Higher Education Needs for Solid Waste Management through 3R in Asian Developing Countries

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Abstract

Waste management sector is looked upon as a soiled industry with primitive technology and usually operated with unskilled people. With 3R, Reduce, Reuse, Recycle gaining momentum, it is essential to transform the waste management industry from grime to green. This could be done by division of labour and specialization, where the former implies creating dedicated trained workforce and the latter requires imparting essential knowledge. Targeted capacity building, education and training provides the necessary impetus in creating the workforce and imparting knowledge. This paper attempts to discuss the current state and fate of waste management industry, the state of 3R implementation and the capacity building needs in Asian countries. The paper takes a stratified approach in identifying the stakeholders to 3R and places recommendations for appropriate capacity building, education and training activities. Academia plays an important role in capacity building. The paper provides an overview of the current state of academic curriculum in capacity building for 3R. The role of regional organizations in capacity building for 3R has been discussed.

Keywords: 3R capacity building, Environmental Education, waste management education

1.0 Introduction

Waste is a multifaceted, subjective and often adversarial issue with many ways to delineate, depict and decide contextually. Stakeholder groups, paradoxically, have different ways of looking at it. End citizens, academicians, businesses, administrators, activists and local municipal authorities - all use a different approach and this explains why waste management is a complex phenomenon.

While businesses see waste as an opportunity, the local municipal authorities look at it as a service. For end citizens and politicians it is a problem and for academicians and activists it is an unattended resource. Whatever is the notion; the issue is the same and is inherently connected to the eye of the beholder.

As Birch (2008) refers, waste is an anthropogenic concept. Humans use this term to describe materials that have been used but are no longer wanted, either because they have no more value to us or because they no longer serve the desired function.

Waste is itself inevitable, but the real problem lies in how much it is and what it contains. Tanaka et al., (MOEJ 2006) estimate the quantity of waste generated across the globe to be around 12.7 billion tons in 2000 and project it to be over 19 billion tons in 2025 and about 27 billion tons in 2050; nearly double in 50 years. In their estimation, Asia alone will witness dramatic increase in the amount of waste it generates. In India, the annual

generation of municipal solid waste is in the range of 35 to 45 million tons. This volume is likely to double by 2015, and double again by 2025, by which time India would be generating over 150 million tons/year (Hanrahan, Srivastava, and Ramakrishna 2006). Chinese municipalities currently generate about 190 million tons/year and, by 2030, this could increase to 480 million tons, nearly double the amount the United States is projected to generate over the same period (World Bank 2005).

Malaysia generated around 7.4 million tons of municipal solid waste in 2005 and expects that this could rise up to 11 million tons by 2030 (Yahaya 2007). Vietnam produced about 12.8 million tons of municipal solid waste in 2003 (Tai 2005) while in Thailand it was 11.2 million tons in 1993 and about 14.4 million tons in 2005 (PCD 2005). Vietnam and Thailand are no exceptions in doubling their waste generation trends in the coming years. Same is the case with other developing Asian countries.

Evidently, solid waste generation in Asia has witnessed a drastic increase on par with the pace of population growth, urbanization and industrialization. Pathetically, the capacities of municipal bodies to manage the waste have not increased at the same rate. In many cases, municipal bodies have very few personnel to handle the technical aspects of waste management.

1.1 3R and its role in solid waste management

The problem is not the waste, it is rather the quantity generated by the society, its toxicity, and the impact that our inefficient use of materials has on resource depletion, climate change, and human health in all corners of the planet. Managing the waste we generate is a formidable challenge to governments around the world. How to dispose of refuse economically and without causing environmental degradation is a problem faced by developed and developing countries alike.

Managing solid waste has been simply transporting it to remote places for dumping; moving it out of sight. Often, only a fraction of the waste is collected, transported and burnt to reduce the volume, minimize the attraction of animals and vermin and to salvage recyclable materials. These practices are being challenged in the recent years due to soaring values of land, inadequate space, and the choking carrying-capacity of the environment, if not the diminishing natural resources.

Discarded wastes often contain huge amount of materials that are excavated, refined, and rigorously processed to make products for use by the end consumer. Enormous quantities of waste, in various forms are released during the production phase. In the changing landscapes of decreasing natural resources and accompanying issues from the disposal of solid waste, reducing the resources we consume and the waste we generate is indispensable. Reducing consumption, reusing products and recycling materials have proven to be practical solutions to the waste crisis and resource depletion concerns. A pragmatic and systematic approach, combining Reduce, Reuse and Recycle in a unified manner, often adverted as 3R, has gained momentum in many developed countries. Reducing means choosing to use things with care to reduce the amount of waste generated. Reusing involves the repeated use of items or part of items which still have usable aspects. Recycling means the use of waste itself as a resource.

1.2 State of 3R implementation in Asian countries

Irrespective of the economic position of the country, developing or developed, 3R is not new to Asian countries; it is only the practices that make the difference. Table 1 presents snapshots of unpremeditated 3R practices in some Asian countries. The Table is not exhaustive, instead presents few initiatives to provide a blanket idea of 3R implementation in some Asian countries.

Table 1. Examples of 3R-related initiatives in some developing Asian countries

Country	Activity
San Lorenzo, Philippines	Ayala Center's program on SWM has been running for a decade now, starting with the pilot implementation of polystyrene and plastic waste collection and recycling in 1996 through the collaborative efforts of Ayala Center Association, Ayala Foundation, Inc., Barangay San Lorenzo and Polystyrene Packaging Council of the Philippines. Designed as a campaign to contribute in the further reduction of solid wastes that go to the landfill, the SWM program was launched among 1,000+ merchants of Ayala Center.
Kota Kinabalu, Malaysia	Kota Kinabalu Material Recovery Facility is a Public Private Partnership at the Kota Kinabalu Malaysia and cater to the surrounding districts. Waste is segregated in the facility where recyclables are recovered for further processing and organic waste is composted. Apart from being able to convert wastes to wealth, the facility has brought immense benefits to the City hall, the single authority tasked with the management of municipal solid wastes in Kota Kinabalu. The facility has reduced the amount of waste that has to be landfilled, thereby lengthening the lifespan of the landfill.
Pondicherry, India	Shuddham, an NGO in Pondicherry, South India has created a model for a zero-waste environment. About 5 years ago members of the NGO started with one street, going door-to-door to educate the households on the value of segregating waste into three streams - compostable, recyclable, and hazardous. “Green” waste is composted, resulting in valuable castings and vermi-wash which are sold to gardeners. Paper, cardboard, plastics, and other recyclables are sorted and then sold to recyclers. Hazardous waste is disposed of safely. Today Shuddham has bagged a contract to offer SWM services to a small municipal ward in the town of Pondicherry.
Dhaka, Bangladesh	Waste Concern, a research based NGO, initiated a pilot project on community based resource recovery project in Dhaka city in 1995. Support from the government and international organizations, helped them further extend the community based resource recovery projects in other places of Dhaka. Activities under the project included house-to-house waste collection, composting of the collected waste in a decentralized manner and marketing of compost and recyclables. Waste Concern later on successfully registered their decentralized composting plant under CDM.
Vietnam, Laos and Cambodia	The Waste-Econ program, through its promotion of Integrated Waste Management, supports a vibrant waste economy that provides enhanced earnings and working conditions, while promoting sustainability, waste reduction and recycling. It is a six-year collaborative program funded by the Canadian International Development Agency between the University of Toronto and a number of government institutions, universities, quasi-NGOs, and NGOs in Vietnam, Laos and Cambodia. This program is helping to provide institutional strengthening essential to create local and national IWM strategies
Bangkok, Thailand	Cimelia Resource Recovery Private Ltd., a Singapore based company specializes in E-waste management and recycling and aims to provide high quality, cost-effective e-waste management, metals recycling and Platinum Group Metals recovery and refining. The company offers various products such as Gold Potassium Cyanide, Plating solutions, Gold – Master Alloys, Au, Ag, Pt Sputtering Targets, Copper Targets and Copper / Aluminum Alloys recovered from e-waste.

1.3 Fate of waste management in Asian countries

Traditionally, waste has a sickening notion attached to it and is viewed as a dirty service offered involving people with no specialized skills and mostly adopting primitive technologies. Governments and municipal bodies do not allocate funds for modernization of waste management services. Some cities still operate and stick on to systems and services designed decades ago and most of these are unable to accommodate rapidly growing modern waste streams, say e-waste and healthcare waste. Waste management systems have to be dynamic to meet the growing and changing needs. Lack of dynamicity, adoption of primitive technology, notion as a dirty service, neglect of socio-economic implications, gender issues, inadequate budgetary allocations, unrecognized role of actors and stakeholders are some undesirable features surrounding the waste industry.

Not all is bad in waste management; the recent decade has seen strides of development. National policies emphasizing better solid waste management have been formulated. Supporting legislations have been developed and enforced. Various market-based, voluntary and mandatory instruments have been adopted and practiced. Independent businesses utilizing waste materials as feedstock have developed in many countries. Overall, a positive outlook on waste as a resource has been emerging in the recent years, however, insufficient to force a dramatic change.

Despite all these heartening initiatives the waste industry still has a bad image and lacks professionalism and long-term planning. Replication of best practices and success stories, tailored to meet local needs are avenues requiring attention. Waste management systems also needs targets, performance indicators and benchmarks as in other industries. When it comes to learning from others experiences, ability to adapt/adopt needs clearer understanding of the subject to ensure success.

Waste sector in Asian developing countries is characterized by poorly educated people without sufficient skills and technologies to perform their jobs efficiently.

1.4 Need for Capacity building

Adam Smith, Father of Modern Economics, in his book The Wealth of Nations, quotes “Division of Labour” and “Specialization” as the key to achieve a larger return in production. The theory has been proved globally and corporate firms have taken advantage out of it thus making their business succeed.

According to the theory of Division of Labour and Specialization, employees would not only be able to concentrate on a specific task, but, with time improve the skills necessary to perform their jobs. Tasks could be performed better and faster, and through such efficiency, time and money could be saved while production levels increase. Several questions arise while applying the theory in the context of waste management. How can this division of labour and specialization be attained? Is it applicable only for production units? What should be done to realize the theory in action for the waste management sector?

A classical situation where waste management strategies have to be thoughtful is the development of material recovery facilities and promotion of source segregation. Material recovery facilities require millions of investments in plant, equipment, machinery, land, operation and maintenance and human resources. Promoting source segregation involves creating awareness, basic infrastructure and facilities to collect segregated waste. When source segregation is promoted and takes off successfully, the role of material recovery facility becomes void, since the waste is segregated at the source and no salvageable materials reach the recovery facility. The investments made in the material recovery facility apparently go down the drain, putting the local government units at irrecoverable debt and loss. Where is the flaw?

A social dimension of waste management is the role of the informal sector and underprivileged settlements in dumpsites. Thousands of families across developing Asia make their livelihood by scavenging the waste reaching the dumpsites. Promoting source segregation or establishing material recovery facilities or implementing a functional 3R system prevents salvageable materials from reaching dumpsites. Families living on these materials are practically left with nothing to make their livelihood. Moreover, if not for these families, most of the already overflowing dumpsites across Asia would have overshot their capacities decades ago putting municipalities into serious troubles. Dumpsites provide livelihood for thousands of families and hence could they be accepted on socio-economic grounds?

A fully functional 3R system is an amalgam of various activities beginning with policymaking, identifying stakeholder roles, exploring investment opportunities, investigating financing methods, integrating social concerns, ensuring sustainability of the system, opening new business opportunities, guaranteeing effectiveness, improving efficiency of the system and above all catalyzing political and public will.

There is no simple cookie-cutter approach to implementing 3R. It involves several dimensions and has no readymade map to reach the destination. Implementing a functional 3R system is similar to creating a map for an unexplored terrain and requires multidisciplinary knowledge and skills.

The waste industry is complex and constantly evolving. Employment and business opportunities are continuously increasing. Distributed and decentralized recycling industries are driven as social entrepreneurship models. Academia, business and technology providers have joined hands demonstrating growing maturity and attaining professional status by investing in continuous development. Yet, the industry still has a dirty image and not a profession of choice at large.

A strategic approach to erase the dirty image and turn it to a professional industry from a soiled service is to orchestrate division of labour and drive specialization. Division of labour implies creating dedicated workforce and specialization implies imparting the required knowledge; the key to creating dedicated workforce and specialization lies in capacity building, education and training.

3R by its mere nature is people-centric, meaning that Reduce and Reuse are strongly connected to human minds and only Recycle is dependent on policy and technology. Compared to Reduce and Reuse, Recycle is an end-of-pipe approach. Prioritizing issues and acting in the order of their importance is vital to tackle the whole problem in one go. Either way, changing human minds or developing policies and technologies, capacity building and education to impart the required knowledge is indispensable for 3R implementation in Asian countries.

Capacity building, education and training needs are to be considered among all stakeholders. This must be focused not only on the provision of appropriate and timely information to decision-makers, but also targeting stakeholders in the public and private sectors, communities and consumers. Another important aspect is building human resources, decision-making capacities and structures. In essence, developing a conducive environment for 3R will require enabling different organizations and institutions (with different kinds of resources and working on different issues), to carry out activities within their respective niches, but achieving together common 3R goals.

2.0 Capacity building for 3R

In creating a favorable environment for 3R implementation, it is essential to note the differences between 3R and conventional solid waste management. Though the subject is the same, garbage or waste or trash whatever it is called, the way it is comprehended has to

change. Through a 3R lens all these are unattended resources. Essentially the eye and its outlook have to be changed. Conventional solid waste management systems cannot cope with the requirements of a successful 3R system and requires deeper thinking. The energy to effect the change in the lens and the technique to retrain the eye comes handy through capacity building, education and training.

Human capacity building is a critical issue in developing country contexts. Experiences across the world in various fields have shown that technology transfer and innovation can be successful only when the host has the requisite technical and managerial skills to establish, operate, maintain and manage the system. Without those skills, new systems and practices often fail to deliver expected services, rather cause new problems and chaos.

3R involves a broad spectrum of stakeholders (Figure 1) with consumers and communities, urban/municipal authorities, federal governments and policymakers and waste handlers at the core to businesses, regional organizations, academia and private sector connected to them through various interactions and offering supportive services.

Figure 1. Stratification of stakeholders for 3R implementation

Evidently, the contribution of each stakeholder to 3R is different and cannot be generalized. For governments and policymakers the role in 3R is in terms of providing policies, laws, regulations and economic instruments that favor 3R development. For private sector, the focus is on recycling technologies, including their transfer, operation and management etc. Consumers and citizens are important in that they are the major waste generation sources. Similarly, every stakeholder group has its own defined role and hence their requirements for successful 3R implementation are totally varied.

When it comes to division of labour and specialization, the role of academia is more crucial. Creating dedicated workforce through division of labour and nurturing specialization involves building relevant capacities at all levels, especially when minds are set – through graduate education.

2.1 Role of academia

Capacity building, education and training for 3R calls for a comparatively larger role for the academia. 3R is intrinsically connected to human behavior and can be successfully achieved only through behavioral change. There is no sphere of human life isolated from waste generation and 3R. In view of this, it is essential to integrate 3R in routine academic curriculums at schools, colleges and universities.

Present academic curriculums are oriented towards waste management and 3R only as an auxiliary issue, not as an integral part of the overall waste management education system. Waste management and recycling are regarded as a grime industry – not as an independent profitable business. Municipalities and local government units interpret them entirely as a public service. Waste management sections in businesses are considered as cost-centers and not revenue generating units. Public outlook on cooperating with municipalities for waste management is mostly evading. Added to this is the increasing transportation of waste from the affluent to poorer economies – transboundary movement of waste – essentially to avoid higher treatment costs. Transporting solid waste to developing countries is reckoned to be cheaper than treating and disposing.

An analysis of present Asian academic curricula, focusing on waste management and 3R, indicates a huge gap between demand and supply of essential knowledge and skills. Table 2 presents a snapshot of a typical solid waste management course curriculum offered at the graduate level in Asia. Curricula adopted in most Asian academia were designed at least a decade or a half ago and focus more on the basics of solid waste management. Though fundamental knowledge of the subject is indispensable, pedagogical improvements imparting advanced knowledge on recycling technologies and their applications, relevant legislations, international conventions and their implications, business principles and social impacts of 3R are vital to create professionals qualified to cater the present day needs. Moreover, present academic curricula have been built on the belief that waste has to be disposed, with or without treatment. Natural resource crunch was not felt widely in the past decade when most of these curricula were framed. Solid waste management was included as part of the curricula only with the objective of providing the knowledge and not with the idea of creating dedicated professionals. While water and wastewater have been governed by dedicated departments and ministries in many Asian countries, solid waste management is often among other responsibilities assigned to municipal engineers or public health agencies. This stands as evidence that dedicated professionals for solid waste management are lacking in many countries. Making solid waste management professionals with in-depth 3R knowledge is the responsibility of the academia.

Table 2 Snapshots of typical academic curricula on waste management

Course Title	Content
Solid Waste Management	Waste Generation Characterization Quantity Public Services, Collection and Transportation Recycling Biological Decomposition Selected recycling issues Thermal Treatment Landfill
Waste Reduction and Recycling	Principles of composting Process design to maximize methane production Phytosynthesis in waste treatment Biochemical reactions in waste-fed fish ponds Functions of aquatic plants Land treatment of wastewater Land treatment of sludge Application and utilization of reclaimed products Research and development needs; Case studies
Solid and Hazardous Waste Management	Municipal Solid Waste Management Collection and Transport of Solid Waste Hazardous Waste Management Hazardous Waste Treatment and Design
Environmental Pollution	Introduction to Municipal Solid Waste Management Sources, Storage, Collection & Transport of refuse Processing techniques

Institutionalizing 3R in a systematic manner and developing independent businesses on recycling involves specialized knowledge and skills beyond conventional solid waste management. Engineering, science and management education needs to increasingly include 3R and waste management. If not in all disciplines, dedicated academic courses producing specialized 3R technologists, and waste managers in targeted domains such as environmental and industrial studies are to be introduced. In essence, present academic curriculums should be revamped by introducing theories, principles, practices and technologies on 3R and waste management to change common perceptions – from grime to green.

The probable effects of integrating 3R in academic curriculum differ largely. A 3R curriculum in a school could make possible changes in the minds of children which could eventually reflect in their lifestyle as they grow and also in their homes. It is easy to change young minds than grownups. The common psycho-social factor of resistance to change is a major barrier to 3R and could be overcome only through educating children.

Integrating 3R in academic curriculum at colleges and universities has both direct and ripple effects. The direct effects could be a possible change in the attitude of consumption

and disposal in all walks of life. The other face of this is the ripple effect they could cause in their chosen professions, be it engineers or policymakers.

With the inherent differences in the role of different stakeholders to 3R, no "one-size-fits-all" approach could be adopted for capacity building and education activities. Tailor made capacity building activities are vital to see 3R come through the society. There isn't a single 'best' way to design a capacity building program. The curriculum and learning methods have to be matched to specific goals and the characteristics of the participants (IBRD 2008).

In 3R implementation, it is essential to observe the differences in the training and capacity building requirements for the diverse stakeholder groups. A conventional approach might not be able to provide the correct picture of the role of the stakeholders in implementing 3R at the local level. A stratified perspective with the real position of the stakeholder in 3R is essential to understand the training and capacity building needs. Figure 1 presents the stakeholders connected to 3R at the local level in different layers. This does not mean that the other stakeholders do not have a role to play, but they rather play a catalytic and supportive role. Everyone on earth has their role in 3R as citizens of the earth. It is only their profession that makes the difference in not being included as a core stakeholder.

The reasons for the move towards 3R are obvious and there is no real need to reemphasize it. However, it is essential to demonstrate the broader rational for capacity building and education for 3R. The following are some of the simple reasons why capacity building and education should be done with a real, on-the-ground perspective.

- Understand and appreciate the value of materials and their lifecycle costs
- Move people from being a part of the solid waste problem to be a part of the resource solution
- Understand, interpret, analyze and appreciate benefits of international treaties and conventions
- Understand, adapt and adopt technologies in the right context and manner
- Enable small-scale and informal recyclers do their jobs in a safe way taking into account occupational health and safety issues
- Including waste management costs in pricing of products so as to reflect disposal cost concerns and as an economic tool to promote 3R

Capacity building is a blanket term that could take different meanings in a broader context including developing human skills by imparting knowledge and raising awareness levels ultimately providing the ability to make informed decisions, be it a simple domestic purchase or the formulation of national policy. It is essential to break this blanket view into different components as below and look at each stratum individually to meticulously understand the needs.

Capacity Building – Federal government and policymakers, municipal authorities
Education – Citizens and the communities
Training – Waste handlers

2.2 Capacity building needs for federal governments and policymakers

The prime role of federal governments in 3R implementation is through policymaking and national strategy formulation. Several initiatives through various multilateral organization and international cooperation programmes are already underway to this effect (UNCRD 2004). The present approach in capacity building seems to be appropriate. However, aspects mentioned below need to be considered more seriously so as to enable federal governments and policymakers to make needs-based policies. At present, policies in most countries arise out of pressure from external agents rather than the realization of their need.

To overcome this and to provide, long-term visionary policies on 3R it is essential to include the following aspects.

- Environmental concerns, mainly on natural resource constraints and waste disposal issues
- Need to move towards 3R stemming from issues on natural resources and waste generation
- Multilateral Environmental Agreements, their pros and cons in a developing country context
- Understand, interpret, analyze and solve issues related to waste such as trans-boundary movement, suspected hazardous nature of wastes etc
- Formulating new 3R policies and reformulating existing policies to reflect 3R, taking into account both local and global, needs and constraints
- Integrate 3R into the existing solid waste management system
- Benefits of encouraging source segregation, community-based waste management and recycling
- Polluter Pays Principle, Precautionary Principle and importance of market based instruments in 3R implementation
- Details of Extended Producer Responsibility, Eco-labeling, Corporate Social Responsibility, and Green Purchasing
- Importance of private sector participation in waste management services

2.3 Capacity building needs for urban / municipal authorities

Unlike Federal Governments and Policymakers, Urban / Municipal Authorities are the sect of a country's administration directly dealing with solid waste and 3R. Their role in 3R implementation is often confined to implementation of day-to-day activities rather than policymaking, with the exceptions of some countries where local governments have their own policies. In most cases these policies are guided by the policies of the federal government and do not differ much. In any case the mere nature of Urban / Municipal Authorities' role in 3R implementation warrants them to be technically exposed to the following aspects:

- Environmental concerns, mainly on natural resource constraints and waste disposal issues
- Need to move towards 3R stemming from issues on natural resources and waste generation
- Role and importance of Material Recovery Facilities
- Conduct demonstration/pilot scale 3R projects
- Recognition of small-scale recyclers and including informal sector waste collectors in main stream waste handling
- Practices in recycling plastics, metals and glasses
- Technologies for biological treatment such as composting and anaerobic digestion
- Simple forms of market based instruments and skills to implement a Pay-As-You-Throw system, waste fees and charges
- Implementation of product take-back, deposit-refund systems
- Handle complaints and issues related to hazardous and special wastes in municipal waste streams

2.4 Training needs for waste handlers and recyclers

Among the stakeholders of 3R, the next sect is the Waste Handlers and Recyclers. This sect includes, the crews of private sector waste management companies and

municipalities, informal waste collectors, small-scale recyclers, junkshops, itinerant buyers and rag-pickers etc. In essence, this includes all those in direct contact with waste and need to be trained on the following aspects:

- Practices in recycling plastics, metals and glasses
- Value of materials and simple practices for segregation of recyclables and non-recyclables from biodegradable
- Act as messengers for 3R where door-to-door collection is practiced
- Necessity to segregate waste at the source and not mix the waste where it is segregated
- Personal protection and safety against hazardous materials in waste streams

2.5 Education needs for citizens and the communities

The bottom most and broadest layer of the 3R stakeholder, playing a crucial role in 3R, are the citizens and communities. Evidently, these are the origin of waste and needs to be carefully educated in implementing 3R. Unlike the other stakeholders where they are a mere driving force or vehicles of 3R, here the results could be achieved only with the fullest cooperation of citizens and communities. Moreover, it is this group of the stakeholders who could play a key role in implementing the first of the 3Rs, Reduce. In most cases, implementing 3R becomes a matter of purchase decisions at the household level and hence needs to be addressed carefully. Ample information to guide purchase decisions reflecting 3R is available on various media. However, a basic sense of 3R could be inculcated only by educating citizens and communities on the following aspects:

- Cooperating with waste management services, whether private sectors or municipalities
- Paying for the service they receive in accordance with regulations
- Making their waste available to the collecting agency in the appropriate way
- Segregating the waste at the source based on the requirements of the collection agencies
- Cooperating with policies and programs that seek to minimize waste generation at the source
- Utilizing appropriate services for special waste categories such as construction and demolition debris, high risk healthcare wastes, hazardous household wastes and bulk wastes
- Insisting on product take-back and deposit-refund systems
- Cooperating with community / regional level recycling programs
- Technologies for biological treatment such as home composting of kitchen waste
- Details of Extended Producer Responsibility, Eco-labeling, Corporate Social Responsibility, and Green Purchasing
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2.6 Role of regional organizations

Evidently, 3R in developing Asian countries cannot be visualized without the presence and push of regional organizations, private sectors and academia. Nevertheless their roles have, until recently, been promotional in nature. This does not mean that their contribution in 3R implementation has been undervalued or unvalued. Overall, these stakeholders have been tasked with the objectives of taking 3R to the top brass of the countries to gain their support. The present situation has drastically improved convincingly with countries acknowledging and accepting 3R as a proactive means of waste management and natural resource conservation. National strategy development and policy formulations /

reformulations are rapidly progressing and will soon reach the desired level for full scale implementation of 3R.

At this stage, it is essential to prepare the ground for implementing 3R. This preparation essentially entails raising awareness levels and imparting knowledge through, capacity building, education and training of relevant stakeholders. Regional organizations could play indispensable roles in mobilizing knowledge resources, assisting in technical tours and providing financial support for deserving countries and communities in conducting capacity building, education and training programmes. For example, the United Nations Centre for Regional Development (UNCRD) has been supporting countries such as Vietnam, Indonesia and Bangladesh in National 3R Strategy formulation.

3.0 Conclusions and recommendations

The role of 3R and the need for the shift towards 3R are clear in the context of developing countries. The present system of education focuses mainly on waste collection, treatment, disposal and is often only a part of the graduate academic curriculum. Training programs focus more on theoretical approaches not considering the ground realities and possibilities. Capacity building programs for policymakers and government officials are more oriented towards other emerging issues and very few are conducted on proactive measures such as 3R.

Given the shortfalls of the current situation it is now essential to turn the problems of waste management into an opportunity through 3R. Relevant measure should be taken to realize the benefits of being a sound material cycle society than just a linear chain where material flow is unidirectional; from production, through consumption to final disposal. In this venture, it is inevitable to develop aggressive capacity building, training and education programmes to suit the diverse needs of the stakeholders. An undeniable need to offer specialized courses on 3R at all levels of education, schools, colleges, graduate programs, and certificate courses for practitioners and policymakers exists. Creating dedicated workforce (division of labour) and imparting knowledge (nurturing specialization) can be achieved only by offering specialized courses and conducting targeted capacity building, educational and training programmes. Present academic curricula on solid waste management have to be revamped to cover 3R as a productive solution. Introducing such academic curriculum, in due course, will bring in changes to foster solid waste management and 3R under dedicated departments and ministries.

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