ESTABLISHING DISPOSAL SITING MECHANISM TOWARDS A SUSTAINABLE INDUSTRIAL WASTE MANAGEMENT IN THE PHILIPPINES

R. P. RAMOS*

***** School of Geography, Planning and Architecture, Department of Geographical Sciences and Planning, University of Queensland, Brisbane 4072, Australia***

ABSTRACT: Proper disposal of toxic and hazardous industrial wastes (THIW) is a challenging effort confronting the less developed countries. In the Philippines, industrial THIW disposal is becoming a pressing issue due to the lack of workable policy framework coupled with insufficient infrastructures to counteract THIW's long-term effects to human health and the environment. This paper focuses on the existing management mechanism in handling THIW in the country as guided by the Toxic Substances and Hazardous Waste and Nuclear Waste Control Act of 1990. Treatment and disposal are becoming critical components of the THIW management hierarchy due to current restrictions towards "incineration", unavailability of acceptable land surface disposal facility, and the "ad-hoc approach" in the disposal site selection process in the country. A Three-Level Disposal Siting/Screening Criteria System was formulated based on existing literature and validated using a participatory process. In addition, an exploratory discussion on the utilization of computer-based spatial support systems such as Geographic Information Systems (GIS) coupled with multi-decision making evaluation techniques for further validation of the siting criteria is also presented.

Key words: toxic and hazardous industrial wastes (THIW), land surface disposal, geographic information system (GIS), disposal siting, nimby (not-in-my-back-yard), nimtoo (not-in-my-term-of-office), whiffy (we-hide-it-freely-for years), spatial decision support system

1. BACKGROUND

Past environmental disasters and industrial accidents like the Exxon Valdez tanker accident, Love Canal, Times Beach, Minamata Bay, and Bhopal chemical accident (Enger & Smith, 1998; Topolski, 1998; Smith, 1990; Wentz, 1989) are proofs of the consequences of improper handling of toxic and hazardous industrial wastes (THIW). These past events contributed in tightening environmental regulations which caused a major economic burden to many industries worldwide (Topolski, 1998). Over the years, awareness towards proper management of THW is increasing, thus changing from 'end-of-pipe approach' to 'cradle-to-grave approach'. To this end, the current emphasis is more on preventing and minimizing the production of THIW in all of the industrial processes adopting the 'pollution prevention hierarchy' (DBP, 1999; Enger & Smith, 1998; Bahu et al., 1997). This approach involves: waste reduction at source, waste recycling, waste treatment and waste disposal. In this hierarchy, however, will not eliminate all wastes from all production processes but rather offers a more cost-effective means of minimizing the generation of wastes (Soesilo & Wilson, 1995). Moreover, incineration and land disposal are the common methods for disposing THIW (Enger & Smith, 1998), and disposal by land is the last resort - wherein all other options or strategies have been exhausted.

Being a developing country, the Philippines is facing tremendous pressures from both the public and the industrial sectors on how to manage the ever-increasing generation of THIW. Industries are concerned on the final disposal of their wastes after undergoing pre-treatment processes on-site, while communities' fear on the other hand, is the health threat and environmental risks from illegal dumping of untreated and residual wastes. To address these issues, the Republic Act (RA) No.6969 or the Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 was implemented, supported by other existing environmental laws and regulations such as: the Environmental Impact Statement System of 1978, Pollution Control Decree of 1976, Clean Air Act of 1999 or Republic Act No. 8749, and Ecological Solid Waste Management Act of 2001 or RA No. 9003 (Ex Corp. & Kokusai, 2001) to regulate the storage, treatment and disposal of THIW in the country. Specifically, RA 8749 deliberately prohibits or bans burning/incineration of industrial wastes, while RA 9003 discouraged open dumping and imposed penalty on unacceptable disposal practices and facilities (Ramos, 2003). These government policies put more burdens to the waste generators, aside from not having a centralised disposal facility. Thus, waste generators are forced to throw their industrial THIW to waterways and other environmentally sensitive areas, and municipal sanitary landfills. Aside from not having a land surface disposal facility, the existing environmental laws do not provide legal framework and guidelines for disposal site selection of THW in the country (Ramos, 2003).

2. CURRENT GENERATION AND MANAGEMENT OF THIW

It is expected that the Philippines generates from 232,306 tons per year to 355,519 tons per year in 2000, 509,990 tons per year in 2005 and 659,012 tons per year in 2010. This projected total THIW production has a 184 percent increase over the 15-year period (Entec, 1996). The JICA study in 2001 revealed that one-third of the industrial waste generators are located in the Southern Tagalog Region, with nearly 28 percent of them concentrated in the National Capital Region (NCR) or Metro Manila (MM) as presented in ***Figure 1***. In terms of type of THIW generation, inorganic chemical waste has the highest percentage share of 25% generation, and followed by alkali waste of 20% (Ex Corporation & Kokusai, 2001).

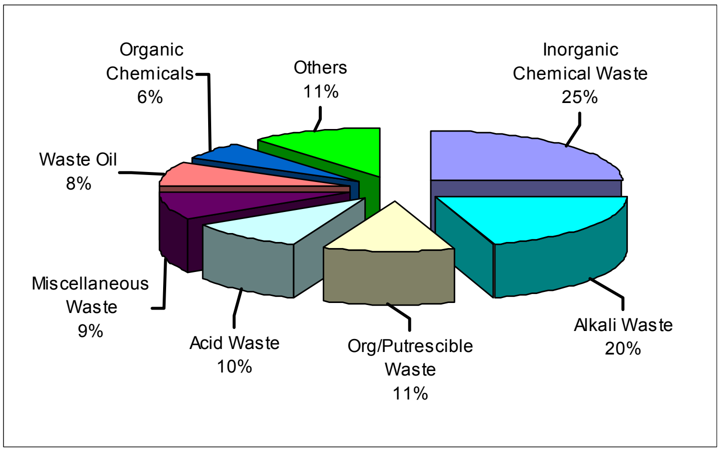

Figure 1. Percentage Composition of THIW Generation

It is also estimated that the annual generation of THIW from the registered industrial waste generators amounts to 280 thousand tons, wherein 50 percent is recycled or treated on-site, 13 percent is managed by haulers/treaters, and the remaining 37 percent is stored on-site and off-site or illegally dumped elsewhere (Ex Corporation & Kokusai, 2001).

It is observed that due to the limited capability for recycling and treatment for waste acids, waste alkaline, waste oils, and sludge containing heavy metals, industries are facing tremendous efforts for managing such wastes (Ramos, 2003; Ex Corporation & Kokusai, 2001). Reduction, segregation, and recycling at source are barely being implemented by the industrial waste generators for some reasons: inadequacy in resources (manpower, financial and technical), unavailability of recycling equipment/facility, existing recycling processes are not suited to the type of THIW generated, and avoidance from accidental spillage during handling and recycling. Thus, most of these industrial waste generators are dependent on the services offered by accredited haulers and treaters to do such recycling (Ramos, 2003).

The generated THIW are treated either off-site or on-site prior to final disposal. Large volume of THIW, particularly from the semiconductor and electronic industries are treated on-site to reduce the volume and cost for final treatment and disposal, while the rest are treated off-site by the accredited haulers and treaters. The final treatment processes employed by these recognized and accredited haulers/treaters include but are not limited to encapsulation, incineration, chemical fixation, neutralization, oxidation, chemical precipitation, ion exchange and compaction (Ramos, 2003). Industrial waste generators store the treated THIW inside their premises, since there is no available final land surface disposal facility in the country. Some of them will always adopt the WHIFFY (**we-hide-freely-for-years**) attitude – bury or dump their wastes illegally due to lack of storage capacity and to avoid from any government penalty for noncompliance.

In response to the emerging THIW problems, the Philippine government has decided to prepare a master plan. Two phases of study are completed in 2001 and 2002 to materialise the plan which aimed to provide an integrated approach in dealing with THIW, particularly in CALABARZON Area and nearby industrialized zones. The first phase of the study aimed to improve the institutional framework of managing such wastes, and to establish potential sites for landfill development. The second phase of the study aimed to develop a model THIW treatment facility to be constructed in one of the top potential sites identified in the previous phase of the study (Ex Corporation and Kokusai, 2001/2002). Unfortunately, the studies have failed to establish a system or framework that is legally accepted on how to identify potential sites in the country.

3. NATIONAL CONTROL SYSTEM

The present planning and management of THIW in the country is guided by five major instruments namely: legal and policy framework, institutional and regulatory framework, administrative systems/procedures, technical, legal and logistical support services, and financial and economic instruments (Ex Corp & Kokusai, 2001). The effectiveness and efficiency in managing THIW is solely dependent in the proper implementation of these major abovementioned instruments, and other driving mechanisms that need to be in place.

Republic Act (RA) No.6969 was enacted and implemented through DENR-DAO No.29, series of 1992 or the Implementing Rules and Regulations (IRR) of the Act. RA 6969 or the "Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990". The Act regulates the generation, transport and disposal of toxic and hazardous wastes from industries, businesses and medical institutions; and provides a mechanism to prevent the adverse impacts of improper toxic and hazardous wastes management to human health and the environment. RA 6969 defines toxic and hazardous wastes as "*substances that present either short-term or long-term environmental hazards which do not have any safe commercial or economic usage transported for dumping or disposal or in transit through any part of the territory of the Philippines*" (Ramos, 2003; DBP, 1991).

The existing listing of THIW categories is currently being reviewed for reclassification by the government for easy compliance of the waste generators. The reclassification is based on the characteristics of the hazardous substances present in the wastes; and the type of processes and facilities that generate such wastes (Ramos, 2003; Ex Corporation & Kokusai, 2001).

The passing of Clean Air Act or RA 8749 magnifies the problem of not having a land surface disposal facility. It creates tremendous pressure for both the waste generators and the government to address the problem. The Act expressly bans incineration as a method of treating industrial wastes, including medical and infectious wastes. In spite of the ruling of the Supreme Court to allow incineration or so called "thermal technology" as a treatment and disposal method, it is still a challenge for the industries to meet the air emission standards set by the government which the existing incinerators could not be able to comply with. In addition, the implementation of RA 9003 or the Ecological Solid Waste Management Act of 2001 gives another burden to the waste generators by imposing penalties for unacceptable disposal and treatment practices and facilities, as well as discouraging open dumping.

Moreover, there are proposed bills under review aimed to improve the present condition of THIW management, as well as to strengthen the existing policies, and to propose a realistic and workable framework towards environmental protection. However, these abovementioned laws and regulations do not identify provisions for proper disposal siting development mechanism for THIW (Ramos, 2003).

The Philippines is one of the signatories of the Basel Convention on the Transboundary Movement of Toxic and Hazardous Wastes, including the Montreal Protocol on Ozone-Depleting Substances, and the Rotterdam Convention on Prior-Informed-Consent (PIC) Procedures for Banned and Severely Restricted Chemicals and the Persistent Organic Pollutants (POPs). These agreements give more pressure to the Philippine government to come-up with a workable mechanism to address the issue of THIW importation (Ramos, 2003; Ex Corporation & Kokusai, 2001).

As cited by Ramos (2003), the THIW management in the country is not moving towards sustainability for several key reasons: insufficient and lack of enforcement of environmental laws and regulations, lack of awareness and the management systems of generators, and limited technical and financial capacities of haulers and treaters (Ex Corporation & Kokusai, 2001). In addition, these problems are aggravated by other issues: (a) unavailability and affordability of appropriate and alternative treatment technologies to incineration (burning technology), (b) absence of a centralised land surface disposal facility, and (c) lack of regulatory instruments for siting of disposal areas.

3. ESTABLISMENT OF LAND SURFACE DISPOSAL FACILITIES

One of the solutions for the current issues and problems is to come up with a mechanism or framework on proper conduct of land surface disposal siting. There is a need to establish sets of site selection or screening criteria for identifying potential sites that could be utilized for final storage, treatment and disposal of THIW. Most of the disposals siting initiatives have been solely dependent on the interpretations of the consultants or study teams/groups. This shows the "ad-hoc approach" of the site selection process.

Ten candidate sites were identified in the Entec Europe Ltd study in 1996. The result was validated including the nine additional candidate sites identified in the 2001 JICA Study. Out of the nineteen sites, six potential sites were short-listed adopting a different set of siting criteria from that of 1996 study. It is common that the initial site selection is based from the criteria set by the study teams. The criteria used include (a) existing land use - designated for industrial use, (b) proximity to public utilities and infrastructure (i.e. electricity, water and roads), and (c) level of groundwater or well water for drinking purposes (Ramos, 2003; Ex Corporation & Kokusai, 2000; Entec, 1996).

Out of the nineteen candidate sites, there are six short listed sites using exclusionary criteria namely: (a) environmentally sensitive areas, (b) areas prone to calamities, and (c) socially sensitive areas. These short listed sites are evaluated for social evaluation (compatibility with other policies, neighbourhood characteristics, and land acquisition); and technical/environmental characteristics based on location and accessibility, infrastructure availability, climate and hydrology, geology and hydrogeology, and environmental sensitivity (Ramos, 2003; Ex Corporation & Kokusai, 2000; Entec, 1996). The evaluation tools or methodologies adopted in the siting processes are combination of "checklist method" and "scoring method" which have shortcomings on the reliability of the results. In addition, it can be observed that the criteria in the initial site identification from previous studies vary considerably in terms of the importance rating and ranking for each criterion. Thus, there is a need to establish a standardized set of site selection or screening criteria to ensure the effectiveness of the initial identification of potential sites for disposal, and eventually to come up with realistic and convincing results.

Locating suitable sites is always a major challenge faced by both the government and the private sector due to NIMBY attitudes among the communities and the political leaders' NIMTOO attitudes. Failure in land disposal siting is contributed to by lack of financial support, appropriate siting methodologies and public acceptance. The NIMBY attitude or public opposition is considered a perennial problem that leads to failure in the THW siting and implementation. Strong local opposition derives from either an inappropriate or incomplete siting analysis or the public's misunderstanding of the siting procedure (Ramos, 2003; Kao, et al, 1997). As cited by Ramos (2003), public participation is an integral part (Wentz, 1989) and an essential ingredient during the early stage of planning and prior to the start of the site selection process (Badilla-Ramos, 2000). Site selection is the initial stage and the critical aspect of the land surface waste disposal development which requires proper planning to reduce administrative cost and lower the degree of disapproval from the constituents or even to prevent the project being rejected (Ramos, 2003).

Establishing and standardizing site selection or screening criteria are necessary to validate the results of the previous studies which ensure the effectiveness of the initial identification of disposal sites. In addition, a spatial decision support model is required to assess the suitability of the identified land using a technical and decision making tool that will facilitate stakeholders' interaction.

4. THREE-LEVEL SITE SELECTION/SCREENING CRITERIA SYSTEM

The system is consists of three levels of criteria: Exclusionary Criteria, Inclusionary Criteria, and Site-Specific Criteria (Ramos, 2003; Cahill & Holman, 1981) as shown in ***Table 1***. The development of this system is derived from consultation with various stakeholders to minimize NIMBY attitude, particularly among the affected communities where the disposal facility will be located.

The first level of the site selection/screening system deals with the exclusion of unsuitable areas. This is an elimination stage of undesirable areas due to their sensitive features which may cause threats to the environment and public health if a surface disposal facility is built on these areas.

The second level involves the identification of favorable physical conditions of the study sites appropriate to locate the proposed THIW surface disposal facility. Unlike with the first level, this level singles out potential sites based on the criteria identified above. The sites that demonstrate favorable and suitable outcomes from the first and second levels of screening will be evaluated under the third level. The last level of siting emphasizes on more detailed site investigation which narrow down potential sites into more desirable areas for final selection.

Table 1. Three-Level Site Selection/Screening System

LEVEL	CRITERIA
I	**Exclusionary Criteria**
• Hydrological Characteristics • Geological Characteristics • Flooding and Erosion Conditions • Other Environmentally Sensitive Areas	
II	**Inclusionary Criteria**
• Land Use and Ownership • Location of Existing Treatment, Storage and Disposal Facilities • Location of Existing and Proposed Municipal Landfill Sites • Location of Proposed Radioactive Repository Sites • Transportation Network • Sources of THW • Location of Identified Contaminated Sites • Location of Existing and Abandoned Mining Sites	
III	**Site-Specific Criteria**
• Hydrogeology • Biological Consideration • Transportation Network • Archaeological Significance • Climatic Condition • Comprehensive Physical Development Plan • Ecological Consideration • Social Consideration • Economic Consideration	

Source: Ramos, 2003

Furthermore, a spatial decision support siting model as shown in ***Figure 2*** is also recommended to enhance the validation of the three-level site selection/screening criteria. This model utilizes geographic information systems (GIS) as computerized techniques making the decision making process faster, efficient, cost effective, realistic and allow the development of networks, participation and a sense of ownership for all stakeholders (Daniel, 2003).

4. CONCLUSION

This paper examined the present mechanism in managing of THIW in the Philippines. It aimed to develop and establish a disposal site selection/screening system which could be adopted to improve the current disposal siting practices in the country. The Three-Level Siting Criteria System presented in this paper could be utilized to validate existing criteria employed in the previous studies. The system could be the basis for the standardization of siting criteria to identify potential sites for land surface disposal facility development and other related siting projects in the country such as transfer stations, incineration system, low-radioactive repositories, recycling plants and other locally unaccepted land uses (LULUs) . Furthermore, a spatial decision support siting model using Geographic Information Systems (GIS) techniques is introduced to assess the validation of the three-level siting system and eventually encourage an integrated approach in disposal siting promoting participation and ownership among stakeholders.

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THE AUTHOR

RAMOS, REYNALDO PEREZ
MPhil Candidate
Department of Geographical Sciences and Planning
School of Geography, Planning and Architecture
University of Queensland, Australia 4072

Mailing Address: Unit 311, Bldg. 3, BLISS II, Sikatuna Village, Quezon City, Philippines
Phone Number: +63 2 259 7287
Email address: s4015642@student.uq.edu.au
: reynaldoramos_98@yahoo.com

Figure 2. Conceptual Analytical Spatial Decision Support Disposal Facility Siting Model