CHAPTER TWO

Municipal Solid Waste Compost

2.1 Characteristics of Municipal Solid Waste in Sri Lanka

According to the description of the term, MSW, it is the non liquid waste material generated by public and private sectors through households, commercial establishments, agricultural activities, industries and institutions (Farrell and Jones, 2009; Ministry of Environment and Natural Resources, 2002). In addition, waste that is produced in public places and owned and managed by local authorities is also considered in this category. Description of waste generated in each sector is given in Table 2.1.

Table 2.1: Sources and Types of Municipal Solid Waste in Sri Lanka

Source	Description
Household	Waste generated from domestic activities, including food preparation, cleaning, fuel burning, yard sweeping, gardening, and miscellaneous household waste (e.g. old cloths, appliances etc)
Commercial	Waste generated by trade, service, processing, and some production enterprises
Markets	Waste from markets selling a high proportion of vegetables, fruits, meat and/ or fish
Institutions	Waste from schools, other education centres, hospitals, central and provincial government offices and religious institutions
Industries	Waste from various industries, including light and heavy manufacturing, fabrication, construction sites, power and chemical plants.
Construction and demolition	Waste originating from construction, rehabilitation and demolition activities etc. Typically they are used as clean fill at other sites or in low-lying areas.
Hazardous	Hazardous waste originating from various sources, including household items (batteries, spray cans etc). The management of sharps, clinical waste, body parts and highly infectious waste from hospitals is a major concern in the country.

Source: Adopted from Abeysuriya, 2007; NSWMSC, 2008

According to (Bandara, undated) composition of MSW of Sri Lanka typically includes very high fraction of perishable organic material which is about 65 – 66% by weight with moderate amounts of plastics and paper and relatively low contents of metal and glass. Composition of MSW generated in some selected cities of Sri Lanka is given in Table 2.2. Long term bio degradable items that takes about 2-3 months for degradation and short term biodegradable items that degrades within 2 months period are categorized under organic wastes.

Table 2.2: Municipal Waste Composition in Selected Cities in Sri Lanka

MSW Compositions (%) of Selected Cities in Sri Lanka (2002)							
Cities	Biodegradable (Short Term)	Biodegradable (Long Term)	Plastics	Metal	Wood	Glass	Paper
Batticaloa	46.79	10.61	8.26	2.90	17.12	2.20	16.45
Colombo	68.15	11.63	6.69	1.85	5.02	1.64	5.99
Galle	41.76	20.25	8.23	4.79	11.18	4.33	9.41
Jaffna	54.85	8.62	7.21	8.49	5.58	2.21	12.80
Kandy	54.83	17.95	4.02	4.46	6.36	5.35	11.08
Matara	56.81	18.60	6.90	3.07	5.78	2.07	8.50
Nuwara Eliya	60.53	9.73	8.46	2.12	8.92	2.90	8.72
Polonnaruwa	35.52	25.10	8.47	3.57	7.63	3.68	16.04
Trincomalee	27.98	20.06	4.33	12.51	22.04	1.85	18.04

Source: AIT,2004 (Cited in Bandara, undated)

2.2 Potential Markets for MSW Compost

Garcia *et.al* (2005) have evaluated the potential of decomposed MSW as an animal feedstuff and concluded that after heat treatment of 65°C for 20 minutes the waste material is effectively sanitized and suitable for animal consumption. However, MSW derived compost will not be of much use as animal feed since it almost certainly unable to eradicate Transmissible Spongiform Encephalopathies (TSE) and other zoonotic diseases present in the material. Even this waste material is safe enough to be used in animal feed production it will not be accepted by society (Farrell and Jones,2009).

Therefore, land application is the largest potential use of compost produced from MSW. Soil organic matter (OM) which is identified as rapidly declining in soils, mainly in arid environments of the world is a key soil quality indicator. Many studies have proved that MSW compost has the potential of at least transiently increase soil OM content and soil biological activity (Akram et al, 2009). Additional benefits provided by MSW compost include reduced erosion losses, improved structural stability of soil and decreased bulk density which will increase its water holding capacity, cation exchange capacity (CEC), and infiltration of water and air in heavy soils. (ibid).

Shiralipour *et.al* (1992) have identified agronomic and horticultural sector with a large potential market for MSW derived compost. By now MSW composting is being encouraged in many countries of the world and researchers have experienced the benefits of using MSW compost in the field (Porkhrel, 2005; Abigail, 1998; Barth and Kroeger, 1998). Many studies have shown that by adding reasonable amount MSW compost it could be used as a valuable source of plant nutrients (Table 2.3). The organic matter in compost also acts as a relatively long-term reserve for major nutrients such as nitrogen, phosphorous, and potassium.

Table 2.3: Typical Nutrient Content of MSW and Other Composts

Compost Type	pH	EC	OM	$NO^-_{3(mgkg^{-1})}$	NH^+_4	Total N	C:N ratio	P	K
MSW				71[a]		11	16	2817	3390
MSW				122[a]		14	12	3281	5559
MSW	7.9	7.0	33			14	9	5000	4100
Pruning Waste	8.1	0.2		16	8.27	10	33		
Mature Compost	7.2			2372	510	25	12		

All data in mg kg^{-1} dry mass unless otherwise stated.
EC indicates electrical conductivity and OM indicates organic matter
[a] Total mineral nitrogen,i.e.NH^+_4 + NO^-_3
Source: Farrell and Jones,2009

MSW compost is being used by landscapers while planting shrubs and trees to backfill individual planting holes. They use a mixture of 25 to 50 percent of compost and native soil for that purpose. However, composts with higher soluble salt contents should be applied at lower rates. Municipal compost mixtures are commonly used in repairing divots on golf courses. Further, municipal composts can be used to rebuild or repair poor soil in rough areas, parks, and other non specified turf areas and to stabilize slopes. Compost with a larger particle size (1/2 inch) is often combined with soil stabilization mats or netting and later they are over-seeded with native grasses to control erosion, especially along highway right-of-ways (Dickerson, 2010).

MSW derived compost also can be used to remediate brownfield sites, land that has been earlier used for industrial purposes or commercial purposes. One example is landfill capping after closure. However, due to health and safety concerns, using MSW derived compost for restoration schemes with possible public access such as housing schemes should be avoided until further field evaluation trials are completed to evaluate the benefits and environmental risks posed by using MSW compost in comparison to other substrates used for restoring non contaminated land(ibid). Municipal composts can be applied to new landscapes at a rate of up to 50 dry ton/acre (2,296 lb/1000 ft^2). Rates vary depending on the soluble salt content of the compost. After rough grading, the compost should be incorporated into the existing soil to a depth of 6 to 10 inches (Gouin, 1995).

2.3 Current Concerns on MSW Compost

However, certain research studies report mixed results as well as negative impacts of using MSW compost for agriculture and horticulture use. Mamo *et.al* (2005) by studying the growth of maize on a MSW compost added loamy sand soil has come up with increased soil water holding capacity without greatly increasing the estimated plant available water within the soil.

There are concerns regarding overloading of soil by heavy metals and other pollutants by long term use of MSW derived composts (Deportes, 1995). According

to a three year field trial conducted in Punjab, Pakistan to evaluate the environmental and economic impacts of MSW compost applications to rice-wheat and cotton-wheat cropping systems, though all treatments with MSW compost have shown significant improvement in soil physical property the trial has not resulted statistically significant increase in OM content for any treatment. For the two types of treatments, MSW compost and fertilizer applications, the levels of DTPA extractable (plant available) heavy metals has increased in the top layer (Qazi *et.al*, 2009).

Logan et.al (1999) has reported occurrences of organic toxins in MSW compost. These are highly chlorinated toxic organic compounds that are known to be persistent in the environment (Muir and Howard, 2006). Feedstock with pesticides, household wastes such as oils and solvents and paper products due to printing ink are said to contribute organic toxins to MSW derived composts (Epstein, 1997).

Due to reaching of partially decomposed MSW compost to farmers, plant roots get damaged due to excess ammonia, organic acids, and other phytotoxic chemicals. The compost must be mature enough before utilizing for agricultural purposes. However, it is still possible to add immature compost to farming fields if added well in advance to planting.

2.4 Experiences of Composting Projects Implemented at Local Authority Level

According to past experiences, composting projects implemented by local authorities have many social benefits such as reducing health problems, improving scenic beauty, reducing environmental pollution, generating job opportunities while producing alternatives for chemical fertilizer (www.environmentlanka.com /sympo, 2010).

However, they have encountered problems related to transportation of waste, lack of space and limited facilities in compost yards, receiving mixed wastes, limited facilities for final disposal and lack of public commitment due to rigid attitudes and lack of knowledge (www.environmentlanka.com/sympo,2010). Odour is one of the major problems in MSW composts and it is due to the release of sulfur compounds such as hydrogen sulfide, methyl mercaptan and methyl sulfide in the early stages of composting. However, with maturity these sulfur compounds decrease (Basnayake, 2001).

The issues faced by the composting project of Kandy city were reported as existing practices; extreme fragmentation of regulations and enforcement; lack of funds, reluctance to impose new taxes or fees, vacillation as to who should conduct the management of solid waste - the government or the private sector; identifying how they can benefit from NGO and Foreign Government aid programs; and deciding if there should be a single unified national solid waste management system (www.bvsde.paho.org/bvsacd/iswa2005/cities). According to Japan International Corporation Agency (JICA), most composting operations have failed due to inadequate attention paid to operation and proper equipment maintenance by the local authorities and embarking on the venture with the misconception that all waste treatment costs can be recovered by the sale of compost.