves various stakeholders such as community and community based organizations, civic communities, urban and rural local bodies, research and academia, service/technology/equipment providers, investors, regulators and policy makers to name a few. Unless these stakeholders dialogue on a common platform, addressing the issues related "resource and waste" over life cycle or "systems" perspective, an integrated approach cannot be implemented.

The scale, context and priorities on resource and waste management vary from country to country. Availability and access to resources, resource demand, waste generation profile, institutional capacities, infrastructure and public involvement differ. Strategies for IWM are therefore not universal. Again even within a country, the challenges associated with resource and waste management may differ for urban and rural context It may not make environmental and/or economic sense to replicate or transplant a strategy that has worked for a developed region in a developing region, on "as is" basis. This is because the drivers for resource and waste management in developed and developing countries are quite different.

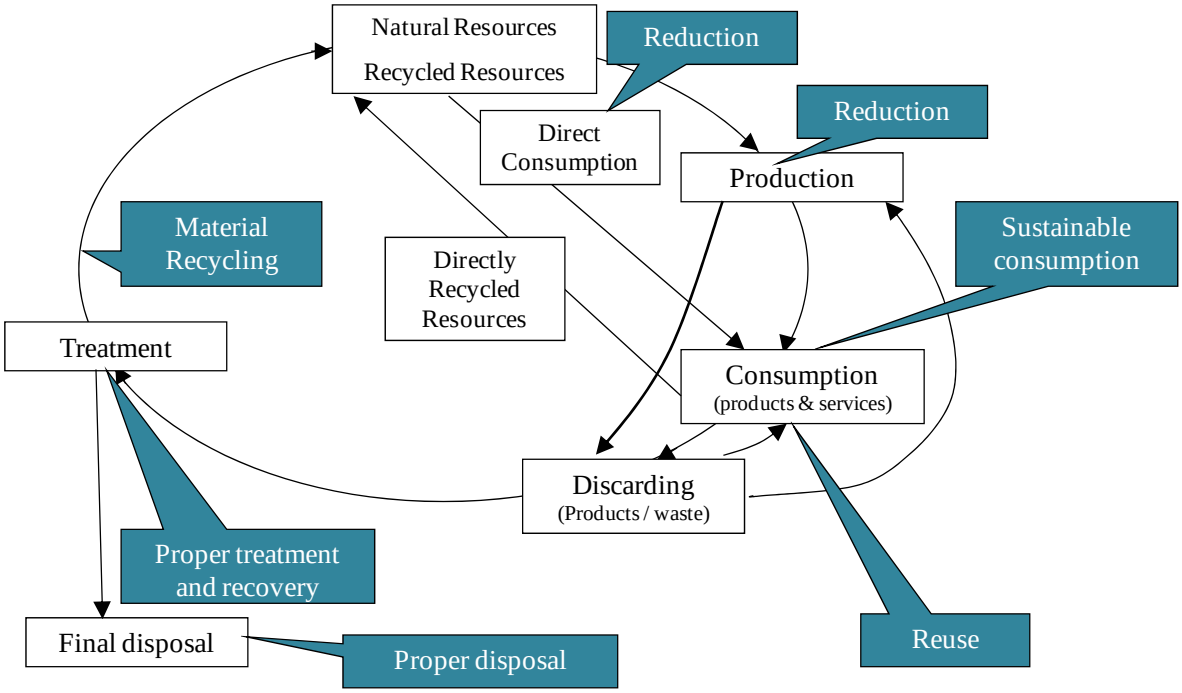

Figure 1 Integration of Resources and Wastes in a Life Cycle perspective (Chandak 2008)

This paper discusses strategies that have been evolved across the world to address an integrated approach to management of resources and wastes – often termed as **Integrated Waste Management (IWM)**. **Box 1** provides few working definitions of IWM.

Box- 1 Defining Integrated Waste Management

One of the earliest descriptions of IWM was given by the Task Force of the Economic Commission of Europe in its Draft Regional Strategy (Staniskis 2005) – "*Process of change in which the concept of waste management is gradually broadened to eventually include the necessary control of gaseous, liquid, and solid material flows [resources] in human environment*".

In a training manual released in 2009, UNEP defined IWM in the context of Solid Waste, *i.e.*, Integrated Solid Waste Management (ISWM) as *the strategic approach to sustainable management of solid waste covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency*.

IWM applies key principles of sustainable resource and waste management in a hierarchy such as

- Resource protection
- Resource conservation
- Resource use optimization
- Designing eco-friendly products/services
- Waste prevention
- Waste minimization
- Waste segregation
- Practicing of 3Rs (Reduce, Reuse, Recycle)
- Meeting compliance using sustainable treatment and disposal technologies
- Involving stakeholders to ensure benefits for all

IWM is thus an **inclusive strategy** that maximizes opportunities for growth and employment and at the same time ensures that the ecosystems are conserved and the human health is protected - to achieve sustainability of this planet. Practicing IWM is essentially **change in the behaviour** requiring understanding and cooperation of the stakeholders – especially that of public bodies, private service providers and local communities. It is more than mere application of technologies. IWM needs to be conceived and grafted in a strategic context armed with right policy instruments, infusion of finance under public-private partnership (PPP) supported by institutional capacity building.

2. Policy Instruments for IWM

Many types of regulatory, economic and information based policy instruments have been widely used for IWM in developed countries. A few of these policy instruments have been successful in developing countries as well. Apart from meeting the basic objectives of IWM, Economic Instruments (EIs) in particular have shown their potential to help generate revenues from waste management. EIs include user and tipping fees, penalties or disincentives, subsidies, pollution taxes, etc, Some of EIs are described in **Table 1**. More recently, revenues from Certified Emission Reduction (CER) units under Clean Development Mechanism (CDM) have become attractive in waste management.

3. Policies and Strategies for IWM in Developed Countries

Amongst the developed countries, United States of America, European Union and Japan represent three corners of the world that have taken interesting leads and initiatives towards IWM. Highlights of some of these initiatives are described below.

RCRA and Superfund in United States of America

The primary regulation governing waste management in the United States is Resource Conservation and Recovery Act (RCRA) passed as early as 1976. The Act prohibits open disposal of non-hazardous solid waste, promotes source reduction and recycling and

regulates the movement of hazardous waste from cradle to grave. Abandoned waste management facilities are called the 'Superfund Sites' and are regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or 'Superfund'.

Table 1. Economic Instruments for IWM

Type of EI	Example
Landfill tax, waste disposal tax & user fees	• Fixed user fee (unrelated to volume or waste type) collected periodically in some parts of Latin America • Has resulted in 55 per cent of service cost in Greater Santiago • Differentiated charges depending on the stage of waste treatment in Ecuador, Colombia, Venezuela and Chile. • Highly adopted in developed countries. For e.g., charges up to 51 euro/ton (71 US$/ton) in United Kingdom (UK).
Recycling credit scheme	• 50 to 100 US$ per ton in UK
Pay As You Throw	• Popular in Unites States. Seattle, Washington and Portland, Oregon in United States are leaders in developing volume-based pricing systems for disposal of garden waste.
Deposit Refund Systems	• Voluntary system in Barbados, Brazil, Bolivia, Chile, Colombia, Ecuador, Jamaica, Mexico and Venezuela for products like paper and cardboard, glass bottles, aluminium cans and tyres. • Mandatory for batteries in Mexico • Brazil recorded a return rate of 30% for soft drink bottles

Sources: Data from Miranda et al. 1994 and UNEP 2005

Policies and strategies in the European Union (EU)

The EU is known for its keen interest towards developing and implementing policies towards strategic management of wastes. Since its flagship initiative on managing packaging waste though the Directive 94/62/EC, the Packaging Directive, EU has frequently come out with innovative policy measures. Examples include the Waste Strategy Communication of 1996, Integrated Product Policy of 1997, End of Life Vehicle Directive of 2000, Directive on Waste Electric and Electronic Equipment in 2002 and Directive on batteries and accumulators in 2006. In a critical step towards propagating its long-term strategy on waste prevention and recycling, the EU presented its new Thematic Strategy on Waste Prevention and Recycling in 2005. This strategy takes a new approach of considering the whole life-cycle of products emphasizing resource-waste integration.

Sound Material Cycle Society in Japan

Japan's heavy dependence on imported raw materials, scarcity of land for the disposal of waste coupled with a stringent regulatory regime necessitated the country to establish and also successfully adopt the "Sound Material Cycle" goal. Full scale efforts to establish a sound material-cycle society in Japan initiated in 2000s. It was agreed upon that in order for the environmental and economic growth to co-exist, it is important to reduce natural resource consumption, which in turn would minimize the environmental burden. Consequently, the "Sound Material Cycle Society" goal was one of the four goals of the country's Basic Environmental Plan launched in 2003.

Japan's material flow indicators fall under three categories, *viz.*, 'input', 'cycle' and 'output'. The key indicators and the targets set for each of these indicators by the country for the year 2010 is indicated below (**Table 2**).

Table 2. Material Flow indicators of Japan's Sound Material Cycle Society

Indicator	Calculation	Status as on 1990	Status as on 2000	Target for 2010
Resource Productivity (in yen per ton)	GDP ÷ amount of natural resources, etc., invested	210,000	280,000	390,000
Cycle Use Rate	Cyclical use amount ÷ [cyclical use amount + amount of natural resource input]	8%	10%	14%
Final Disposal Amount (in tons)	Amount of waste landfilled	110 million	56 million	28 million

4. Policies and Strategies for IWM in Developing Countries

In the developing world, national level economic and policy reforms by countries such as China and Republic of Korea stand out as good examples for adopting IWM principles. Such innovative strategies and approaches have been described below.

Circular Economy approach in China

China houses some of the most resource intensive manufacturing activities in the world with 19.8% of the world population residing in the country. The 'State of the World' (2006) report, has mentioned that China has consumed 26% of the world's crude steel, 32% of its rice, 37% of cotton and 47% of cement. To address the challenges in meeting its burgeoning resource demands, the country adopted a crucial policy decision in its five year plan for 2006 to 2010.

China's eleventh five year plan is a move towards achieving a more balanced growth by adopting the Circular Economy (CE) approach. According to NDRC (2006), "*CE may be interlinked manufacturing and service businesses seeking the enhancement of economy and environmental performance through collaboration in managing environmental and resource issues. The theme of the CE concept is the exchange of materials where one facility's waste, including energy, water, materials - as well as information - is another facility's input. By working together, the community of businesses seeks a collective benefit that is larger than the sum of the individual benefits each enterprise, industry and community would realize if it intended to optimize its performance on an individual basis (i.e. industrial symbiosis).*"

Two most relevant targets for IWM set by the eleventh five year plan are,

- Rate of comprehensive use of solid industrial waste up from 55.8 percent in 2005 to 60 percent in 2010.
- Total discharge of major pollutants down 10 percent in five years.

The definition of CE clearly emphasizes on the importance of realizing the resource value of waste and capitalizing on the overall benefits of pursuing an integrated approach to waste management. In order to monitor the move towards CE, Pintér (2006), in a report submitted to the World Bank, lists CE indicators that could give credible information on the status of implementation to decision-makers in order to clarify and reach desired outcomes. Out of the 7 aggregative national indicators and 15 sectional indicators, 2 input indicators, 1 output indicator, 2 consumption indicators and 2 balance indicators have been shortlisted for this purpose. (Refer to **Figure 2**).

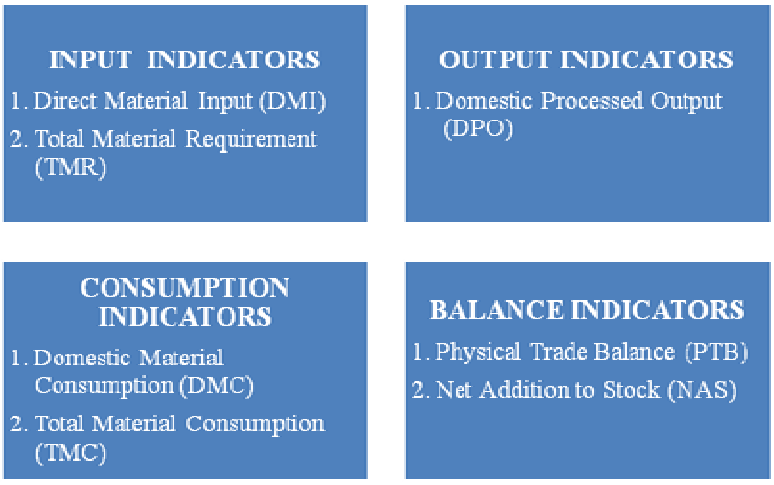

Figure 2. Indicators for Circular Economy (Adapted from Pintér, 2006)

It is interesting to note that all these indicators have been derived from material flow accounting and show linkages between resources and waste. The main input indicator is the Direct Material Input (DMI) which is the combined weight of all materials having

economic value and directly used in production and consumption; equals domestic extraction of materials and imports; does not include hidden flows and Total material requirement (TMR) that measures the total primary resource requirements of an economy and in addition to DMI includes domestic hidden flows plus hidden flows associated with imports in their place of extraction.

The main output indicator is the Domestic Processed Output (DPO) – includes all outflows of used materials, whether domestic origin or imports to air, water, landfills and dissipative flows; materials that are recycled are not included.

The main consumption indicators are the Domestic Material Consumption (DMC) which is the total quantity of materials with economic value that is used within a system, excluding hidden flows associated with domestic extraction of resources or imports; calculated by extracting subtracting exports from DMI; and Total Material Consumption (TMC) which includes the total material requirement of domestic consumption; equals TMR minus exports and their indirect flows.

Balance indicators such as Physical trade balance (PTB) that denote physical trade surplus or deficit of an economy, calculated by imports minus exports; may also be calculated to include hidden flows and Net Addition to Stock (NAS) that measures the physical growth rate of the economy, a balance between new materials and products added each year minus old materials removed and disposed of have also been recommended.

Green Growth in Republic of Korea

Owing to its high overseas dependence for energy and poor energy efficiency in manufacturing activities, Korea was compelled to think of alternative sustainable developmental paths. As a result, 'Green Growth' became the new vision for national development in the next 60 years for the Republic of Korea in 2008. The country has been highly commended for its exemplary commitment to green initiatives, particularly for being a forerunner by dedicating 80 percent of the total ($38 billion) fiscal stimulus package (3% of GDP) to green measures. The country is in the process of actively formulating the National Strategy on Green Growth and a Five-year action plan. Increasing the percentage of waste regeneration from 1.8% in 2007 to 31% has been one of the many green targets that the country has identified for 2010.

5. Practicing IWM

Industrial Sector

Voluntary programmes have been particularly useful as instruments to achieve IWM in industrial sectors. For example, *Cleaner Production* (CP) is a preventive strategy that integrates the various processes involved in a production cycle in a manner that there is both efficient resource utilization and waste and emission reduction to achieve increased production. UNEP and UNIDO have established and led the concept of CP widely.

Figure 3 illustrates the different approaches within the CP concept that have potential for application for achieving IWM.

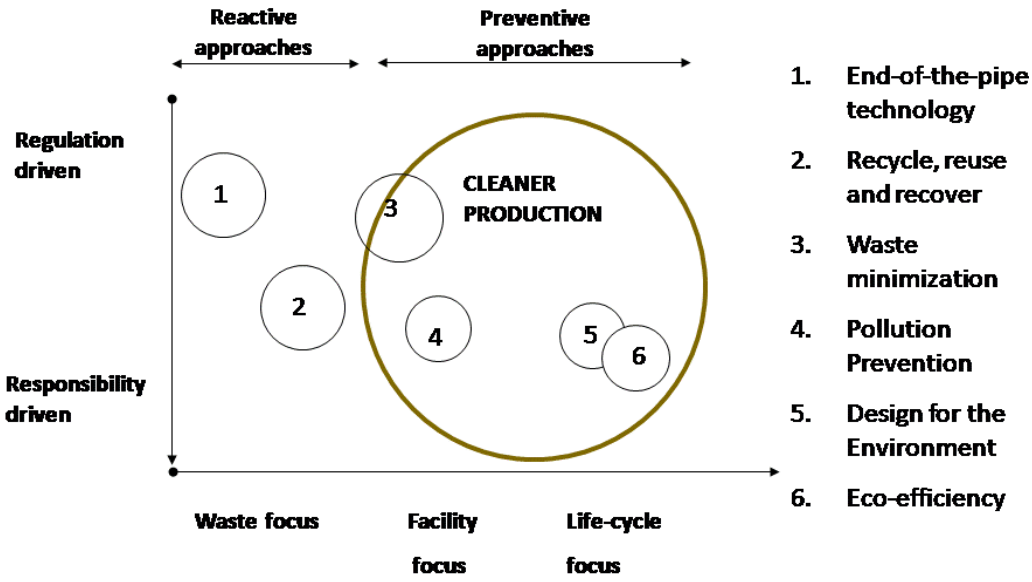

Figure 3. Cleaner Production and related concepts (Modified from Berkel and Meer, 1997)

The CP concept, as shown in **Figure 3,** is not limited to an industrial facility but across the supply chain and at area wide or regional level such as industrial estates.

Extended Producer Responsibility (EPR) has been quite successful in countries such as Japan and Korea as a voluntary programme to manage industrial products that have become obsolete or discarded. Under EPR, manufacturers are compelled to take more responsibility for the products and packaging they produce. This may be through deposit-refund systems, non-refundable product fees, and design requirements for packaging or restrictions on the distribution of disposable goods as in Korea.

Other voluntary programmes adopted by leading industries towards IWM include Design for Environment and/or Design for Disassembly. For example, Fuji Xerox Eco-Manufacturing Co. Ltd. recycles about 40,000 machines and 1 million cartridges every year across nine countries in the Asia Pacific region by completely disassembling and classifying the parts into 64 categories. Hitachi manufactured washing machines with just six removable screws making disassembly easier, cutting down the manufacturing time (33%) and cost and simultaneously achieving considerable waste reduction.

Eco-Industrial Park (EIP), as a concept, was first introduced at the United Nations Conference on Environment and Development (UNCED), Rio de Janeiro 1992. According to Lowe et al (1998), *"EIP is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials. By working together, the community of businesses seeks a collective*

benefit that is greater than the sum of individual benefits each company would realize if it optimized its individual performance only". EIP is considered to be a very promising tool for achieving the goals in Industrial Ecology that embeds the concept of IWM.

Developing countries such as China, Philippines, India, Thailand, and Malaysia have successfully demonstrated EIP in the recent years. A major difficulty in implementing an EIP in developing countries is to address the informal sector that operates in the industrial area. This sector is believed to collectively consume more materials than materials consumed in the industrial estate itself. Key features of the successful EIPs in Asia are given in **Table 3.**

Table 3. Some Examples of EIPs in Asia

Eco-Industrial Parks	Example case	Key features and outcomes of the example case
CHINA Dalian, Tianjin, Suzhou, Yantai, Guidang, Nanhai	• Dalian Industrial Zone	• Spreading to 220 sq. km • Programmatic Cleaner Production • post-EMS development
PHILLIPINES Laguna International Industrial Park, Light Industry & Science Park, Carmelray Industrial Park, LIMA, Laguna Technopark, Philippine National Oil Company Petrochem Industrial Park; Clean City Center project (USAID)	• Calabarzon & Bataan Industrial Estates	• Intra- & inter-estate product exchange • Integrated resource recovery system • Programmatic EMS planning • Greening the supply chain • Common Effluent Treatment Plants • National IE Policy and Framework & Development Plan
INDIA Naroda; Tirupur Textile sector; Tamil Nadu tanneries; Calcutta foundries; Tamil Nadu Paper / Sugar; Bagelore Water project; Ankleshwar, Nandeseri, Thane-Belapur	• Naroda Industrial Estate	• Common Effluent Treatment Plant • Injection of CP strategy into existing eco-industrial partnerships in management of waste such as biologically degradable waste, mild steel scrap, spent sulphuric acid, iron sludge etc.
THAILAND Industrial Estate Authority of Thailand plans (Map Ta Phut, Northern Region, Amata Nakorn, Eastern Sea Board, Bang Poo); Samut Prakarn Province CPIE project (ADB funded); Bangkok	• Map Ta Phut Industrial Park	• Product exchange • Integrated resource recovery system • Community enhancement office to manage projects with neighboring communities

Eco-Industrial Parks	Example case	Key features and outcomes of the example case
JAPAN 12 ecotowns (e.g. Kitakyushu, Itabashi), Fujisawa, Toyota City	• Kitakyushu Ecotown, Japan	• Comprehensive Environmental Industrial Complex (Hibiki Recycling Area) • Practical Research Area with an Eco-Town Center

Source: Chiu 2008

Urban Sector involving Communities

The decentralized community based composting project in Mirpur, Dhaka, Bangladesh is one of its kind case of sustainable community composting programme that entailed full cooperation from the stakeholders involved. Zurbr¨ugg et al (2005) emphasized that the formal permission from the Bangladesh Agriculture Research Council to use the compost for agricultural purposes as well as policy support by the Ministry of Agriculture were the key elements that led to the success of the project of such a large scale. The compost produced was sold in bulk to fertilizer companies that used it as an additive and/or nutrient to make custom-made products. The fertilizer companies also took care of the marketing and sale of the compost leading to a financially attractive arrangement benefiting all stakeholders involved.

Another example of community involvement in IWM is the waste management and recycling program in Curitiba, Brazil (Rabinovitch and Leitmann, 1993 and Anschütz 1996). Massive awareness campaigns in the name of “Garbage isn’t Garbage Program” were conducted with the participation of 70 percent of the households. Other successful programs included “Garbage Purchase” where the community members were given food and transportation tokens in exchange of bags of waste and “Green Exchange” where only recyclable waste was exchanged for food parcels. On a social perspective, the program successfully engaged ex-alcoholics and very poor people for recycling and started a school to encourage children to make toys from the recycled materials.

Several recycling cooperatives are successfully operating in Argentina (World Bank 2005). Some are run exclusively by women (E.g., El Ceibo, Buenos Aires) and generate an average earning of US$ 200 – 250 per month for members. Most of the cooperatives are engaged in collection, sorting and export of recyclable materials to China. A waste cooperative in Salta (CEOS SOL) consists of 300 volunteers, recovers 140 tons of waste daily and generates revenue to support basic health care services to children of 31,000 families.

A couple of micro-enterprises for waste collection, GIE and COFESCA, have gained good support from the local communities in Mali, Western Africa. GIE is supervised by neighbourhood committees of elderly and other respected people, is managed by a team with an elected president and employs a separate collection crew. Communities pay their fees to the senior person from each group of household who hands the money over to crew.

6. Emerging technologies, financing and institutional mechanisms for IWM

The choice of waste management technologies involves consideration of a multitude of issues, typically revolving around the local situation in terms of economic, social, cultural, environmental, and to some extent, also the technological maturity. Recent innovations in waste management technology front have led to many new and emerging ways to recover energy and other useful products from waste. For example, incineration is being increasingly replaced by 'Waste to Energy or WtE' plants in Organisation for Economic Co-operation and Development (OECD) countries. The market for WtE is expected to grow exceptionally in Europe with an estimated investment of US$ 8.2 billion in the year 2008 (Herold 2009).

Thermal technologies such as Plasma Arc Gasification are being tested in countries such as Japan, Canada and England. Anaerobic digestion has been used to tap biogas from sewage, which in turn can generate electricity. Mechanical biological treatment (MBT) systems pioneered by Germany, combine sorting with a form of biological treatment such as composting or anaerobic digestion and have been extensively implemented in United Kingdom. High calorific value substances separated in MBT have been used to produce Refuse Derived Fuel (RDF). Three million metric tonnes of RDF has been estimated to be produced in the EU. In countries such as Austria, Belgium, Finland, Italy and Netherlands, the capacity of RDF producing MBT plants is on the rise.

As a country attains higher levels of development, a shift from high organics to increases in recyclables such as paper and plastics is expected with the increase in relative standard of living. Developed countries resort to consumerism; dependency on packaged food stuffs would lead to reduction of organic waste discards. Urbanization would also lead to an amplified generation of special waste streams such as construction and demolition waste and electrical and electronic waste. It is therefore important to incorporate flexibility in policy planning to accommodate changes in waste discards that may arise due to rapid growth in economies of the developing countries.

The choice of technology and the supportive financing and institutional mechanism differs according to the socio-economic profile and performance of the region. In many developing countries, particularly in the rural regions, it makes financial and economic sense to opt for labour-intensive rather than capital-intensive technologies. Financing and institutional support should be developed to benefit the community at large to ensure good cooperation and support from the users. Decoupling government grants, loans and tax fund allocations from waste management services are essential for long term sustainability.

Table 4 gives an overview of examples that link technology, finance and institutional models at various stages of IWM.

Appropriate cost benefit analysis must be carried out for optimal private involvement in every stage of waste management. Other significant focus areas include upgradation of knowledge and skills for improving waste service efficiency, planning for infrastructure

improvement, increasing accountability of the private partner, developing methods of performance monitoring to ensure best productivity and fair interest rates to private borrowers.

Community level approach should encompass steps towards institutionalisation of IWM, including community cooperation through cooperatives and micro enterprises, reduction of waste through austere lifestyle, segregation of waste by the individual households and commercial buildings and building micro credit funds dedicated for waste management through donations. Municipal level plan should utilize institutional arrangements such as PPPs and PFIs, develop innovative financing models such as hybrids and prudential borrowing, garner possible revenue as CERs through CDM and promote awareness among civic communities and commercial sector. Monetization from waste, especially following CDM is an untapped opportunity in the developing countries and hence should be factored, guided and supported in the IWM.

Table 4. Technology, Financing and institutional models for IWM

Stage	Technology	Examples of innovative financing and institutional models
Collection & transport	Human-powered or semi-motorized carts & collection and compaction trucks	- Cooperatives and micro enterprises in Africa, Asia and Latin America - PPP has worked in many big metros and mega-cities in developing countries. The firm is hired through open competition or private subscription.
Recycling	Material recovery facilities Recycling plants	- Private companies (E.g., Wongpanit Garbage Recycling Separation Business in Thailand) - Cooperatives and micro enterprises in Africa, Asia and Latin America - Waste Exchange Programs
Energy Recovery during Biological and thermal treatment	Waste to energy plants - Bio-methanation plants for organic waste treatment Landfills with gas capture Incineration with energy recovery	- PPP (DBO, BOO, BOOT) - Clean Development Mechanism for additional revenue (Methane capture) - Funding from MDBs
	Composting producing useful manure	- Decentralized community composting in Bangladesh - NGOs organize the informal waste pickers - Manure sale through industries (Bangladesh model) - Clean Development Mechanism for additional revenue (methane avoidance)

Institutional models such as microenterprises and cooperatives have been used on a community level to implement waste management technology solutions successfully. PPP models have been useful in bringing together the private sector and municipality in waste management activities such as collection, recycling and treatment. In North America for example, involvement of private waste management companies has reduced the waste service cost by at least 25 per cent in countries such as United States and Canada. Further, the waste recycling industry has accounted for about 2 per cent of the U.S GDP and nearly 12,000 firms are involved in collection, transport, treatment and final disposal of solid waste with small and large firms providing approximately 80 per cent of urban services. (GTZ,2005). The recycling industry in North America has earned US$ 236 billion in revenues in the year 2007, employing over a million people (CSR press release 2008).

On the financing perspective, borrowing capital and expertise from the private sector has been looked upon as a viable option in waste management. Private Finance Initiatives (PFI) in waste management have evidently increased in UK since 2004. In developing countries, innovative financing mechanisms such as micro-financing have shown some success. For example, micro-credit funds created through donations have been used to support informal recyclers in Brazil and a hybrid financing system that combines PP and micro-enterprise approach has been adopted for running a material recycling facility in Philippines.

7. Role of various stakeholders in IWM

Complexity in financing and coordination of IWM necessitates multi-stakeholder involvement in every stage of the waste stream. Recent developments in IWM reveal that co-operation between the different stakeholder groups can be very helpful in achieving financial sustainability in the waste management projects. The roles and responsibilities of these stakeholders have been described in **Table 5**.

Table 5. Roles and Responsibilities of Stakeholders in IWM

Stakeholder	Role and Responsibility
Government and regulatory organizations	• Design policies and regulations related to IWM • Monitoring urban local bodies • Assigning targets to ULBs • Capacity building and training of ULBs and industries on IWM
Urban Local Bodies	• Work with the ideal stakeholders at the different stages in IWM
Communities	• Source segregation • Educating family and friends
NGOs/ CBOs and Informal sector	• Stimulate civic communities through awareness campaigns for source segregation & composting

	• Monitoring IWM projects in communities
Technology providers	• Research and innovation to design environment friendly technologies for IWM
Industries	• Sponsor awareness campaigns • Sponsor infrastructure requirements such as bins/handcarts or community recycling units • Collection, Recycling, Marketing of recycled and recovered products such as composts
Financing and Donor Institutions	• Support for implementation of IWM projects with social benefits • Support for capacity building and awareness programmes for IWM

An illustration of the case of stakeholder cooperation in recovery and sales of recyclable materials in Manizales, Bogota, Colombia is given below in **Figure 4** and the stakeholders involved in the different stages of IWM are listed in **Table 6.**

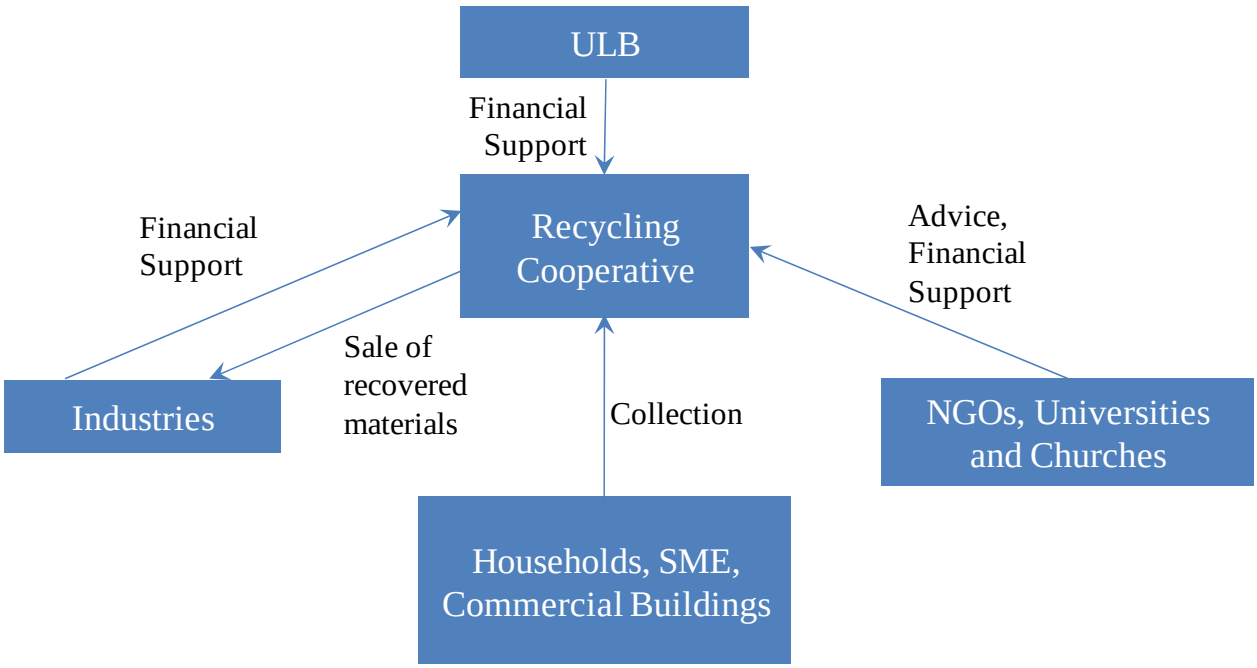

Figure 4. Stakeholder cooperation – an example (UWEP/CWG 2000)

Table 6. Stakeholders involved in the different stages of IWM

Stage	Stakeholders
Collection & transport	- Generators/ Service users - Urban Local Bodies - Private waste collection companies
Reuse and Recycling	- Informal waste material buyers and dealers - Urban Local Bodies - Private waste recycling companies - NGOs/ CBOs
Thermal treatment with useful energy or material recovery	- Urban Local Bodies - Technology providers - Private operators - End users (Residences, Industry) - Donor agencies - Financing organizations
Biological treatment with useful energy or material recovery	- Urban Local Bodies - Technology providers - Private operators - NGOs/ CBOs - End users (Farmers, Industries) - Donor agencies - Financing organizations

8. International and Regional Cooperation for IWM

International and regional cooperation are essential in capacity building, information sharing, technology adaptation r, and promotion of safe trade of secondary or recyclable materials in support of IWM. Technology and knowledge transfer relevant to IWM can happen between developed and developing countries through regional (south-south) and international (north-south) cooperation. These efforts could trigger sharing of information on various aspects such as – national regulations and standards for recycling, national policies and framework for recycling and waste management, standard product information regarding recyclability and proper management and best practices in IWM. A few examples of such successful cooperation and declarations that have resulted in significant development in the area of IWM have been listed below.

Agenda 21 of 1992

Agenda 21 was an outcome of the "Earth Summit" conducted at Rio on 14 June 1992 by United Nations. The Agenda established the general principle of the waste hierarchy and recognized waste as one of the major area of human impact on the environment which deserves distinguished concern and solution.

Basel Convention on the Control of Transboundary Movements of Hazardous Waste, 1992

The Basel Convention, which was adopted in 1989 and entered into force since 1992, has played a major role in regularising the global transport of hazardous waste and has helped in arriving at the quantity of authorised import and export of waste occurring globally across the national boundaries. The overall goal of the Convention is to protect, by strictly controlling, human health and the environment against the adverse effects which may result from the generation, transboundary movement and management of hazardous and other waste. Effective cooperation has encouraged exporting countries and exporters to take necessary responsibility for safe trade of recyclables, especially considering the insufficient capacity of many importing countries in tracking these materials and in treatment technologies.

International Declaration on Cleaner Production, 1999

International Declaration on Cleaner Production is an initiative of UNEP-DTIE (Division of Technology, Industry and Economics) on increased public commitment to cleaner production strategy and practice. The Declaration outlines a set of principles, which when implemented will lead to increased awareness and understanding and ultimately, greater demand for CP.

Marrakesh Process of 2002

The Marrakesh Process is a ten year framework of programmes on Sustainable Consumption and Production and was launched in 2002. The aim of the process was to minimize waste for consumers and producers while the Strategic Approach to International Chemicals Management (SAICM) of 2006 was evolved to ensure that chemicals are produced and used in ways that minimize significant adverse impacts on the environment and human health by the year 2020.

3R Knowledge Hub in Asia of 2006

The 3R Knowledge hub (3RKH) is an outcome of regional cooperation to create, collect and capture 3R knowledge for its subsequent storage, retrieval, sharing and dissemination. The product was a result of the 3R Initiative of Government of Japan that was launched in April 2005. In the subsequent year (August 2006), with the cooperation of Asian Development Bank (ADB), Asian Institute of Technology (AIT) and United Nations Environment Programme Regional Resource Centre for Asia and the Pacific (UNEP RRCAP), the 3RKH were created mainly to support and strengthen Asia-Pacific's regional capacity on 3R.

UNEP International Environment Technology Centre

The International Environment Technology Centre (IETC) of the UNEP supports implementation of environmentally sound technologies (ESTs), including management systems, for disaster prevention, production and consumption and water and sanitation. Under one of its focal areas, Waste Management, the Centre has supported numerous IWM projects, publications and workshops in various countries such as India (Pune), China (Wuxi), Africa (Lesotho) and Mauritius among others. Recently, the Centre has

conducted a special event on waste management in Bali, Indonesia (25 February 2010) and has conducted a consultation workshop on WM partnerships in Geneva, Switzerland (30 Nov and 1 Dec 2009, respectively).

Global Programmes for Vulnerable Countries

Special interest must be exercised in implementing waste management solutions for most vulnerable regions of the world such as Small Island Developing States (SIDS), Africa and South Asia among others. In this regard, UNEP's Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities developed for SIDS finds relevance. Many international seminars and awareness programs on waste management have been launched in these regions by global organizations such as UNEP and World Bank. Further, South Asia and Africa have benefited the most with 86 and 74 per cent of the waste management project cost met from the World Bank's funding.

Recently, in order to make 3R action strategies, Asian countries have come together on a common platform called the Regional 3R forum in Asia (**Box 2**). Government, donor agencies and the private sector of all the Asian nations have come together to "reduce," "reuse" and "recycle" materials and waste, aiming to promote efficient resource use and harmonization of the environment and the economy.

Box- 2 Regional 3R Forum in Asia

In 2009 the Regional 3R Forum in Asia was established through the joint effort of the United Nations Centre for Regional Development (UNCRD) and the Ministry of the Environment of the Government of Japan with an overall objective to help mainstream 3R into national policies in Asia. The specific objectives of the Forum are to - (a) facilitate high-level policy dialogues on 3R issues, challenges, and opportunities; (b) facilitate improved dialogue and cooperation with international organizations and donor communities for materializing and implementing 3R projects, including 3R and waste management-related projects and programmes at the local and national levels identified through national 3R strategies; (c) provide a strategic and knowledge platform for sharing experiences and disseminating among Asian countries best practices, tools, technologies, and policy instruments on various aspects of the 3Rs; (d) provide a platform to develop multilayered networks of stakeholders such as national and local governments, academia, scientific and research community, the private sector, media community, NGOs, and the informal sector; (e) generate regional consensus and understanding on the beneficial aspects of the 3Rs in the context of achieving the MDGs, resource and energy efficiency, resource-efficient economy, and climate change mitigation; (f) provide a platform for the proliferation of national 3R strategies; and (g) promote awareness among the general public, including schoolchildren, on the beneficial aspects of the 3Rs. The Inaugural Regional 3R Forum, held in Tokyo, Japan, on 11-12 November 2009 agreed on the Tokyo 3R Statement, which articulated a comprehensive set of priorities and recommendations for Asia, provides a comprehensive basis for the proliferation of 3R in support of IWM approach.

Source: www.uncrd.or.jp/env/

9. Concluding Remarks

An integrated approach that emphasizes linkages between "resource" and "waste' across "life cycle" of products and services is necessary today to ensure sustainable production and consumption. IWM provides such an opportunity. Policies and strategies to encourage sustainable production and changes in unsustainable consumption patterns should therefore be developed as part of IWM. The focus of policies should address the very early (i.e. manufacturing) and very late phases of the life-cycle (i.e. waste management), reducing the negative environmental impacts of products throughout their life-cycle. **Applying a life-cycle approach however brings in more challenges, particularly due to the fact that multiple stakeholders are involved in resource-waste life-cycle.**

IWM strategies need to be highly region-specific and related solutions should be customized to suit the differing situation, priorities, institutional capabilities and financial resources in the different parts of the world. For instance, immediate focus for developing regions should be improvement of collection coverage, treatment and disposal systems and rehabilitation of existing open dumps in a most cost effective manner. Closure of open dumps and formalization of the recycling sector should receive high priority to begin with.

IWM related programs that offer good scope for innovation to manufacturers (for e.g., EPR, CP, Design for Environment) to reduce waste quantities and increase resource efficiency and cost savings should be encouraged. Waste exchanges must be made essential in industries as such arrangements will divert waste from disposal to a beneficial use and at the same time save considerable cost through avoided disposal.

It is important to parallely address concerns on health and safety risks from use of recycled and recovered products to win consumer and/or user's confidence. With the exception of a very few countries such as the U.S.A, EU and Australia, efforts towards this important health aspect of waste management on a regional or national level has been negligible. For example, the European Commission and EPA of South Australia have stringent standards on usage of RDF (EC 2003 and EPA 2009) while EU, North America and Australasia have compost standards.

National level action should include creation of national waste policies and regulations through waste management acts, rules and laws, development of waste related quality standards, introduction of market based instruments such as taxes, fee, penalties and subsidies, organising the informal recycling sector and training and capacity building for waste management. There is also a need to develop standards for "recycled products" from waste at national and local levels. Finally, international cooperation to regulate waste movement, regional waste data inventorization to enable transparent waste exchange, and international policies and regulatory frameworks are critical to achieve IWM on a global scale.

There are quite a few opportunities to reduce Green House Gas (GHG) emission in the waste lifecycle. The waste sector is a significant contributor to GHG emissions accountable for approximately 5 per cent of the global greenhouse budget. Landfill gas recovery from 1 million metric tonnes has the potential of yielding revenue of US$ 140,000 per year, when registered as a CDM project. Apart from landfill gas capture, composting and recycling (e.g. fly ash) also have the potential of generating revenue through CDM. Further, there is a pressing need to harness the role of low-carbon technology towards better economic “decarbonization”.

Strategies for IWM will work only when there is adequate institutional capacity. Extensive awareness raising, education and capacity building efforts are essential, especially in the developing world, supported by appropriate resources and “tool-kits”. This may require a long term well designed capacity building programme harbouring on multi-layered and cross-cutting stakeholder networks for knowledge exchange.

Finally, an attitudinal change towards viewing waste as a resource is needed. Strengthening (and not replacing) of the informal waste recycling sector in terms of technology and finance will be useful. Leapfrogging could happen when coupled with the formal business sector for up-scaling as well as to reach and maintain quality and Environmental, Health and Safety standards. This would lead to safe employment, “green economy as well as trigger innovations. Indeed only then IWM could become a reality and help all to draw on its true benefits towards achieving sustainability of this planet.

References

Anschütz, J. (1996). Community-based solid waste management and water supply projects: problems and solutions compared. A survey of the literature, Urban Waste Expertise Programme (UWEP) Community participation in waste management, UWEP Working Document 2.

Berkel, R. Van and Meer J.V.D. (1997). Training Course for Future Trainers on Environmentally Sound Technology Transfer. IVAM Environmental Research, University of Amsterdam.

Chiu (2008). Eco-Industrial Networking in Asia Anthony SF Chiu, Manila, uploaded on 2008-01-28, http://www.chinacp.com/EN/ItemDetail.aspx?id=10

CSR Press Release (2008). Recession Proof Cleantech Investing: The Recycling Industry, submitted by sustainablebusiness.com, Sustainability research reports and publications, April 2008.

EC (2003). Refuse derived fuel, current practice and perspectives, Final Report (B4- 3040/2000/306517/mar/e3), European Commission, July 2003. www.ec.europa.eu/environment/waste/studies/pdf/rdf.pdf

EPA (2009). Guideline: Refuse Derived Fuel—Standard for the production and use of refuse derived fuel, Environmental Protection Agency.www.epa.sa.gov.au/pdfs/standard_rdf.pdf

GTZ (2000). ECO-Industrial Parks, Strategy towards Industrial Ecology in Developing and Newly Industrialised Countries. Pilot Project, Strengthening Environmental Capability in Developing Countries (ETC).

GTZ (2005). Private Sector Involvement in Solid Waste Management - Avoiding Problems and Building on Successes, commissioned by Federal Ministry for Economic Cooperation and Development by Adrian Coad.

Herold, I. (2009). Biomass & waste-to-energy investment trends, New Energy Finance, London, www.eubia.org/uploads/media/NEF_B_WtE_Investment_trends_01.pdf

Lowe, Ernest A., Moran, Steven, R., Holmes, Douglas B. (1998). Eco-Industrial Parks – a handbook for local development teams, Draft. Indigo Development, RPP International, Oakland, CA.

Miranda et al. (1994) Market based incentives and residential municipal solid waste. Journal of Policy Analysis and Management, 13 (4), pp. 681-698.

Pintér L. (2006). International Experience in Establishing Indicators for the Circular Economy and Considerations for China, Report for the Environment and Social Development Sector Unit, East Asia and Pacific Region, The World Bank.

Rabinovitch, J. and Leitmann, J. (1993). Environmental innovation and management in Curitiba, Brazil. World Bank/UNDP. UMP Working Paper Series No. 1.

Staniškis J. (2005). Integrated Waste Management: Concept and Implementation, Environmental research, engineering and management, 3 (33), pp. 40-46.

State of the World (2005), Redefining Global Security, Worldwatch Institute.

UNEP (2005), Training Manual on the Use of Economic Instruments for Environmental and Natural Resource Management.

UWEP/CWG (2000), The sustainability of alliances between stakeholders in waste management, Working paper for UWEP/CWG, 30 May 2000 – Draft www.gdrc.org/uem/waste/ISWM.pdf

Wilson D.C. (2007), Development drivers for Waste Management, Waste Management & Research, Vol. 25, No. 3, 198-207

World Bank (2005). Waste Management in China: Issues and Recommendations May 2005. www.go.worldbank.org/2H0VMO7ZG0

Zurbr¨ugg C., Drescher S., Rytz I, Sinha AHM, Enayetullah I. (2005), Decentralised composting in Bangladesh, a win-win situation for all stakeholders, Resources, Conservation and Recycling, 43, pp. 281–292.

www.gov.cn (Chinese Government's Official Web Portal)

www.korea.net (Korea's Official Website)

www.3rkh.net (The 3R Knowledge Hub)