Management of Urban Organic Solid Waste Applied in Romanian Metropolitan City

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This paper explains the interest in urban organic solid wastes, the relevance of these wastes to municipal solid waste management, the main ways in which organics are reused, and the problem that arise from the wish to ensure safe and effec-tive reuse as part of sustainable development in cities in Romania. Wastes are substances resulting from biological or technological processes that can no longer be used as such, some of which are reusable. Dangerous substances are any substance or product which, when used in apparently non-hazardous quantities, concentrations or conditions, presents a significant risk to humans, the environment or material goods (eg explosives, oxidizing, flammable, toxic, harmful, corrosive, irritant, mutagenic. Urban administrations nowadays are seeking ways to divert organic wastes from municipal solid waste streams for a variety of reasons, as noted below. Recommenda-tions are made for separation at source so that safe composting can be carried out. Private companies are being encouraged to undertake composting, often via forms of public-private partnerships. More attention is being paid to the role of non-govern-mental organizations in promoting citizen awareness of organic waste issues, and co-operation with separation at source. This paper draws attention to the many informal ways that organic wastes are currently reused, which are rarely taken into account in official plans for managing organic wastes.

Keywords: organic, environment, waste, products, damage, management,

Since the mid - 1980s it has been recognized that waste, as with other environmental problems, is a global issue [1]. New EU regulations on waste management issues transposed into national laws have improved this sector, but, the population access to such services is still low compared to others new EU members [2]. Waste is now not only a danger to the environment, but it is increasingly a threat to human health and the way of life. The Article 8 of the Sixth Action Programmed sets down proposals relating to the sustainable use and management of natural resources and waste [3]. *Environmental protection is the obligation and responsibility of central and local public administration authorities, as well as all natural and legal persons* (art. 6 of O.U.G.195/2005).

According to experts it can be stated that *the first benefit of waste recycling is that it creates job opportunities for many people involved in the waste management process such as waste collectors* [4].

The nature and uses of urban organic solid waste have been discussed and researched from a number of disciplinary and policy perspectives: Food, Fuel and Fertilizer from Organic Wastes (NRC, 1981), a pioneering book with a technological orientation, reported on research in the context of the late 1970's concern about limited world resources. The World Bank Water Supply and Sanitation section set up the Integrated Resource Recovery Programed in the early 1980s. Environmentalists' interest in urban waste recycling developed at the same time. An interest in low-cost techniques prompted the documentation of organic waste reuse by WASTE, a Dutch consulting foundation [5-6]. The accelerate economic growth and operating cost are the main driving forces put pressure on waste production, change in composition analysis and overuse of land area. As state factors are the emissions and the environmental pollution which cause impact on human health and biodiversity [7]. Epidemiologists and water and sanitation experts initiated health risk studies.

Experimental part

Materials and methods

Measuring progress towards sustainable development is part of the strategy and Eurostat has to draw up every two years a report based on monitoring the Romania set of indicators of sustainable development. Eurostat has published three reports to monitoring the strategy: in 2007 and 2015.

These information sources are detailed in the text, but the main ones were the 8 Regional Plans for Waste Management and the National Statistic Yearbooks, 2011-2015 [8].

It is based on literature in the field and the ideas belong the authors who synthesized the main aspects in a critical manner.

Results and discussions

The main problems facing urban areas today are agricultural waste, sewage and municipal solid waste. However, few studies have been conducted on the utilization of urban waste for composting and/or animal fodder, and none of them has been implemented in a sustainable form [9].

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Everyday waste consists of 45% food waste, 24% plastic, 7% paper and 6% iron. Approximately 95-97% of waste collected is taken to landfill for disposals. Wastes which

The waste composition consists in organic waste (bio waste: food waste and garden waste, generated in gardens and streets from plants and grass) which represents the fraction with the major percentage (approximately 50%) followed by paper and cardboard, plastic, glass, metals [10].

Remain are sent to small incineration plants, or diverted to recyclers/re-processors or is dumped illegally. Actually, only 5% of waste is recycled, however the government aims to reach a ceiling of 22% in terms of waste recycled by 2020 [11].

Waste collection and recycling is a success business in Romania. Investments in equipment which are not currently encouraged only by the availability of EU funds, but is equally a necessity given the lack of capacity to meet EU recycling by 2017. The companies invested significant amounts in waste recycling in Romania, especially in equipment, transport machines and installations.

Romania still has fixed the issues concerning waste recycling, although it is better situated than other states (table 1).

Companies focus on the development of solutions in accordance with European legal framework in order to avoid landfills that are poorly managed and producing adverse effects on the environment.

The big companies specializing in waste recycling comply with the legislation in force and looking for ways to be efficient and environmentally friendly, so that they can be closed illegal landfills.

Industrial waste management includes materials recycling and recovery, storage, final storage, incineration, composting, etc. The share of these options is on average approximately the same every year: storage, about 81.0%; capitalization for 15.0%; temporary storage 3.3%; incineration, about 0.7% [12].

For this strategy can be implemented successfully, the following actions are needed:

- Improving soil quality, waste management and reduce the number of historical polluted areas (table 2);
- Development of infrastructure for waste management in urban centres;
- Development of infrastructure in terms of water supply and wastewater collection followed by treatment in rural and urban;
- Reduce polluted water with cleaning agents and elimination of water pollution by hazardous substances.

Waste landfill storage is the most important way of eliminating industrial waste, with more than 80% of the generated waste being stored each year. Thus, over the years, a very large amount of waste has accumulated in existing landfills.

Most industrial landfills are simple (usually concreted platforms); there are also a large number of mining tailings dumps and tailings ponds. Most industrial landfills (approximately 76%) occupy relatively small areas of land (up to 5 ha).

Only 30% of industrial warehouses have operating licenses. The rest works without authorizations, many of which are located improperly and are not controlled warehouses. For example, 34% of industrial deposits are located in urban areas, and 6% of industrial deposits are located on the shores of watercourses (table 3). Only 60% of the warehouses are outside the localities [13].

At present, a city-born novel generates, on average, about 346 kg of household waste per year (plastic, metal, cardboard, glass, food, etc.), while rural people produce, up to 3.5 times less, or about 95 kg of household waste per year. Of this total, recyclable waste accounts for about

Country	Landfilled waste (kg/capita/year)	Country	Incinerated waste (kg/capita/year)
Germany	3	Bulgaria	0
Netherlands	14	Romania	0
Belgium	21	Poland	1
Sweden	21	Czech Republic	36
Austria	86	Hungary	38
France	185	Great Britain	53
Poland	239	Italy	67
Czech Republic	243	Belgium	162
Romania	284	Austria	180
Italy	286	Germany	192
Great Britain	324	France	194
Hungary	341	Netherlands	200
Bulgaria	388	Sweden	240

Source: Eurostat, 2009. (Online), Available at: http://epp.eurostat.ec.europa.eu

Table 1
WASTE LANDFILLED AND INCINERATED

No	Priority Axis	EU Investment [euros]	National Public Contribution [euros]	Total Environmental Investments [euros]
1	Extension and modernisation of water and way ewer system	2.776.532.160	489.976.263	3.266.508.423
2	Development of integrated waste management	934.233.079	233.555.770	1.167.778.849
3	Implementation of adequate infrastructure of natural risk prevention in most vulnerable areas	171.988.693	42.997.174	21.4985.867
4	Technical assistance	130.440.423	43.480.141	173.920.564

Source: Sectorial Operational Programme "Increase of Economic Competitiveness" 2007-2014

Table 2
BREAKDOWN OF FINANCES BY PRIORITY AXIS 2007-2014

Municipal waste	Quantity of waste - million tonnes-2014	Quantity of waste - million tonnes-2015	Quantity of waste - million tonnes-2016	(+/-%) 2016 versus 2014
Household waste collected:	6.76	7.28	7.02	3.9
-in the mixture	6.68	6.88	6.90	3.3
-from the population	4.77	4.66	4.61	-3.3
-from economic agents	1.91	2.21	2.29	19.9
-separated	0.08	0.41	0.12	40.6
Public service waste	1.18	1.31	1.27	7.8
Construction waste/ demolition	0.85	0.62	0.62	-27.7
Total municipal waste collected/ un-cleaned	8.79	9.21	8.91	1.3
Household waste	1.95	2.11	2.70	38.3
Total municipal waste generated	32.97	34.69	34.44	4.5

Table 3
MUNICIPAL WASTE GENERATED AND COLLECTED BETWEEN 2014 AND 2016

Source: National Agency for Environmental Protection (NAPH)[14].

39% of the city, and 52% of the rural area, and about half of them are packaging.

Of the total industrial landfills, at least 50 have no environmental protection facilities, and most are just fenced. Some warehouses have one or more special arrangements (waterproofing, drainage, guarding channel, monitoring drilling), but very few have all the facilities to meet the necessary conditions for environmental quality protection.

Slag dumps and thermal power ash are the most numerous warehouses:

-waterproofing with mineral substrate,
-drainage system for leachate collection,
-dams for stability,
-groundwater drilling drills,
-Surface spraying systems.

Also in some chemical and metallurgical landfills there are drying or batting beds for different types of sludge, which are designed with water protection arrangements.

The counties with the most hazardous industrial waste dumps are: Prahova (7 warehouses), Alba, Arges and Vaslui (6 warehouses) and Timis (5 warehouses).

The largest areas are occupied by the following hazardous waste sites:

-tailing ponds at Sodium Govora Plant (168 ha),
- slag heap / ash from Sidex Galati (100 ha),
- Upsom Ocna Mures tailings pond (92 ha).
-industrial warehouse Turnu Magurele (62.3 ha)

Table 4 presents the list of hazardous substances contained in household wastes.

The gravity of this problem lies in the fact that these wastes are stored, which calls for specific, very severe protection measures.

The presence of hazardous components in urban waste limits the possibility of recycling because of the danger of contamination.

It must be emphasized again that the organization of solid waste management differs significantly between rural and urban centers in terms of sources, composition, storage, and collection. Various studies have shown major sources of solid waste in urban Romania in an order of domestic, commercial (including institutions), and industrial, respectively [15-18].

The domestic sources include single family and multiple families and low, medium, and high apartment's dwellings. The commercial sources are stores, restaurants, markets, office buildings, hotels, motels, print shops, auto repair shops, medical facilities, and other institutions; while industrial constitutes construction, fabrication, light and heavy manufacturing, refineries, mining, and power plant demolishing [10]. Besides, the domestic remains the highest source of solid waste in the rural areas in Romania. According to the author Oteng-Ababio [19], this is followed by the industrial sources. Waste management practices, especially the solid waste, differ significantly for developed and developing countries, for urban and rural areas, and for residential, commercial, and industrial producers [20].

For instance, in Romania, urban domestic waste collection services are often provided by local government authorities or by private companies for a fee while the rural residents dump their solid waste on open dumping sites for free [21].

This is as a result of the general assumption by various governments that the rural people do not have the purchasing power to pay for the solid waste disposal services. However, the repercussions of this act are mostly

No.	The name of the product	The type of accidental substances contained
1.	Plastic pesticides	Organoleptic compounds, organic solvents, PVC
2	Medicines expired paintings	Chlorinated compounds, phosphorus compounds
3	Battery	Solvents and organic wastes, traces of heavy metals
4	Petroleum products metals	Heavy metals, pigments, solvents, organic residues
5	Skin	Heavy metals, acids, other chemicals
6	Textiles	Oil, heavy metals, trace catalysts, phenols, acids, solvents, etc

Table 4
HAZARDOUS SUBSTANCES PRESENT IN HOUSEHOLD WASTES

Source: Boateng S. Factors influencing solid waste management in Romania [Mphil thesis] Lambert Academic Publication; 2015 [15].

immeasurable as the open dumping methods create unsightly scenes which degenerate into various poor environmentally related diseases such as malaria, typhoid, and cholera. This makes the current environmental sanitation status of Romania serious as less than 40% of urban residents are served by a solid waste collection services, less than 30% have acceptable household toilet facilities, and only about 10% of solid wastes generated are properly disposed [15-18].

Urban organic solid wastes include not only the organic material in municipal waste streams, but wastes generated by gardening, urban agriculture, park and road mainte-nance, livestock keeping, food processing, tanning, and the like. Although human excreta are also organic wastes, they are not usually covered in discussion of waste reuse in solid waste management and are not included in this discussion [22-26]. The gener-ators can be classed as bulk generators of raw wastes (such as green markets, parks, stables, slaughterhouses), bulk generators of processed wastes (such as food processing industries, large hotel/institutional kitchens), and small generators of raw and processed wastes (such as households). Most of the organics in waste streams are generated by kitchens in the course of daily living.

It is the organics that are put out for general collection and so are mixed in the solid wastes that most concern managers. Interest in controlling the organic fraction of waste streams (which typically comprises from 35%-70% of total waste generated in large cities of developing countries) has a long history. Composting and reuse tech-niques (including use for animal feed, fuel and construction) have been documented in Africa and Asia, going back hundreds of years. The interest in urban organic solid waste has become more general, however, in the context of environmental thinking about waste reduction, strategic planning for solid waste management and greenhouse gas emissions [27, 28]. The amount of waste generated each year by European countries is steadily increasing, reaching more than 2000 million tons, of which about 200 million tons of household waste, as much as the annual urban waste streams in the US, i.e. about one-fifth of the annual amount of urban waste globally.

Assessing the rate of waste generation is difficult, given the lack of accurate and severe monitoring in some countries [29].

A study by the World Bank shows that this rate is two or three times higher in industrialized countries than in developing countries, the main feature being discussed is moisture by chemical composition and origin. The study shows that the informal solid waste management sector contributes significantly to the productive use of waste materials. It can implement recycling activities at a much lower cost than the formal sector (table 5).

Thus, Western European countries, compared to Eastern European countries, produce a large amount of solid waste, both industrial and urban, the latter being a large proportion of packaging materials for consumer goods (packaging) and in a proportion low organic, biodegradable.

Two thirds of urban waste is the household waste. It is estimated that more than one billion tons of household waste is produced annually.

They have a variable composition, depending on the level of economic development (table 6).

In Romania, the separate collection of municipal waste for the recycling of recyclable materials from household waste (paper, cardboard, glass, metals, plastics) is practiced to a small extent at local level in pilot projects initiated by companies sanitation and mayoralties, in cooperation with economic operators who place packaging and packaged products on the market. These projects are being carried out in collaboration with the housing associations (for the population), schools, institutions and economic agents and are constantly expanding according to the results obtained and the available funds.

Quantitative significance is also the preventive waste from construction and demolition as well as ash and slag in the district heating system, where solid fuels are used.

In contrast to industrialized countries, the composition of solid urban waste in developing countries has high proportion of plant debris and a low percentage of paper and non-food items.

A particular category in the solid urban waste composition is hazardous waste, such as used auto batteries, electrical equipment and used electronics (especially mobile phones, computers - so-called e-deck, i.e. *cyber-waste*), harmful elements, respectively lead, mercury, chromium, biphenyl ether etc. and which are particularly characteristic of industrialized countries where their accumulation has an annual growth rate of 18%.

The increased volume of solid urban waste is a difficult issue for local governments. At urban level, the major difficulty is the collection and disposal of huge amounts of waste as well as the cost of related services.

Urban authorities allocate between 20 and 30% of the local budget for the collection and disposal of solid urban waste. In the structure of these costs a high percentage,

Table 5
CHARACTERISTICS OF SOLID URBAN WASTE ACCORDING TO THE LEVEL OF INDUSTRIALIZATION

Characteristic	UM	Poor countries developed	Countries medium developed	Countries industrialized
Waste generation rate at source	Kg/person/day	0,4-0,6	0,5-0,9	0,7-1,8
Moisture	Kg/m³	250-500	170-330	100-170
	%	40-80	40-60	20-30

Source: National Agency for Environmental Protection (NAPH) [14].

Table 6
THE COMPOSITION OF SOLID HOUSEHOLD WASTE ACCORDING TO THE LEVEL OF INDUSTRIALIZATION

Composition	UM	Poor countries developed	Countries medium developed	Countries industrialized
Paper	%	2	14	31
Metal	%	2	2	8
Plastic materials	%	2	11	8
Glass	%	4	2	10
Textiles	%	7	14	5
Vegetation	%	60	47	27
Other	%	22	10	13

Source: National Agency for Environmental Protection (NAPH)[14].

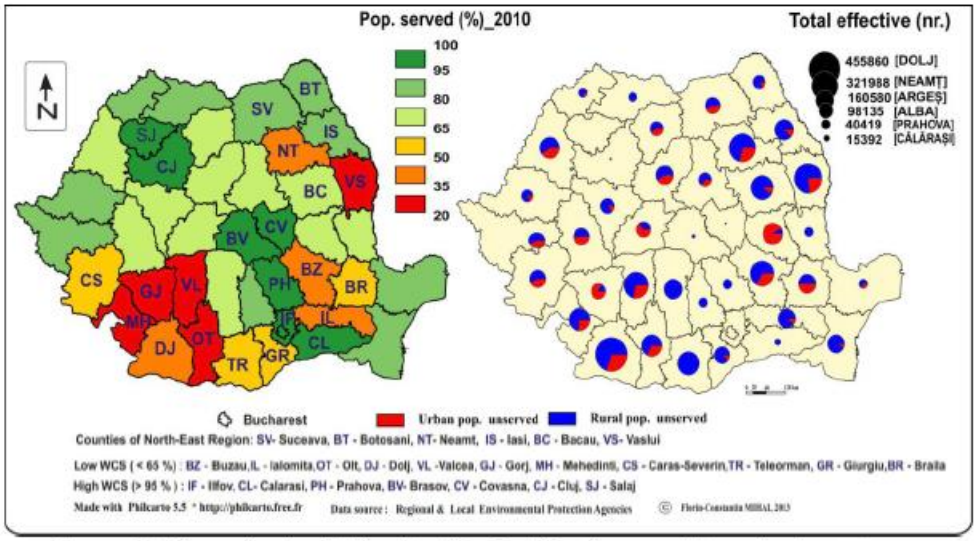

Fig. 1. Total population access to waste collection services in 2010 [2]

about 70%, represents transport costs from the initial storage site to the final storage as well as for the acquisition and management of the actual landfills.

The poor access of population to formal waste collection services in 2010 is explained by the lack of proper waste management facilities in rural areas of Romanian counties (Vaslui, Neamt, Buzau, Dolj, Olt, Teleorman, Giurgiu and Mehedinti). These services from urban areas have a lower coverage (concerning the number of inhabitants served) than rural areas as follows: Vrancea, Gorj and Sibiu counties or similar values among urban and rural areas such as Braila and Hunedoara (fig. 1).

All these have repercussions both on factors involved in solid waste management and on the population that should benefit from local government services. Along with the increase in population incomes, the authorities' competence to regulate waste collection for as many private households and commercial activities increases, increasing the share of collected solid waste at the same pace.

In parallel with the official solid urban waste management system, it is imperative to have a *waste economy* that involves recovery and recycling/recycling.

The environmental policy, related to the domestic waste of many industrialized states, develops a series of management options consistent with a *waste economy* and refers to:

reduce sources of pollution;

- recovery and reuse of used products;
- recycling of materials included in used products
- proper disposal of household waste to landfills and/or ecological landfills;
- Incineration of waste products (those that cannot be reused or recycled) and energy recovery embedded.

Incineration, through the risk impact it induces, is a way of *distance* trans boundary transport of urban solid waste, in the form of gaseous pollutants, which contributes to the amplification of global pollution.

Table 7
EVOLUTION OF URBAN WASTE PRODUCTION IN ROMANIA

Years	Quantity mil. tone	Indices of products	
		Kg/place/an	Kg/place/day
2014	6.8	254	0.70
2015	6.7	356	0.97
2016	5.9*	366	1.00
2017	5.4*	336	0.92

** without the city of Bucharest*

Regarding the sludge problem from water treatment, overcoming the major impediment in their recycling involves the separation of domestic and industrial waste water [30-32]. This recycling requires sewage treatment plants with sludge decantation and its recovery for bio-production (table 7).

In relation to the urban population, Romania is a country with average production of urban waste. As far as their production index is concerned, it can be compared with Western European countries (1 kg/person/day). Within the structure of these wastes, the major share is held by household waste from dwellings, institutions and various other entities.

Over 90% of the amount of urban waste in our country is stored in special city facilities. In 2009 there were 303 such deposits, representing 25% of the national deposits, which occupy approximately 1236 hectares, approx. 9% of the total landfill area for landfilling at national level. Of these deposits, 30% are destined for simple household waste, 10% for city sludge from water treatment, the rest being mixed deposits for both household and industrial waste, usually non-hazardous.

Domestic waste resulting from the domestic activity of the inhabitants consists of debris from the preparation and consumption of food, packaging, newspapers, cartons, textiles and old damaged objects.Percentage of household waste at Bucharest level (table 8).

More or less legally, hazardous waste is also accepted in municipal landfills. The mixture of these types of waste can lead to the production of a leachate loaded with harmful substances which, through infiltration, pollutes the surface and underground waters, and thus implicitly affects the state of health of the population in the area.

Of the total urban deposits, 87% are located outside the cities, 6% on the waterfront, and the remaining 7% are

Table 8
HOUSEHOLD WASTE COMPOSITION - GLOBAL AND FOR BUCHAREST

Type of waste	Percentage content	
	Global	City of Bucharest
Paper	13.8	3.46
Plastic materials	11.0	1.60
Metal	2.5	1.59
Glass	5.5	2.20
Textiles	3.2	2.10
Miscellaneous	6.4	58.65
Humidity	Unknown	30.30

Sources: National Agency for Environmental Protection (NAPH)[14].

Name	Symbol	U.M.	Information source	
			I.S 1	I.S 2
Carbon	C	%	10,253	11.90
Hydrogen	H	%	1,386	1.49
Oxygen	O	%	9,060	11.92
Nitrogen + Sulfur	N+S	%	0.072	0.07
Ash	A	%	21,808	19.72
Total humidity	W_t	%	57,439	54.90
Lower calorific power	H_i	kJ/kg	2330	2650
		kcal/kg	556.5	633.0

I.S. 1 [33] and *I.S. 2* [34]

Table 9
ELEMENTAL ANALYSIS AND INFERIOR CALORIC POWER ARE DOMESTIC WASTES IN ROMANIA

located within the localities. Also, 40% of these deposits do not benefit from environmental protection facilities. At the level of Bucharest, household waste is the household waste, commercial waste, domestic sludge, and building and demolition waste and used domestic products.

It is characteristic of Bucharest Municipality that it has an area of 228 km^2 and has a population of 2,064,464 inhabitants (density of 9,055 inhabitants per km^2), and a number of 109,194 dwelling buildings, respectively 726,987 dwellings.

The household waste producers are: the population, the associations of tenants, the collectivities (schools, hospitals, hostels, hotels, and crèches), agro-food markets, etc. The solid waste generation rate is 1.2 kg/inhabitant/day, globally 3,600 – 3,800 t/day, of which paper and cardboard 122 t, glass 360 t, plastics 110 t etc.

Solid household waste, low-moisture solids or high moisture scraps suffer a specific and variable degradation process, from a few months (food scraps, paper) to decades (metal, glass, plastic).

Waste in sanitary units' forms a special category in household waste, not by their chemical nature, but also by the risk of their microbiological infections, requiring special detoxification-sterilization.

Public road waste (187,300 t/year) is quantitative and compositional variable depending on season, pavement type, vegetation/asphalt coverage. Generally, they are solid biodegradable waste.

For the proper management of urban waste, it is important to know not only the quantity produced, collected and discharged by storage, but also their characteristics, both depending on the choice of the medium/long-term disposal or storage solution. Collection methods practiced in Bucharest are applied through specialized service units - Rasub, Adp, Remat or interested economic agents. Frequency of collections, variable, is: daily for collectives, bi-weekly for the blocks very high for the city center, weekly for blocks with less than 10 floors and 10 days for individual households.

In order to solve the problems related to the disposal of household waste, the draft National Waste Management Strategy provides for the construction of 41 new warehouses by 2010, respectively a minimum of one deposit in each county. Also, the establishment of 56 new deposits by 2016.

Industrial waste degrades soils by:

- industrial waste halls blocking large land plots that become unusable;

- unreasonable location causing accidents. Example: sterile sliding;

- spread of oil on land in extraction and processing areas through river waters;

- ash halls from the non-ferrous metal industry containing toxic heavy metal urns (Cu, Zn, Cd, Pb), sulfur dioxide and arsenic. Example: From a sulfuric acid plant of 100,000 tons/year capacity, it results at the same time 200,000 -300,000 tons/year of black ash for the storage of 2-3 ha of land.

The old soda-making method (Leblanc), which produced high amounts of non-qualitative calcium sulfide which, oxidized and washed by rain, polluted air and toxic gas (H_2S and SO_2), the technology abandoned today (Table 9).

The approximate energy value (E) for individual waste materials can be determined using the equation:

$$E\ (J) = 145C + 610\ (H\text{-}1/8\ O) + 4S + 10N$$

where: C - carbon (% by weight), H - hydrogen (% by weight), O - oxygen (% by weight), S - sulfur (% by weight) and N - nitrogen (% by weight).

In the fight against soil pollution, municipal solutions are preferred to the issue of urban or technological sanitation in the case of industrial waste.

The soil is subject to air and water pollution, being the meeting point of the pollutants:

- Airborne dust and toxic gases dissolved in the rain return to the ground.

- Infiltration waters impregnate the soil with pollutants, trained to the depths

- Polluted rivers infect flooded or irrigated surfaces.

The efficiency of citizenship education in favor of environmental protection is the most ingenious technical solution to remedy pollution. Municipal and industrial wastes should be managed according to the solid waste management hierarchy for healthy environment (fig. 2).

For the evaluation of the waste management system, the three criteria selected include different indicators [35] (fig. 2):

-economic criteria (C1): economic indicators (costs (C.1.1), benefits (C1.2), market prospect of products (C1.3), land requirement (C1.4)),

-Environmental criteria (C2): environmental indicator (acidification (C2.1) eutrophication(C2.2), climate change (C2.3), human toxicity (C2.4), photochemical ozone formation (C2.5), wastewater (C2.6), water consumption (C2.7), noise pollution (C2.8)).

-Technical criteria (C3): technical indicators (existing experience reliability (C3.1), adaptability to local conditions [35].

Waste hierarchy does not attempt to assess environmental impacts for a waste management system and does not take into account any local conditions which may significantly change the environmental consequences [35].

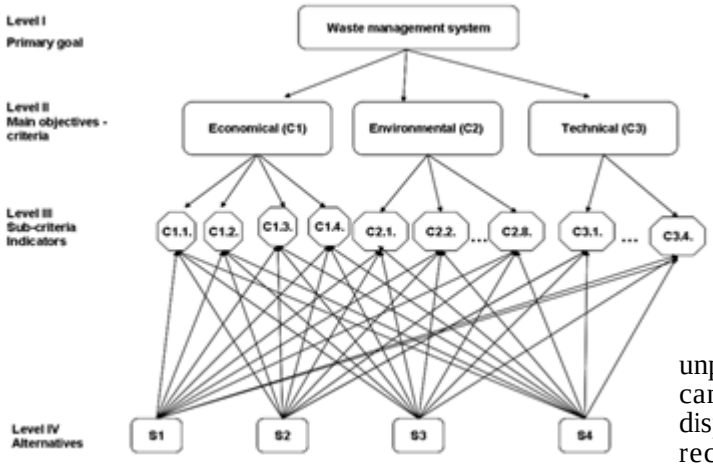

Fig. 2. Proposed hierarchy for municipal solid waste management system [35]

Conclusions

There are a lot of recommendations that can be deducted from the experiences described above. We only want to focus on some points that are primarily addressed at decision-makers, but require partnerships with other stakeholders like donors and NGOs, private enterprises etc.:

-Analyze the informal solid waste management activities, its linkages to the formal solid waste management system and its impacts

-If significant informal waste management activities exist, foresee strategic measures for the inclusion of these activities in National Solid Waste Management Strategies, laws and regulations

- Involve representatives of the informal sector in local solid waste management planning processes.

The per capita waste generation is 0.29 kg./person/day in all the zones of the city. It seems to be slightly lower than that of the earlier studies (0.46-0.5 kg./person/day) [14] and higher than the recent study of the Municipality. Recent study by Romania Metropolitan City also shows the low rate of waste generation (0.225 kg./person/day) (KMC/KVMP 2001). The low per capita waste generation may be due to the increase in household sorting of paper and bottles at the point of generation since they are easily sellable. The per capita waste generation is found to be the lowest in the core zone and highest in the outer zone. It was also found that segregation practices are the highest in the core zone relative to other zones. Thus, the low per capita waste generation in the core zone may be due to the household sorting of waste more intensively in the core zone than in other zones. This may also be true because the core zone people have been facing the waste problem since a long time whereas the outer and middle zone people have open space and have no problem of waste disposal. Thus, as there are more open space people usually generate more and vice versa. In the core zone households, which are not participating in the door-to-door collection system, are managing their wastes mostly by throwing it on the streets. Whereas in the middle and outer zones the majority households are managing their wastes either by burying or burning on their land. They also prepare compost within the compound. The waste component relationship shows that size of the household and income are the major factor determining the total quantity of the waste in all the zones. It was also found that education has a negative effect on waste generation.

Recycling waste can be considered as the cornerstone of the entire environmental issues, including giving it some solutions on the conservation of natural resources and energy, and in terms of maintaining a healthy and unpolluted environment in all aspects. At the same time, it can keep part of the present natural resources at our disposal to aid recycling. In this context, Romania has recovered a large gap with the advanced European countries, both in terms of legal framework and especially, behaviors and attitudes that are to be improved and adjusted to European practice in the field.

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