CHAPTER 1. THEORY

1.1 Principles of urban ecology

1.2 Definition of parameters

Ecological condition

Urban ecosystems

Air

Water

Land cover

Human health

1.3 Waste

Waste definition

Waste emission

Leachate

Local impact of waste emission

Global impact of waste emission

1.4 Waste management

Waste generation

Waste storage at the source

Waste collection

Waste transfer and transportation

Final disposal

1.5 Summary of parameters


DIVISION DE EDUCACION CONTINUA

1.1 Principles of urban ecology

Urban ecology, which in German is known as Stadtökologie, embodies the idea that humans influence the natural environment in their cities. This theory originates from the "biology notion of the interaction of living things and their environment" in times were cities were not considered a study field for ecologists, biologists and environmentalists (Marcotullio et al., 2003, p. 39). This belief emerges from the natural sciences domain in European countries and was put forward by scholars who wanted to demonstrate that humans living in cities had similar interactions with nature as plants in their own ecosystems by using the principles of ecology (Collins et al. 2000).

The idea that cities were indeed ecosystems also provided the possibility to re-examine cities and to add other components to biotope and ecological interpretations (Sukopp, Wittig, 1998). Namely, studies regarding human behavior and its impact on the natural environment, and explorations on urban growth and its influence on the transformation of land can be included as an extended study format under the concept of urban ecology.

Waste placed in cities

Opposite page

Plants growing on a pile of discarded computers in Morelos

Sukopp and Wittig and offer two definitions of urban ecology:

1- Biological standpoint.

Urban ecology is a branch discipline of ecology and deals with biocenosis, biotopes, ecosystems, their organisms, and the conditions of their habitats, as well as structure, function, and history of urban ecosystems (1998, p.2).

2- Integrated standpoint.

Urban ecology in its broader sense is an integrated field of research of scientists from various fields and of planning with the goal of improving quality of life and a long lasting ecologically sound urban development (1998, p.2).

These statements are somewhat different from the views of Chicago scholars such as Park and Burgess who have developed a sociological approach based on the views of space competition and social characterization. They suggested that cities were environments similar to nature, influenced by different forces. One of them is the competition of different groups for physical space and the distribution of individuals in different "colonies". The authors compare "natural areas" to "areas of population segregation". Their definition of human ecology is expressed as " a study of the spatial and temporal relations of human beings as affected by the selective, and accommodative forces of the environment" (Park, Burgess, Mckenzie, 1925).

With time both European and American views have approached says Sukopp, leaving however a certain degree of skepticism among those who prefer to search for answers in undisturbed habitats such as mangrove swamps. The study of human behavior as an integrated social and ecological phenomenon and not as a factor of disturbance is a task attributed to few ecologists, despite strong evidence showing the influence of humans on the natural environment (Collins et al.,2000). Indeed, people consume fossil fuels for transportation and development processes which have great influence in gas emissions; people multiply and migrate, which plays a role in the changes of land use and typology of land cover; people produce waste which has been proven to be a major environmental issue worldwide. In that sense, cities should be considered as a "laboratory where ecological change can be viewed at close hand" (ibid., p1).

1.2 Definition of parameters

The framework on which this study shall be based are those of urban ecology viewed as an integrated sphere of actions, putting a particular emphasis on the preservation of natural habitat both for humans and other living species. The definition of terms should therefore not only embody a biological component but also include elements reflecting the human factor.

Ecological condition

EPA
Established in 1970, EPA represents the United States Environmental Agency. It is considered a reference point for many researchers in the field of environmental protection

According to the Environmental Protection Agency (EPA), the term ecological condition (under a biological perspective), refers to the structure of the natural environment, namely "its physical, chemical and biological characteristics and the processes and interactions that connect them" (2007, p.28). Among ecologists, the term is broad. It includes a wide range of concepts with numerous scientific ramifications. The principles of biodiversity, natural conditions for living organisms, ecological processes are all related components.

Urban ecosystems

An essential attribute of ecological conditions is the ecosystem. An ecosystem is a community of living organisms and inert matters in a location. The term was first coined by English ecologist Arthur Tansley in 1935 who proposed the term "ecosystem" to define the interaction of living creatures in a specific physical setting (Breuste et al, 1998). In other words, the ecosystem constitutes the environment in which we live in and upon which we depend on. It includes plants, animals, microorganisms, soil, rocks, minerals as well as water and air.

The size of ecosystems varies and scientists also stress their connection to one another. When fragmentations occur due to human activities or natural occurrences, "the habitat is broken up" (EPA 2000, p. 29). This

causes much of the environmental stress that is widely commented nowadays, as the ecosystem fails to support groups of living organisms (ibid.).

The term "Urban ecosystem" which has appeared in an array of written documents on urban studies in the last years, conveys the impression that cities are indeed ecosystems (Douglas, 1983). There are several types of studies on the subject; one of them is oriented toward understanding the city as an organic matter. It views the urban sphere "a consumer and digester of resources and creator of waste products" (Marcotullio et al 2003a, p.5). Solutions to tackle challenges of air pollution, water and soil contamination emerge from taking the metabolic processes of cities into account. In this sense, researchers focus on the interaction of systems in cities rather than the study of specific problems.
Another line of research extends urban ecosystem analysis on a global scale. Research along these lines includes the work of authors such as Sassen as well as Rees and Wackernagel who have suggested the interconnection of cities, extending therefore their urban borders (Marcotullio et al, 2003).

Air

The condition of air is critical to the health of humans and animals as well as plants and other living organisms, as it provides nitrogen, oxygen and carbon dioxide necessary to sustain life. It has his origin in the late 16th century in the French word *aire* and it is described in the Oxford American Dictionary as an "invisible gaseous substance surrounding the earth, a mixture mainly of oxygen and nitrogen" essential for breathing (2005).

The sources, types and effects of air pollution are known and can be monitored. Scientists look at the emissions sources that release pollut-

ants into the air and their effects on the natural environment. Some kinds of air pollution can be perceived or detected by humans, others cannot. Pollutants can be transported long distances and are measured as concentrations of ozone, sulfur dioxide, nitrogen dioxide, particular matter and carbon monoxide among other components. Scientists have proven that a high concentration of all the above causes discomfort such as eyes irritation and respiratory problems (Porteous, 2000).

A large body of data is available on the air contamination and its consequences in ecological systems. Particular emphasis is given to outdoor and indoor air, as well as greenhouse gases.

In high levels of the atmosphere the ozone shield protects the earth from solar radiation. According to the Intergovernmental Panel on Climate Change (IPCC), the depletion of the ozone layer is known to cause health problems and changes in the composition of plants. In addition to those studies, explorations are undertaken on the connection between the ozone depletion and global warming due to the emission of gases. Table 1 provides an outlook on the causes and effects of pollutants in the air.

Table 1. Outlook on causes and effects on pollutants in the air

focus	Source	consequences	impact
outdoor air pollution	human activities electricity production, industrial processes, and transportation	threat to human health	local/global
	natural causes wildfires and wind-blown dust.	lost of species	
acid deposition (wet or dry)	fossil oil burning	increase in acidity of soils causing harm to fish, amphibians, water birds, and other species	local
regional haze or dust	solid suspended due to desintegration of matters	visibility issues	local
ozone depletion	substances include chlorofluorocarbons (CFCs)		global
greenhouse gases	energy emission, industrial processes, and transportation	heat retention in the atmosphere, climate change	global
indoor air	households activities(cooking, cleaning, smoking)	threat to human health	local

Goudie, 2001

Water

A significant element of life is water. It fills oceans, rivers, and lakes, and can also be found in the ground and in the air. Water sustains plants and animals and has multiple uses as drinking water, for irrigation purposes, fishing, and for production and recreation. Water is a "conveying medium" as it transports waste and slurries, and also a "heat–exchange medium" as it is utilized as a solvent and for heating purposes (Porteous, 2000, p.664).

The debate on water resources these days centers in its condition and capacity to sustain both ecological needs and human life for the generations to come. People and ecosystems are affected by the extent and condition of water resources (EPA, 2007). Dow and Downing report a substantial gap in the amount of water utilized in different countries. Based on several evidences, the authors stipulate that regions and communities in developing countries lack the infrastructure to effectively manage their water supply while, territories reporting high industrial activities use and have more water (2006).

Water linked to human health
surface water
ground water
drinking water
recreational water

Water is categorized as surface or ground water. It circulates above and below the surface of the Earth. Most water resources are connected. The condition of a particular water stream can affect other water bodies. Scientists are able to assess the quality of water through biological indicators; they look at the behavior of animals and plants in the water which are sensitive to pollutants and hostile environments. The most important physical characteristics are water depth, flow and transparency among others. The chemical attributes are acknowledged by assessing the acidity and oxygen level (EPA, 2007).

Land cover

Land is not covered of water as opposed to oceans. (Oxford American Dictionary, 2006). It provides food to people and serves as shelter for a large number of animal species. Resources such as minerals and petroleum are found in land, water is stored and filtered through land and materials are decomposed in land (EPA, 2007). Moreover, land supports housing buildings, industries and transportation. It hosts not only a large variety of vegetation but also qualities which humans appreciate when being in nature.

Albedo
reflectivity of land and the amount of solar radiation that it receives

The issues surrounding land are related to its use or changes in its use. A majority scientists agree that changes in land use, whether human induced or by natural alteration, affect the distribution and nature of land cover. Specifically, it can lead to "erosion, water runoff, sedimentation and flooding" (EPA, 2007, p.18). Goudie comments "Land use changes create differences in albedo which have important effects on the energy balance of an area" (2001, p.86). He also suggests that variations in land use can also cause alterations in "the moisture content of the atmosphere" (2001, p.88).

Land cover is comprised of vegetation and other materials, (rock, grass, paved streets), located on the top layer (soil) of the land's surface. It is a major indicator reflecting the condition of environment in which we are embedded. Environmental reporters expose several aspects influencing land cover (EPA 2007). Humans create some of them, such as demographic changes, industrial and urban developments, and waste production.

Human health

Defining human health has raised several debates in the past. It is either considered too broad a field to be measured effectively, as has been the case in definitions which include factors of living conditions such as working, household state and nutrition level, or to narrow when the definition is limited to "the state of being free from illness or injury" (Oxford American Dictionary, 2006). The conclusion that experts from the World Engineers' Convention on Environment, Climate and health have developed is that any valid definition of health should reflect "social influences of the different respective cultures and societies" (Eikmann et al. 2000, p.6).

The health condition of a group of individuals can be measured in many ways. EPA experts suggest that life expectancy and death rates are useful indicators. They give a signal of trends in the overall well-being of a locality and can provide information on possible local environmental hazards.

Environmental protection is a cornerstone of human health sustainability. Increasing news on health issues due to "anthropogenic environmental contamination" raise safety concerns around the world (Eikmann et al 2000, p. 5). The World Health Organization within the United Nations (WHO) highlights several physical, chemical and biological risk factors that have an influence on people's health and death. They are for instance air pollution, local and global environmental hazards, water and sanitation issues (2007). The abundance of literature for policy makers reflecting on the provision of clean drinking water and adequate sewage disposal suggests that water and sanitary issues as key services, which can influence the conditions of life.

Other associated risks that can affect health conditions are the collection, processing and disposal of waste. Most refuse produced by humans as such do not have the potential to affect people and other living creatures; however when large amounts of waste are concentrated and poorly managed other situations carrying an element of danger to human health may occur. The following section introduces the concept of waste and its relation to the ecological conditions of urban built environments.

1.3 Waste

Waste definition

A quick look at definitions of waste in media and printed documents reveal that waste is considered an unwanted good that is no longer useful or desirable. In the German Waste Act of August 1993 waste is defined as "a portable object that has been abandoned by the owner" and also as an "orderly disposal garbage" (Bilitewski et al 1994, p. 21). The Framework Directive on Waste in the United Kingdom states that waste is a substance and/or object that is discarded by its owners. This statement is followed by 16 waste categories that are currently in force (Porteous, 2000). The Mexican view on waste, expressed in the General Waste Amendment of October 2003, refers to a material or product that owners or holders discard, which can be found in a solid or semi-solid state, as well as liquid or gas in a container or thrown away and can be revalued, treated or disposed of according to specific regulations (Congreso General de los Estados Unidos Mexicanos, 2003).

Waste is classified in categories such as municipal solid waste (MSW), agricultural and animal refuse, industrial residues, extraction and mining waste, construction and demolition debris and sewage sludge among others. In this thesis the focus will be given to MSW. The distinction that is made from MSW to other types of waste is in its origin. MSW emerges from households, commerce and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings). MSW is defined by the United Nations as "household waste and similar waste". This includes bulky waste, which includes voluminous unwanted items such as old furniture, found in households; green waste such as garden waste (i.e. leaves, grass, tree branches); street sweeping products and market cleaning materials (United Nations Statistic Divi-

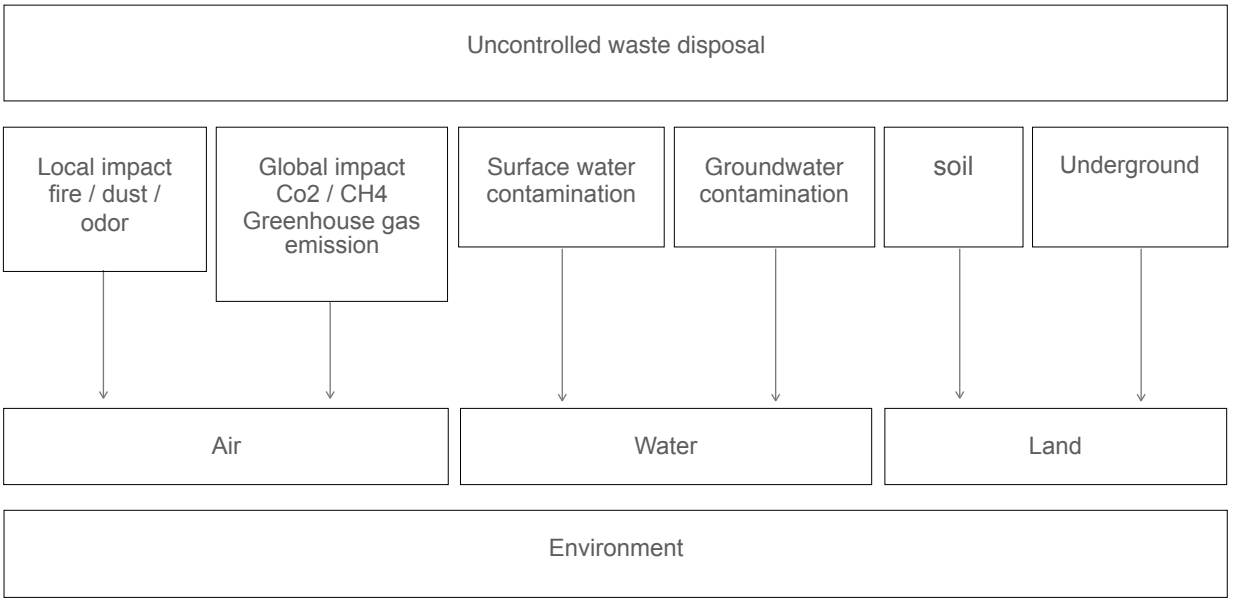
sion, 2007). In the United States, EPA categorizes MSW as "everyday items such as product packaging, grass clipping, furniture, clothing, bottles, food scraps, newspapers, appliances, paints and batteries" (2003, p. 40) which is disposed of by households and other establishments such as small businesses and institutions. In Mexico MSW is considered waste from domestic and commercial activities in towns and cities.

Those definitions bring forward the particular place that waste occupies in our society. Waste is intimately related to our consumption patterns as well as the development, population growth, and economy of every nation. It is part of the fabric of our life; its adequate disposal is crucial to sustaining the well-being of all living things in our world.

Waste emission

In the present waste continues to be disposed of on the land cover, in the intermediate zone of the ground, in the air and in water. Most scientists, environmentalists and waste management practitioners coincide that disposal of waste still poses a major environmental problem. MSW for instance has the potential to contaminate our natural environment (air, water and land), if its disposal is not correctly managed, thus affecting human health and compromising ecological conditions (Bidlingmaier, 1990). Landfills (described further in the text) have been historically associated to environmental issues such as gas emissions, surface and ground contaminations and land cover issues. Figure 1 shows the impact that may occur to the environment if proper care are not given to landfills and dump sites.

Figure 1. Impact of landfill and dump sites on the environment



Adapted from Hädrich et al., 2007

The literature reviewed on waste issues indicates that apart from economical considerations, health concerns, odor control, land availability (considered local impact), and more recently climate change (accounted as a global consequence) are some of the main forces behind finding appropriate solutions to waste disposal problems.

Leachate

Waste can also affect water and soil through the slow escape of liquid from waste disposal sites, heaps of garbage, and inadequate waste collection systems. Leachate is known to be contaminated water that percolates through waste. Bilitewski et al. define leachate as "all contaminated water that has been in contact with waste" (1994, p. 283).

The authors further note that leachate properties differ depending on the type of waste, the physical condition where it is generated, weather conditions, and the chemical processes occurring in disposal sites or landfills. Extensive research on leachate from MSW has shown that it includes a high level of organic components from household waste. Leachate is characterized by a high concentration of ammonia and organic nitrogen compared to uncontaminated water. The leaching of household waste that is untreated can produce a substance with a "high biochemical oxygen demand" BOD which has negative effect on neighboring water sources (Porteous, 2000).

Local impact of waste emission

Nuisances caused by MSW to the natural habitat are commonly generated through processes involving waste collection and waste disposal. The following observations are some of the effects that may occur when waste is inadequately processed in cities.

- Areas where large waste piles are concentrated disrupt the ecosystem and are known to burst into flame if not properly managed.
- Depending on the weather condition, the production of dust and the spread of particles are likely to occur at waste unloading activities.
- Transportation noise through heavy motor vehicles are also a concern when undertaking environmental assessments.
- Odor emissions are caused by the concentration of organic matter. According to Bilitewski et al. odors from landfills are not perceivable at 500 meters, partially tolerable at 300 meters and unbearable under 300 meters (1994).

- The concentration of refuse attracts communities of rodents, insects and flies causing the possibility of diseases proliferation (UNCHS cited by Weingaertner, 2003).

Global impact of waste emission: Carbon dioxide CO_2 and Methane CH_4

The EPA's report on Greenhouse Gas (CHG) and municipal solid waste exposes the following emissions produced through a number of activities involving waste management:

- The combustion of fossil fuels through waste collection and transportation producing carbon dioxide emission
- The emission of Methane gas CH_4 in disposal sites
- The emission of carbon dioxide CO_2 and Nitrous oxide N_2O

When organic waste is disposed on the ground in such a manner that bacterial decomposition is induced through anaerobic processes, two main gases are produced: Carbon dioxide CO_2 and Methane CH_4. Both gases rank high on the list of greenhouses gases.

Carbon dioxide is considerate to have the highest concentration growth rate among all gasses emitted into the atmosphere. In the Summary For Policy Makers produced by the Intergovernmental Panel on Climate Change (IPCC), carbon dioxide is described as "the most anthropogenic green house gas" (IPCC, p.2). Scientists express that CO_2 emissions are partly responsible for global warming as they remain in the atmosphere for a long period of time.

Methane gas is considered 21 times more effective at warming the atmosphere then carbon dioxide (Goudie, 2001, Down and Dowing, 2006). Scientists estimate that methane gases average atmospheric lifetime is approximately 12 years, a reduction of methane gas production would therefore, have a positive effect on the environment. Methane is produced through activities such as "rice cultivation, coal mining, energy production and rearing of livestocks" (Down and Dowing, 2006, p. 44). Methane can also be found in landfills and disposal sites. The estimate rate of methane gas is about 70%, compared to carbone dioxide emission, which is estimated to be 30% (Bilitewski et al., 1994). Because of its highly volatile characteristics, fires and explosions can occur if proper care is not given to those sites.

1.4 Waste management

Problems with the disposal of waste have been put forward throughout the history of human kind. A number of old documents report the practice of throwing garbage in roadways in former centuries. The lack of plan for the management of waste in villages and communities in Europe have had serious consequences on human well-being. The plagues occurred at the time were consequences of the lack of plan to control rats, flies and other vectors of diseases from improper storage of waste (Tchobanoglous et al., 1993).

Mexica
Name used by the people who inhabited Tenochtitlán and ruled the Aztec empire; they are popularly known as Aztecs.

Accounts on the Mexican waste management tradition are mentioned in prehispanic times. Street cleaning is for instance an ancient practice. Old documents give a written account on the *Mexicas* who were used to frequently cleaning the waste from their streets, temples and other communal areas. *Tlazoltótl* was their "God of Waste" who was responsible for cleaning the "filth, human refuse and the guilt of carnal desire". the *Ochpaniztli*, which can be interpreted today as a general cleaning day was a popular festivity in which Mexicans' ancestors clean their houses, streets, temples, gardens and other communal areas with the same thoroughness as their own body; showing in some way that their community and neighboring surroundings were an extension of themselves.

Domestic waste was buried in each household, the organic waste was used to feed the animal or mixed with green foliage as a form of compost. Poor cleaning conditions are reported during the colonial period. The first effort for implementing a domestic collection system as well as street cleaning strategies in the main urban settlements occurred at the end of the 18th century.

Paradoxically, increase in solid waste disposal problems is related to development processes. Modern life patterns, such as the packaging of goods and the use of electronic devices have changed the composition of waste throughout centuries. This means that the solutions in handling MSW must consider the evolution of mankind and contemporary consumption trends.

Solid waste management is described by Tchobanoglous et al. as "the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations, and that is also responsive to public attitudes" (1993).

According to Bilitewski et al. waste management incorporates "the collection, transport, storage, treatment, recovery and disposal of waste" (1994). Both definitions concur with Mexican scholars who view waste management as the body of actions related to waste characterization and classification, waste selection, storage and transportation, as well as its transfer, treatment and final disposal (Mora Reyes, 2004).

In the literature on waste management a number of concepts are mentioned as to systematize the steps of handling MSW from the moment a good is turned into waste at the source of generation until its final disposal.

Waste generation

The term encloses the activities where waste is produced. Every day people identified a number of materials as no longer valuable and throw them away or gather them for its posterior disposal. Waste generation says Tchobanoglous et al. is not easily controllable as it is an activity involving an array of factors and different groups of actors (1993). According to Bilitewski, the waste generation arena includes direct and indirect actors. Those who are directly implicated in waste generation are households and service sectors, retail, and product manufacturing and industry. Indirect players are made up of local government, regulatory agencies, responsible for the overall environmental strategies necessary when it comes to waste generation (1994).

Experts have suggested that every single waste item generated nowadays, produce some kind of pollution. Contamination may occur either from raw material acquisition or during intermediate production. Transportation, final production and marketing may also generate environmental hazards as well as the final disposal of any good. Waste avoidance strategies look to reduce or avoid as much as possible the production of waste at production and consumption levels.

Waste storage at the source

Solid waste management systems encompass activities handling waste in places where it is generated. For instance, separating and storing waste in households as been proven to be economically beneficial for further recycling processes. More homeowners nowadays realize the importance of separating newspapers, cardboard and glass from their waste and to divert them from landfills. Appropriate storage at the source of generation not only reduces costs in the overall waste management system but also respond to public health concerns and

esthetic considerations. This is suggested by Tchobanoglous which refers to "unsightly makeshift containers" and "open ground storage" as both "undesirable" in residential areas (1993, p. 12).

Waste collection

Waste collection plays an important role in waste management processes. It is also a wide and complex subject. It involves diverse elements such as collection systems, special equipments, personnel requirements and the layout of collection routes as well as loading and unloading activities. It starts at the moment where filled waste containers or garbage bags are loaded in waste trucks. Waste collection represents almost 50% of the total cost of waste disposal say Tchobanoglous et al. (1993). Management arrangements include municipal services to franchised private companies and informal groups in developing countries.

There are several methods that can be employed for waste collection. Among them, the most common are:

- *Simple emptying method* where standardized containers are mechanically emptied into a collection vehicle and then returned at the source.
- *Exchange method* where containers are replaced by others. This technique is often use to handling high volume waste such as construction debris and waste in industrial areas.
- *Curbside collection* is very common. It involves picking up garbage bags placed on the sidewalks or other specific locations. The collection is generally manually handled.
- *Special collection or non-systematic collection* involve picking up bulky waste and other voluminous items. This service is generally provided upon request.

In developing countries, the informal collection of recyclable goods from households and at other locations plays an important role in the overall waste management system. Informal collection involve individuals organized or not into structured groups who target valuable goods for reuse or retailing purposes.

In general the most appropriate waste collection method is the one which best serves the need of a community and take into account factors of efficiency, health and environmental requirements, physical demand and zoning parameters. The methods previously mentioned carry both advantages and disadvantages. Weingaertner indicates for instance, that the simple emptying method which requires special vehicles, standardized waste containers and road access can be viewed as a drawback in developing communities, whereas curbside and informal collection, which have been both proven to alleviate poverty, despite their high physical demand on personnel (2003).

Waste transfer and transportation

Transfer stations are employed to load the waste collected from smaller waste trucks to higher capacity vehicles. This process is used a a transition step before the further transport of MSW to remote areas for its final disposal. Separation and recovering of recycle goods may occur previously to transfer and final transportation. This process often includes the separation of bulky waste, shredding, metal selection among other processes. Tchobanoglous stresses that generally the decision to use transfer stations is based on economics as transfer operations become a necessity when haul distances to final disposal sites are no longer economically feasible (1993). Bilitewski on the other hand suggests that transportation costs, location analysis and the assessment of the type of waste to be handled are the main concerns for planning a transfer station (1994).

A difference is therefore made between local transportation of waste and waste transportation to final disposal.

Final disposal

Waste final disposal take many forms. there are biological, thermal treatment treatments as well as landfilling. This last technic has been a traditional way of discarding waste in developing countries however there is a tendency to look into other alternatives such as composting.

Composting is a natural process which undertaken under favorable environmental conditions transforms organic waste into a substance that can improve the soil and promote plant health. The end product obtained from the process is a biologically stable, humid substance that makes excellent soil amendments. The World bank document by Hoornweg on composting in developing countries, describes composting as a "natural process which provides several benefits: the process can be inexpensive; it addresses over 50 percent of a city's waste stream; it reduces one of the world's largest contributors to Greenhouse gases" (2000).

Thermal treatments include incineration, which a method commonly used in European countries. The waste is incinerated through high temperature generating energy, gases and solid residues.

Landfilling is the preferred method in the American continent says Wheeler, It is also the oldest method of waste disposal consisting in burying waste in different layout and forms by using the soil removed during the excavation as a cover layer (2004). Tchobanoglous et al. describe landfill as "the physical facilities used for the disposal of residual solid wastes in the surface of the earth" (1993, p. 362).

1.5 Summary of parameters

In this work, the parameters of the terminology "ecological condition" are viewed as the necessary measures for environmental protection and recovery of contaminated nature. If we take into account that urban ecology integrates a diversity of fields which include principles of ecology and social sciences. The exploration of physical, infrastructural, sociocultural factors featuring detailed examinations of waste management can be used to tackle ecological challenges in a substantial way.

The key components which challenge the ecological conditions of cities, shall be tackled by considering some of the characteristics of urban lifestyle in relationship to air, water, land and human health under the following criteria:

Box 1. Parameters of ecological conditions

Air
Through the reduction of pollutants from human activities, i.e. reduction of gas emission through traffic control.

Land condition
The ability of the land to sustain life i. e. to provide local resources
Sustainable habitat for other species
Mix land cover / landscape as an integral part of the urban environment
The reduction of soil contamination from waste collection and disposal

Water
Clean watersheds and ravines
The reduction of chemicals and pollutant agents in surface water
Protection of ground water

Human health
Access to improved sanitation coverage
Collective hygienic behaviors improving the well-being of communities.