6. Results obtained from measuring food waste from residential dwellings

Chapter 6 presents the results obtained from measuring food waste from residential dwellings. This Chapter offers an overview of 27 fieldwork cases selected in MCMA and three cases located in Jiutepec in the State of Morelos. The cases were grouped into less and more affluent circumstances, taking into account selected structural differences such as housing characteristics and access to urban services. The Chapter highlights the household structure and dwelling condition of all cases and offers specific details on their basic service provisions. It then presents in more depth the food waste composition of four specific cases. The criteria for selecting these cases is that they serve as typical examples with regard to the dwelling structure, the average number of occupants as well as the average food waste produced per capita per day. An influence schema is then proposed to explain the interrelation of contextual external and internal factors that affect food waste management in residential areas.

6.1 Overview of fieldwork cases: distinguishing between less and more affluent dwelling units

The fieldwork cases investigated in Mexico City's Metropolitan Area vary in household size and structure, building types and settlement characteristics. The cases were selected in both central and peripheral[1] urban areas. The heterogeneous nature of the cases reflects the contextual diversity that surrounds each household as well as the internal important variations between households. Indeed, in many cases, the household served as the most important element that influences the extent to which its members participate in communal activities, negotiation and improvement. In the following section the main variations between households and their dwelling structure provide a clearer picture on internal as well as external food waste disposal determinants.

Preliminary results showed that it was difficult to categorize these cases into definite high, middle and low socio-economic groups with regard to their food waste production. In fact, all the cases investigated were embedded into a complex low to middle-high income sphere. Though income levels were not specifically investigated, informal interviews and observations conducted in the homes offered some clues and revealed that the socio-economic boundaries between the cases are influenced by the micro-economics of each household. It was seen that the welfare of each household stems from a set of factors that varies depending on the social development of each occupant.

The research design focused less on the socio-economic differences and more on the building and infrastructural characteristics that may indicate a certain level of wellbeing. In other words, attention was placed on the physical characteristics that reflect a certain state of welfare, financial health, living comfort and social security.

[1] Peripheral here means that the settlements are situated on the edge of the Federal District. Many are known to be located in compact areas with poor quality service provision, low housing standards and low income consumption patterns. Some may also be susceptible to environmental hazards that may impact the wellbeing of entire localities.

The case analysis marked some contrasts between the level of education (which serves as a common socio-economic indicator) and the condition of the housing and quality of service provision. Physical internal and external agents (household assets, building features, neighborhood context as well as infrastructure and urban services) offered a more accurate estimation of the households' contextual conditions. Based on these features, a broader grouping was established considering two main categories: **Less affluent** and **more affluent** fieldwork cases.[2] These two categories were established based on observations made during field trips, indicators obtained from the questionnaire as well as the subjective interpretation of participants' own perceptions of their socio-economic conditions.

6.1.1 Attributes of less affluent fieldwork cases

The differences between less and more affluent cases are structural. The contrasts are more evident in housing and access to urban services. Less affluent cases are households located in perceived economically challenged settlements at the periphery of the Federal District's limits. Some of the settlements are poorly suited for formal service provision (water access, waste collection and sewage connection). This was the case for four homes situated on slopes in the south west of Mexico City in *Torres de Potrero, Amplación Talcoyaque and Lomas de la Era.* Field visits confirmed a mix of challenging conditions ranging from access or mobility to workplaces to security and reliability of service provision. Other less affluent cases exist paradoxically on flood-prone desiccated lake beds on the eastern border of the Federal District and a within compact urban grids at the north-east end of the city. The periphery traditionally hosts many rural migrants known to be more socially vulnerable. Many peripheral settlers are employed in secondary, tertiary and informal economic activities and are characterized by low salaries and limited access to social

[2] Given the exiting social and economics divide between groups, it became necessary to draw a broad differentiation between households with more human, economic and material assets and those more vulnerable. The differentiation therefore was made considering the following indicators: education, occupation, condition of the settlements.

services. The cases investigated on the periphery often feature endemic vulnerabilities such as lack of human resources affecting their living conditions and environmental behavior. About half, 13 of the 27 cases were identified as 'less affluent' and are indicated with red dots in Figure 6-1. They are classified as follows:

- Less affluent peripheral North: Case No.s 11, 13, 14, 17, 21 and 24
- Less affluent peripheral South West: Case No.s 25, 26, 27 and 28
- Less affluent peripheral South: Case No.s 10, 12 and 18

6.1.2 Attributes of more affluent fieldwork cases

Though more affluent cases have a certain degree of heterogeneity and may vary in their social nature, they are however more economically stable, financially healthy and are characterized by some autonomy or resilience when faced with shortcomings with regards to service provision. The more affluent cases investigated are located in wealthier urban boroughs or neighborhoods. These households feature some internal capacities in terms of networks and social capital that transform into benefits, affecting in turn their life conditions and environmental behavior. From a total of 27 cases, 14 were identified as 'more affluent'. They are highlighted in yellow dots in Figure 6-1 and are classified as followed:

- More affluent peripheral North: Case No.s 4, 15, and 16
- More affluent Center: Case No.s 3, 7, 8, 9 and 29
- More affluent South: Case No.s 1, 19, 20, 22, 23 and 30

The satellite image illustrated below offers an overview of the Federal District with its 16 boroughs '*delegaciones*' and its limit with the State of Mexico. The 27 cases are meant to be neither representative of any particular neighborhood nor to follow the rationale of probabilistic theory. Each case rather reflect the effort of engaged participants contacted through networks and recommendations who were willing to actively contribute to the research. The vast majority of the households researched were composed by family members. Most of the cases located north of the map are situated in the State of Mexico outside the Federal District limit. Case No.s 1, 18 and 19 area located in an ecosystem conservation area south of the capital. No cases were investigated cases in the eastern part of the city.

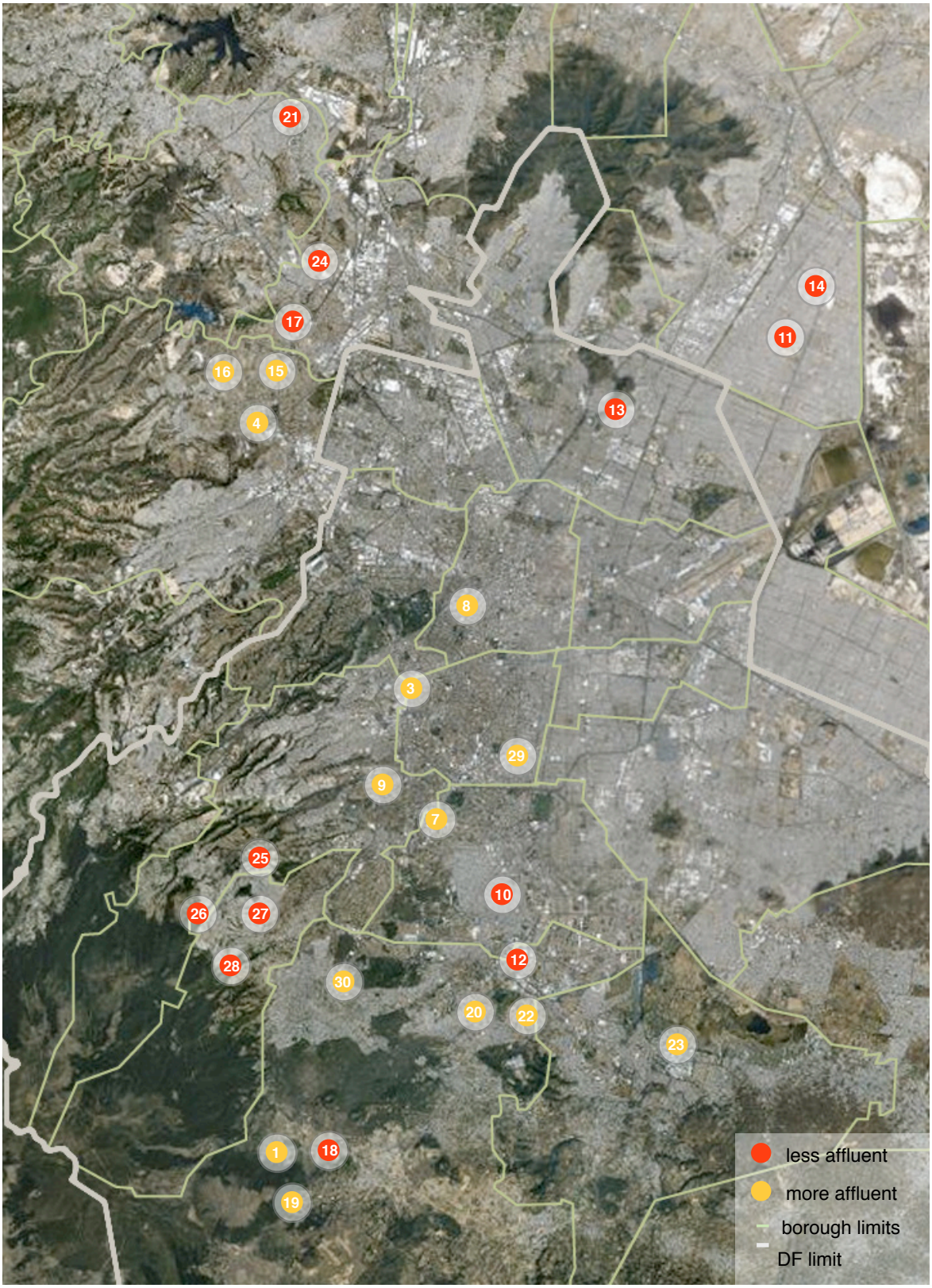

Figure 6-1 Location of fieldwork cases in the metropolitan region of Mexico. Map source: Adapted from Límites Delegacionales INEGI, Google Earth Satellite Map

Table 6-1 below complements Figure 6-1 as it summarizes the results obtained from household and dwelling characteristics as well as the food waste weight obtained in both less and more affluent fieldwork cases. This offers a preliminary view of household characteristics and organic waste production in both groups. For more details on the fieldwork cases see a general matrix in Appendix A-8.

Table 6-1 Household characteristics, dwelling type, length of residence and food waste production

Less affluent fieldwork cases

Case No	Household size	Household highest education level	Dwelling Type	Length of residence (LOR) in the community	Most common shared meal	food waste weight registered per week (kg)*	food waste weight per week per capita (kg)	food waste weight per day per capita (kg)
10	1	E3	I	10 years	none	1.05	1.05	1.05
11	4	E3	I	8 years	none	2.20	0.55	0.08
12	1	E3	I	4 months	none	0.86	0.86	0.12
13	6	E3	I	18 years	D	2.32	0.39	0.06
14	7	E2	I	16 years	D	3.64	0.52	0.07
17	**2**	**E2**	**I**	**24 years**	**D**	**2.22**	**1.11**	**0.16**
18	7	E2	I	10 years	L	7.80	1.11	0.16
21	5	E3	I	3 years	BLD	2.20	0.44	0.06
24	4	E3	I	21 years	LD	2.03	0.51	0.07
25	4	E2	I	20 years	L	12.47	3.12	0.45
26	**4**	**E2**	**I**	**11 years**	**D**	**4.17**	**1.04**	**0.15**
27	5	E1	III	20 years	D	2.85	0.57	0.08
28	4	E1	II	22 years	BD	-	-	-
	Average			**14 years**		**3.65**	**0.93**	**0.20**

More affluent fieldwork cases

Case No	Household size	Household highest education level	Dwelling Type	Length of residence (LOR) in the community	Most common shared meal	food waste weight registered per week (kg)*	food waste weight per week per capita (kg)	food waste weight per day per capita (kg)
1	**4**	**E3**	**I**	**18 years**	**BLD**	**4.8**	**1.20**	**0.17**
3	2	E3	III	20 years	L	0.50	0.25	0.04
4	6	E3	I	4 years	D	2.20	0.37	0.05
7	2	E4	I	3 months	BD	4.13	2.07	0.30
8	4	E4	II	15 years	L	0.98	0.25	0.04

Case No	Household size	Household highest education level	Dwelling Type	Length of residence (LOR) in the community	Most common shared meal	food waste weight registered per week (kg)*	food waste weight per week per capita (kg)	food waste weight per day per capita (kg)
9	4	E4	II	7 years	L	4.47	1.12	0.16
15	4	E3	I	10 years	D	1.82	0.46	0.07
16	5	E3	I	1 year	none	2.91	0.58	0.08
19	2	E3	I	3 1/2 years	BD	1.80	0.90	0.13
20	**2**	**E2**	**I**	**35 years**	**none**	**3.00**	**1.50**	**0.21**
22	3	E4	I	18 years	LD	8.26	2.75	0.39
23	4	E4	II	13 years	LD	5.53	1.38	0.20
29	1	E3	III	7 months	none	0.45	0.45	0.06
30	6	E3	I	10 years	none	-	-	-
	Average			**11 years**		**3.14**	**1.02**	**0.14**

List of abbreviations in Table 6-1:
E1'secondary school', **E2** 'high school', **E3** 'graduate school/professional', **E4** 'postgraduate'
Type **I** 'detached house', Type **II** 'attached townhouse or enclosed unit', Type **III** 'apartment'
B 'breakfast' **L** 'lunch' **D** 'dinner'

* Includes the weight of bin which in most cases was: 0.217kg. The data was retrieved from weighing record sheets from participants

Note: Less affluent Case No.s 17 and 26 and more affluent Case No.s 1 and 20 were selected for an in-depth investigation of their waste composition. The criteria for their selection is detailed later in this chapter.

Table 6-1 provides on the left side an overview of the number of occupants in each residential unit as well as the highest education level reported in each household and the type of dwelling that was investigated. On the right side, the table summarizes the weight of the food waste that was reported by household informants.[3] The table also reveals the length of residence in the current location and the most common types of meals shared in the home. This indicates the period in which meals were prepared and shared, which in turn signals the time of

[3] Given that the weight reported only represents a sample of food waste from 7 days, it is difficult to confirm whether the results are a representative measurement of food waste produced in these residential units. Nevertheless, the weight obtained offers a first portrayal of what is produced at the household level and is meant to serve as an element of discussion for further refinement among waste practitioners and researchers.

production of unavoidable food waste items during meal preparations and food waste residues following a meal.

Recent food waste studies have put forward the idea that household food waste is generated in close relation with the number of household occupants as well as due to some socio-economic and cultural determinants such as education and household cohesion among others. Given the limited number of cases researched, this table cannot confirm nor deny these claims, instead it provides a parallel between basic data on the household structure and the food waste weight reported in particular cases. What is interesting to observe is that the results vary across the 30 cases. Each case represents a unique demonstration of environmental behavior in a specific urban environment. The average household size in less affluent cases is 4.1 occupants, higher than the average of 3.6 occupants per dwelling registered in the Federal District (INEGI, 2010b). The more dominant dwelling type is 'Type I' (detached house) which refers to independent compounds or houses separated by a wall or a garden or even a green plot. In the settlements investigated, detached dwelling units made up for a large portion of the urban landscape and usually offered a continuous facade aligned with the streets. Most of the less affluent cases - 11 of the total of 13 were detached units.

In more affluent cases the average household size was 3.5 which is lower than the average household size in less affluent cases. Two cases featured a household size of 6 members, which is less common among middle-high income households in the Federal District. Three more affluent cases featured a dwelling 'Type II' which refers to attached townhouses or enclosed units. These types of dwellings are separate building units attached with one another in a common compound and/or enclosed within a larger housing estate often characterized by a closed perimeter of walls, shared amenities and with controlled entrances. In the Mexican context, they are

commonly referred as *condominio*.[4] Four enclosed dwelling units were investigated. Additionally, two cases in self-contained units (i.e. apartment) that occupied a portion of an apartment building were researched, they were categorized as Type III.

The proportion of building types investigated echoes to a certain extent the reality of the building typology in Mexico City. Only 6% of new housing built in 2000 is categorized as Type II buildings (Parnreiter, 2005). The vast majority of residential buildings in Mexico are single detached dwelling units. Within the cases investigated, 10 detached housing units have two floors, four each have one floors and three have three floors.

The results obtained for the highest level of education of a member of the household are reflected by codes varying from E1 (secondary school attendance) to E4 (postgraduate education). Overall more than 40 % of respondents confirmed belonging to a household with a member with graduate or postgraduate educational attainment. The level of education is critical in this research as it provides a first indication of how informed the household is and what learning skill set that occupants have. The education also serves as an indicator for a broad human resources estimation which in turn can be linked to consumption patterns and ultimately household waste production. In general the cases investigated in both less and more affluent contexts are those of informed residents who had a good understanding of the terminology used in the research.

The numbers of bedrooms indicate the dwelling size, which provides further information on the adequacy of the housing in relation to the number of occupants. In other words, it offers signs of whether the housing unit is appropriate to the size of the household and whether the unit is compatible with the needs of its occupants. It also provides some insight on varying levels of welfare and ways of life, which is inherently linked to environmental behavior. Case No. 18, for instance, is an

[4] Parnreiter (2005) notes that the Mexican term '*condomio*' includes also enclosed or gated apartment buildings. However, in this research, only multi-unit dwellings in the form of townhouses or detached houses within a common compound, also known a *fraccionamiento* were considered as dwelling Type II.

extended household with seven members; a married couple with three dependent children, two daughters and one son. Also sharing the unit is the couple's older son and his female partner. All seven live in a three bedroom single-story modest house with a cement roof, brick walls and tile floors in the mountainous south of Mexico City. They report living in the same unit for ten years and have had to adapt their home to provide additional space as the household expanded.

With regard to the length of residence, most respondents confirmed having spent more than five years in their community. Table 6-1 shows an overall average of 14 years of length of residency in less affluent cases, which suggests that household occupants know their neighborhoods well and have been able to perceive communal changes over time. Another point to consider is the land tenure issue in economically challenged settlements. As fewer options of land ownership exist for the poor, and sanctions on illegal occupation are being more strictly enforced, those occupying a plot of land remain, adapt and consolidate their house through subdivisions. Self-help housing, *auto-construcción* is a way of securing the most valuable asset that less affluent dwellers have which is their home.

In addition to the critical element of housing security, the responses obtained confirmed that the length of residence plays a role in the production of positive social attachments. In more affluent cases the average length of residence is of approximately 11 years. In Case No. 01, for instance it appears that the length of residency of 18 years plays an important role in the ability that householders have to create and to maintain attachments to their immediate context and the extent to which they can indicate any transformation of the urban sanitary conditions in which they live.

Results obtained for the most common meal shared provide some signs with respect to the level of cohesion in meal consumption habits. This can be in turn linked to the quantity of food waste produced in the households. In less affluent cases it appears that dinner is the most common meal shared. In more affluent cases, lunch and dinner are equally shared.

Lastly the results obtained from the food waste weighing and recording exercise show disparities within and between less and more affluent groups. A total of 42 weighing recording activities were undertaken. These activities were conducted mostly once or twice a week. The results obtained in less affluent fieldwork cases show values ranging from 0.06 to 0.45 kg/d.ca.[5] The food waste weighing records obtained revealed that the average food waste produced in households with six to seven occupants, was on average 0.07 kg/d.ca, while the average weight in smaller households with one to two persons was 0.41 kg/d.ca. A higher food waste weight per capita, 0.18 kg/d.ca was also observed within households with four members, which is higher than for dwellings with less occupants. The average food waste produced in less affluent cases is 0.20 kg/d.ca.

In more affluent households, the results ranged from 0.04 to 0.39 kg/d.ca. Households with five to six occupants reported an average food waste production of 0.06 kg/d.ca, while in smaller households with one to two persons, the average was 0.17 kg/d.ca. In households with four members, the results show an average of 0.12 kg/d.ca, which is lower than the data obtained in less affluent cases. The average food waste produced in more affluent cases is 0.14 kg/d.ca.

6.1.3 Overview of fieldwork cases investigated in Jiutepec, State of Morelos

The fieldwork cases investigated in the neighboring city of Jiutepec present many contextual similarities as the cases examined in the Federal District.[6] Jiutepec is the second most populated municipality of the State of Morelos, and fits the profile of

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[5] The abbreviation kg/d.ca represents the weight of food waste in kilogram per day per capita.

[6] In 2007, research activities exploring the ecological potential of waste in urban areas in the city of Jiutepec were conducted. The research primarily focused on the impact of waste on the city's natural environments. See: (Jean-Baptiste, N. (2008). People, Nature and Waste, the Ecological Value of Waste in Urban Areas: Case of Jiutepec, Morelos, Mexico. Unpublished M.Sc., Faculty of Architecture, Institute for European Studies (IfEU), Bauhaus University, Weimar, Germany. Retrieved: 14 June 2009, from: http://www.wastestudies.com/download.html). The three cases selected in the same city aim to complement earlier findings and allow a more prolonged perspective particularly on issues of waste awareness.

medium-sized cities with a rapid development pattern. The city extends on 70.45 km^2, representing 1.42% of the total surface of the state. It is relatively small compared to other municipalities however, it has the highest density rate in the state, a boosting economy, special infrastructure requirements and endemic natural assets.

The municipality has always been privileged with rich natural resources and abundant water. Indigenous groups and hacienda owners were all attracted by its fertile land and favorable climate. The area has valley regions and lakes which supply water to the residents however, there are internal conflicts for water and land in some small rural areas. Like most parts of Morelos, the municipality is known for its mild climate and natural surroundings, which to some extent stimulates the local service orientated economy. Sanitation has been a traditional problem in Jiutepec and there are reports of environmental problems related to water contamination, lack of adequate sewage system, traffic and transportation issues.

Figure 6-2 Location of fieldwork cases in Jiutepec, State of Morelos.
Map source: Google Earth Satellite Map

The cases investigated are enclosed within a larger housing estate '*fraccionamiento*', in the city center of Jiutepec and have access to urban services as well as has good accessibility to other areas. These cases categorized as more affluent, feature the same household size, similar education level, dwelling type and length of residence. These cases provide some insight into the differences in food waste production within a more contained area and homogeneous group with similar contextual conditions. The food waste weighing results ranged from 0.10 to 0.34 kg/d.ca, resulting in an average of 0.22 kg/d.ca.

Table 6-2 Household characteristics, dwelling type, length of residence and food waste production in three fieldwork cases in Jiutepec, State of Morelos

Case No	Household size	Household highest education level	Dwelling Type	Length of residence (LOR) in the community	Most common shared meal	Food waste weight registered per week (kg)*	Food waste weight per week per capita(kg)	Food waste weight per day per capita (kg)
2	4	E4	II	14 years	BD	9.51	2.38	0.34
5	4	E3	II	14 years	L	6.17	1.54	0.22
6	4	E4	II	14 years	BLD	2.85	0.71	0.10
				Average		**6.17**	**1.54**	**0.22**

6.1.4 Summary of attributes of less and more affluent cases investigated in MCMA

There is no single spatial pattern in the Federal District. The city is a socio-demographic diverse territory which hosts fragmented heterogeneous residential areas. Given that there is a strong ideological value of housing across both less and more affluent contexts, the aspiration of home ownership is high and is mostly reflected through a landscape dominated by detached single dwelling units. The cases investigated offer detailed structural characteristics of different types of households found in the Capital. Each case remains unique, however some general

attributes are revealed in Table 6-3. These features represent some of the most important differences found between less and more affluent cases.

Table 6-3 Summary of household and dwelling attributes

Attributes	Less affluent cases	More affluent cases
Location	peripheral	peripheral and central
Average household size	4.1	3.5
Dominant dwelling type	detached single unit dwelling with various state of transformation	mixed dwelling types (detached and *fraccionamiento*) prevalently single unit dwelling
Education attainment level	50% with graduate school and /or professional as highest education level	90% with graduate school/ professional and/ or postgraduate as highest education level
Average length of residence	14 years	11 years
Most type of meal shared	dinner	lunch and dinner
Average food waste weight registered per capita per day	0.20 kg/d.ca	0.14 kg/d.ca

Less affluent households were found to be mostly settled at the periphery of the Federal District while more affluent households are spread heterogeneously across the Federal District and some are concentrated in the center. In both cases, detached single unit dwellings are dominant. The results show a perceivable gap in education attainment between less and more affluent cases implying that education may serve here as a vector of wellbeing and economic stability. Most of the cases presented a length of residence of more than a decade which implies a certain attachment to the space in particularly in less affluent cases which presented an average of 14 years of length of residence. In more affluent cases, there were twice as many types of meals shared than in less affluent cases and the average food waste weight per capita per day was found to be higher in less affluent households than in more affluent cases (See Appendix A-8).

6.2 Physical attributes of less and more affluent cases: Dwelling conditions and urban service provision

Adequate food waste management in urban environments requires more than just a functional waste collection and final disposal system; it also entails favorable circumstances for undertaking household separation practices. In less affluent contexts, the struggle for urban services is a well-known fact, in some localities provisional electricity and informal water networks are solutions hardly adequate to cope with the demand of growing numbers of settlers. The following segment offers a detailed account of basic services such as energy and water supply and sanitation options reported by participants and observed during field trips.

Tables 6-4 and 6-5 summarize internal characteristics of each dwelling and the level of procurement of services such as water and energy supply as well as sanitation. The results highlight the built context that surrounds the separation of food waste within the homes and separate organic waste collection.

Table 6-4 Dwelling conditions, urban services and street cleaning in less affluent cases

Case No.	Area/ Location	Dwelling description	Urban service provision	Street cleaning frequency
10	peripheral south *Santo Domingo*	Rented apartment on the second floor of a detached dwelling unit Building material: cement roof, brick wall, tile floor.	Water supply through communal water connection and energy supply through electric grid connection from CFE*. Connected to municipal drainage system	frequent
11	peripheral north-east *Ciudad Azteca*	3 floor 3 bedroom detached house owned by occupants Building material: cement roof, brick wall, tile floor.	Water supply through communal water connection and energy supply through electric grid connection from CFE. Connected to municipal drainage system	rare
12	peripheral south *Uscoby*	2 bedroom apartment rented on third floor of a detached dwelling unit Building material: cement roof, brick wall, tile floor. Other housing characteristic: garage	Water supply through communal water connection and energy supply through electric grid connection from CFE. Connected to municipal drainage system	frequent

Case No.	Area/ Location	Dwelling description	Urban service provision	Street cleaning frequency
13	peripheral north-east *La Villa*	1 floor 5 bedrooms detached house owned by occupants, Building material: cement roof, brick wall, tile floor.	Access to water through water connection. Unspecified energy supplier. Connected to municipal drainage system	rare
14	peripheral north-east *Ciudad Azteca*	3 floor 4 bedroom detached house owned by occupants Building material: cement roof, brick wall, tile floor.	Access to water through water connection. Unspecified private energy supplier. Connected to municipal drainage system	no street cleaning
17	peripheral north *Santa Mónica*	5 bedroom detached house owned by occupants Building material: cement roof, brick wall, marble floor.	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	rare
18	peripheral south *Ajusco*	3 bedroom detached house with garden, owned by occupants, building material: cement roof, brick wall, tile floor.	Unspecified private water supply. Informal electricity supply *colgado*. Septic sewage treatment system	frequent
21	peripheral north *Villas de la Hacienda*	detached house, owned by occupants Building materials: cement roof, brick wall, tile floor.	Access to water through water connection. Unspecified energy supplier. Connected to municipal drainage system	frequent
24	peripheral north *Tlanepantla*	1 floor 4 bedroom detached house owned by occupants, with garden Building material: cement roof, brick wall, cement floor.	Unspecified private water supply. Electricity supply through CFE. Connected to municipal drainage system	rare
25	peripheral south-west *Torres de Potrero*	2 bedrooms annexed to another dwelling unit building in construction. Owned by occupants. Building material: cement roof, brick wall, tile floor. The dwelling is vulnerable to landslides. Current consolidation aimed at reinforcing the foundation.	Water through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
26	peripheral south-west *Ampliación Tlacoyaque*	3 bedrooms detached house disposed in 2 floors. Owned by occupants A third floor is in construction. Building material: cement roof, brick wall, tile floor. The house has a pedestrian-only access	Water supply through communal water connection and rain water collection. Energy supply through electric grid connection from CFE. Connected to municipal drainage system	low
27	peripheral south-west *Lomas de la Era*	2 bedroom apartment on second floor. Owned by occupants. Building material: cement roof, brick wall, tile floor. Apartment in consolidation	Water supply through communal water connection. Energy supply through electric grid connection from CFE. Connected to municipal drainage system	frequent**

Case No.	Area/ Location	Dwelling description	Urban service provision	Street cleaning frequency
28	peripheral south-west *Ampliación Tlacoyaque*	1 bedroom annexed to another dwelling. Granted with conditions. Building material: laminate roof, brick and compacted earth wall, cement floor.	Water supply through communal water connection. Energy supply through electric grid connection from CFE. Connected to municipal drainage system	low

* Since October 2009 the Federal Electricity Commission *Commission Federal de Electricidad* (CFE) is the main institution responsible for generating, distributing as well as marketing electrical power to the central region of Mexico which includes the States of Hidalgo, Puebla, Morelos, State of Mexico and Mexico Federal District.
**Respondent specifies that the street cleaning is done by neighbors

Table 6-5 Dwelling conditions, urban services and street cleaning in more affluent cases

Case No.	Area/Location	Dwelling description	Urban service provision	Street cleaning frequency
1	peripheral south *Ajusco*	2 floor 3 bedroom detached house in large property with green area, owned by occupants.	Water supply through rain water collection. Energy supply unspecified. Septic sewage treatment system	non existent
3	center *San Pedro de los Pinos*	3 bedroom apartment on second floor. Owned by occupants. Building material: concrete roof, wooden floors, brick wall	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	don't know
4	peripheral north *Satélite, Naucalpan*	4 bedroom detached house disposed in 2 floors, owned by occupants Building material: cement roof, tile floors, brick wall	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
7	south *San Ángel*	3 bedroom detached house disposed in 2 floors in prominent neighborhood, rented by occupants. Building material: concrete roof, tile floor and brick wall	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
8	center *Roma Norte*	3 bedroom condominium house disposed in 2-3 floors owned by occupants. Building material: concrete & wooden roof, tile & wooden floor and brick wall	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent

Case No.	Area/Location	Dwelling description	Urban service provision	Street cleaning frequency
9	south-west *Las Águilas*	3 bedroom condominium house disposed in 2-3 floors owned by occupants. Building material: concrete roof, tile & wooden floor and brick wall	Water through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
15	peripheral north-west *Lomas Verdes*	4 bedroom detached house disposed in 2 floors with garden, owned by occupants Building material: cement roof, tile floors, brick wall	Water through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
16	peripheral north-west *Atizapan*	4 bedroom detached house with garden, rented by occupants, Building material: cement roof, tile, wooden, marmol, carpet floors, brick wall	Water through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
19	peripheral south *Ajusco*	2 bedroom detached house disposed in 2 floors, owned by occupants Building material: cement roof with tile, laminated floor, brick wall	Private water and energy supply. Septic sewage treatment system	non existent
20	South *Tlalpan*	3 bedroom detached house disposed in 2 floors owned by occupants Building material: concrete roof, tile & wooden floor and brick wall	Private water supply. Energy supply through electric grid connection from CFE. Connected to municipal drainage system	frequent
22	south *Tlalpan*	3 floor 4 bedroom detached house owned by occupants Building material: concrete roof, marble & wooden floor and brick wall	Private water and energy supply. Connected to municipal drainage system	frequent
23	south *Xochimilco*	2 floor 3 bedroom condominium house owned by occupants Building material: concrete roof, tile & wooden floor and brick wall	Private water and energy supply. Connected to municipal drainage system	frequent
29	center *Benito Juárez*	1 bedroom apartment on second floor, rented by occupant Building material: concrete roof, tile floor, brick wall	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent
30	south *Tlalpan - Reino Aventura*	2 floor 4 bedroom detached house owned by occupants Building material: concrete roof, wooden floor and brick wall	Water access through communal water connection and electricity supply through CFE. Connected to municipal drainage system	frequent

The results from Table 6-4 (less affluent cases) show that 76% of the dwellings are owned by occupants. 61% are detached dwelling units, varying from 1 to 5

bedrooms. The remaining buildings are apartments or annexed rooms to existing constructions. The building materials most often used are cement roof, brick walls and tile or cement floor. Case No. 28 features the poorest conditions of all and reflects the family's stressful situation. The household comprises a married couple with two dependent daughters under the age of 18, one of them is mentally and physically disabled. Among the less affluent cases investigated, this household presented the least signs of prosperity. The family lives in one annexed room which is rent free and granted in exchange for some unspecified services. The building materials are a laminated roof, compacted earth walls and a cement floor. A double bed and a small stove are the largest items inside the dwelling.

The other less affluent cases feature buildings with various states of consolidation as can be seen in Case No.s 25, 26, 27 where there are a second or third roofs over the construction, uncompleted internal divisions, missing windows or doors. The vast majority of respondents reported having conducted some type of renovation since living in the property. Three major kinds of consolidation work were identified:

(1) the construction of a second floor

(2) improvement of bathroom

(3) kitchen renovations

These gradual improvements in living conditions are mostly self-help construction which can last several years which in turn explains the length of residency of occupants in the same location (Figure 6-3).

Figure 6-3 Dwelling units in less affluent cases located in the peripheral south-west of Mexico City in the area of *Ampliación Tlacoyaque*

The results from Table 6-5 (more affluent cases) similarly show a high percentage of property ownership with 78% positive responses. Detached dwellings make up 64% of the buildings and are units with an average room number of 3.5. The remaining buildings are houses in *condominio* and apartments. The findings about the building materials and overall physical aspects of the homes show a different picture than the one illustrated in Figure 6-3. The building materials more commonly used are cement with a tiled roof, brick walls with different types of finishing and tile, marble or wooden floors. In contrast with Case No. 28, Case No. 22 exemplifies living conditions of wealthier households. Occupants confirmed having completed vast renovations in the 3 floor dwelling unit occupied by a female single parent with a non-dependent son and daughter. The building materials are a concrete roof, brick walls with finishing and tile and wooden floors. Figure 6-4 illustrates the type of dwelling units researched in more affluent contexts.

Figure 6-4 Dwelling units in more affluent cases located South Mexico City in *San Angel & Tlalpan*

With regard to urban service access, water and electricity suppliers were not always well specified by respondents. According to local statistics from the Federal District 97% of houses have access to water and 98% have access to energy/electricity services (INEGI, 2010). The results obtained on energy supply access showed that the majority of less and more affluent cases were indeed connected to the state-owned

electrical power system. One case reported having an illegal lighting source, which in local colloquial terms is known as *colgado*.

The results obtained regarding water access and provision inquiries urge us however to question the claims of local statistics. The Mexico City Metropolitan Area features historical water management challenges (Sosa-Rodriguez, 2010; Tortajada, 2007). Since the 1940s new catchment areas have been incorporated and their exploitation has caused important territorial conflicts in smaller localities. Long distance connections and water supply projects such as the one of the *Cutzamala* Bassin were implemented to serve a growing demand for water in the Capital. The *Cutzamala* project which includes several complex stages, allows water to be transferred from a distance ranging from 60 to 154 km, then pumped through 102 stations to a height of approximately 1,000 meters, which makes this project energy-intensive, costly and has provoked a number of social uprisings (Tortajada, 2006). Despite the coordinated efforts from federal and local entities, water supply in the less affluent fieldwork cases is limited compared to more affluent cases. One respondent stressed that water was supplied once or twice a week which implies that water access or connection is perceived as one element (reflected positively in surveys) and water provision as another. The latter heavily relies on water tank capacity rather than the consistency of water supply lines.

Frequent street cleaning activities were specified in 46% of responses specify in less affluent cases in contrast with 30% of responses judging street cleaning as rare. In contrast the more affluent cases show 71% positive responses regarding the frequency of street cleaning in their neighborhoods. It is important to specify that street cleaning takes many forms in the city. This is an activity performed by a number of actors, namely municipal street sweepers, informal sweepers/waste collectors or by residents themselves. Municipal sweepers are often equipped with a hand-cart and one or two brooms, whereas informal workers are known to either purchase or rent their cart and rely mostly on tips, or other arrangements with householders and small local businesses.

An earlier research on street cleaning patterns in Jiutepec revealed several factors affecting the performance of municipal street cleaners (Jean-Baptiste, 2008). These considerations were revised and triangulated with more recent results obtained from informal discussions with locals practitioners and are summarized in Table 6-6 below.

Table 6-6 Factors affecting street cleaning in Jiutepec and Mexico City

Factors	Jiutepec	Mexico City
social	• locals make little difference between street cleaning and waste collection	• while locals may recognize the distinction between street cleaning and waste collection, many utilize indistinctly their services for household waste disposal
	• locals dispose of their waste illegally in the hand-cart while sweepers are at work	
		• service provision is established on a reward basis. Services are perceived to be more frequent and are rewarded accordingly in more affluent areas
	• continuous festivities make street cleaning activities difficult considering that the volume of waste vastly increases during those days.	
urban	• poor street lighting contributes to an increase of garbage in public areas	• reduced size of sidewalks in some locations make it difficult for thorough street cleaning activities
	• reduced size of some streets as well as barriers such as automobiles and informal commerce slow street cleaning	
	• paradoxically streets with very low traffic as well as concentration points such as markets and bus stations produce the highest volumes of garbage	
	• lack of security creates a limit for street cleaning schedules	
planning & economic	• lack of modern equipment as well as incentives and programs for sweepers	• lack of coordination between different sectors and changes in administration as well as a lack of continuity of programs break the momentum of sanitary services
	• lack of adequate solutions and personnel to solve high waste production during festivities	• lack of adequate budget and human resources affects street cleaning coverage
environmental	• difficulty of operation during rainy seasons due to the increased weight of the waste.	

Source: (Adapted from Jean-Baptiste, 2008)

Social, urban, planning and economic as well as environmental factors intertwine in the effectiveness of street cleaning activities. However households also play a central role in meeting the goals of municipal sanitary programs. According to urban sanitary regulations street cleaning activities are shared responsibilities between residents and local governments. Residents have the obligation of maintaining their front door clean and of disposing of waste according to organic and non-organic separation criteria.

On the topic of street cleaning, informants suggested disenchantment from the performance of local authorities and therefore there is an overall attitude of skepticism with regard to urban sanitation in residential neighborhoods. "We do it ourself" commented one informant, "we can't wait for the government to do these things... We will have to wait forever!". These are far from being paternalistic expressions, instead these are autonomous sentiments which have been repeatedly identified during interviews throughout the study.

Disparities in the assessment of street cleaning from different actors (municipal street sweepers, informal sweepers/waste collectors and residents), suggest there is an opportunity for integrated group discussions and dialogue towards solving what seem to be operational issues rather than attitudinal issues. In Mexico City even more so than in Jiutepec, street cleaning activities take on a more predominant role in waste management. It covers a dual collection/cleaning function at neighborhood levels and complements overall waste collection activities. While this segment has sought to highlight the physical attributes of less and more affluent cases by showing selected dwelling conditions and service provision, the next section explores food waste separation and composting habits as well as the frequency of waste collection and the level of community participation in all cases investigated.

6.3 Food waste separation and composting habits, frequency of waste collection and community participation

A successful separate household waste collection and treatment system - like the one aimed for in Mexico's Federal District - requires a favorable support from household members. This support is closely related to the involvement, interest, resources and willingness of residents to effectively separate their waste at home. The responses obtained on the inquiries on food waste habits show that the majority of household members are exposed to, or actively practice food waste separation in their daily life. In less affluent cases 9 respondents out of 13 reported separating their organic waste at home. Only four households do not conduct any waste separation prior to collection. In contrast, more affluent households showed less disposition to waste separation. The results on waste separation show eight negative responses against six positive ones. The findings obtained from all cases suggest that the food waste produced is collected (separately when this applies), then transferred with other discarded materials and transported to its final disposal. During further exchanges, respondents explained that they were less motivated to separate their food waste given the fact that waste collectors appeared to mix the organic waste separated at the source in their collection vehicle.

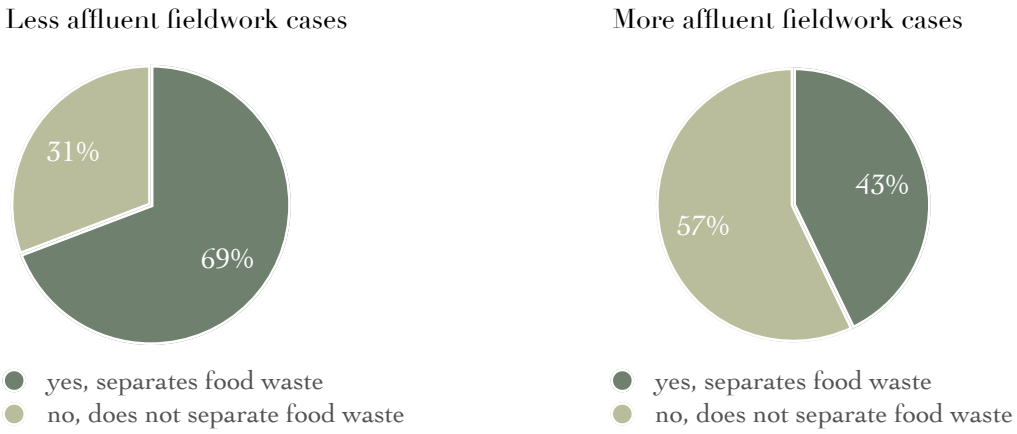


Figure 6-5 Responses concerning existing household food waste separation habits

In addition, Figure 6-5 suggests a higher propensity for household waste separation in less affluent cases, the discussions on integrated solid waste management connected with organic waste confirm an increase in household separation practices in the last 5 years. As mentioned in Chapter 4, household waste separation (organic and non organic) in Mexico Federal District is required by law since 2003. Although this directive is not applied in all homes across the capital, it is however fomented in different public and private establishments such as schools, public institutions and government offices, which to some extent helps contribute to public awareness in terms of organic waste separation. In addition, it was observed that households with pets, as well as dwellings with a green parcel were more likely to separate their food waste.

In contrast with food waste separation, home composting habits appeared low among the cases investigated. Of the 30 households 22 do not compost, as illustrated in Figure 6-6. In less affluent households some composting activities[7] were reported in four dwelling units. In more affluent cases only one case of home composting was reported; the vast majority do not compost.

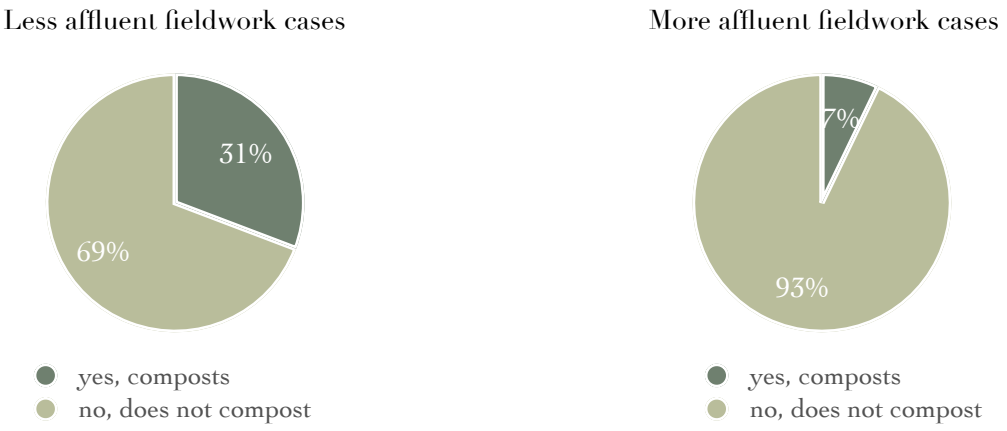


Figure 6-6 Responses concerning habits of home composting

[7] Further inquiries were not conducted to define the degree of effectiveness of the composting activities reported. Informal discussions with informants suggest however that these are slow techniques whereby organic matter is gradually added to a pile or in a pot and is naturally decomposed over time to form compost.

Lastly, the frequency of waste collection services varies from between twice a week to daily. Figure 6-7 reveals that household waste is collected three times a week in four out of 27 residential dwellings, and twice a week in 11 out of 27 households. There was only one case which featured waste collection only once a week. This implies that the majority of residential units researched have access to waste collection services at least twice a week. The results show a higher frequency of waste collection services among more affluent cases.

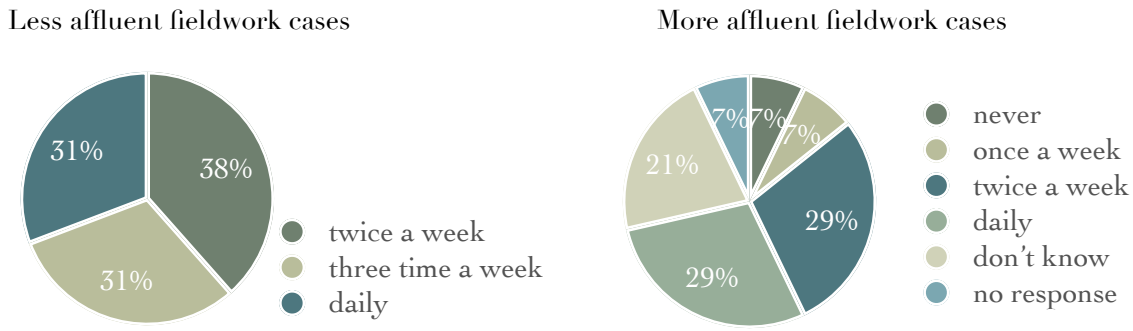


Figure 6-7 Responses concerning the frequency of waste collection services

With regard to the perception of the level of participation of the community (Figure 6-8), eight respondents from less affluent cases ranked the level of community participation as medium and five respondents conceived their community with a low level of participation. Responses obtained from more affluent cases show that community participation is perceived as medium by half of the respondents. In this context, community participation refers to the involvement of individuals in the arena of neighborhood improvement and welfare. This may include basic urban sanitary services, neighborhood security and any other specific needs that the community or neighborhood might have.

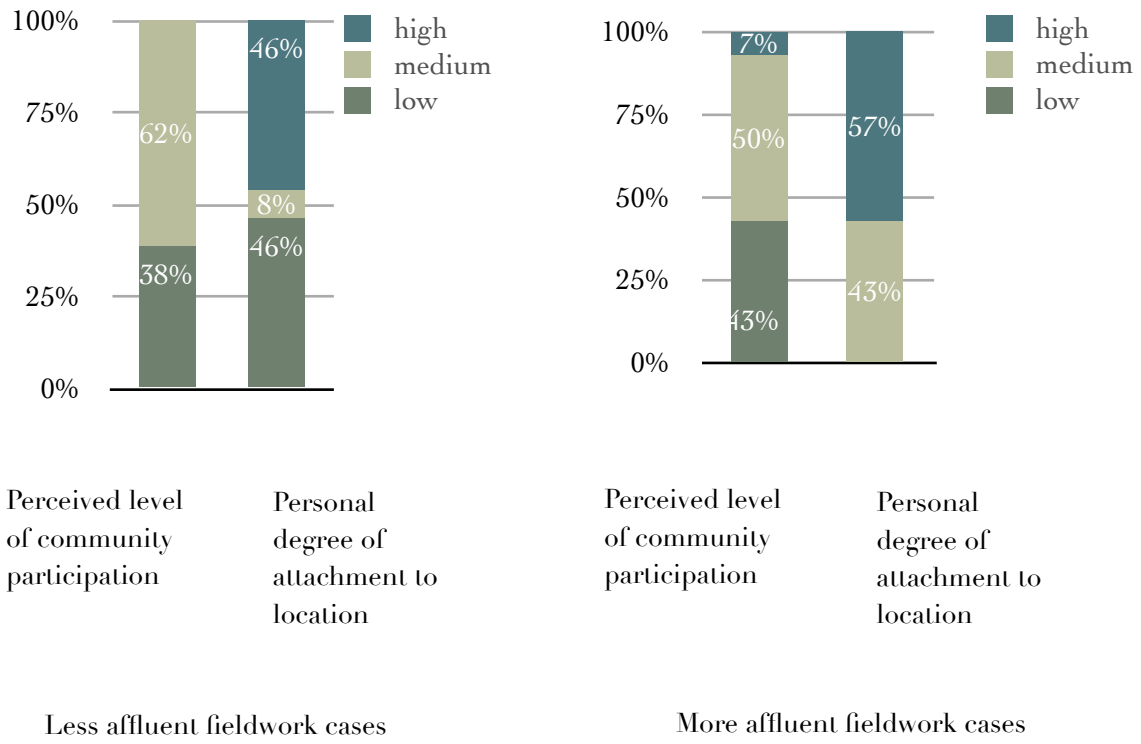


Figure 6-8 Responses concerning the perception of community participation and the degree of neighborhood attachment

Despite ranking community participation low and medium, respondents showed positive signs of place attachment. In less affluent cases, the same number of responses were obtained for high and low personal degree of attachment to their neighborhood. In contrast, informants from more affluent cases ranked their personal degree of attachment higher with more responses with a high rank than those with a medium rank as illustrated in Figure 6-8.

Additional questions on neighborhood trust revealed that respondents had more faith in their neighbors in more affluent fieldwork cases. Results show four times as many positive responses than in less affluent cases. The question on trust was intended to elicit respondents' views on the extent to which they could rely on their neighbors for help and if they were considered trustworthy. The next segment explores further the questions of food separation and disposal as well as the amount of waste generated in four selected cases.

6.4 Food waste composition analysis in selected fieldwork cases

Although dwelling characteristics are significant for an understanding of how the built environment influences household food waste management, it is also important to investigate characteristics beyond the physical if food waste trends are to be understood in the domestic sphere. The food waste diary kept for seven days aimed at providing a deeper insight on the composition of food waste produced in each household and provides more facts on food waste disposal practices. In total, 210 dairy entries were reviewed. At first glance, the diaries reveal a large amount of fruit and vegetable peelings being discarded in both less and more affluent Mexican households, which supports in fact the notion that Mexican meal preparation practices contain many raw ingredients such as onions, garlic, herbs which are non-edible in their raw state and is removed or added to a particular meal. A change in the composition of food waste on weekends and special occasions was also observed.

A detailed account of four selected households follows.[8] This was done by correlating the information obtained from the questionnaire, the food waste diary and the weighing recording sheets with informal discussions and additional data obtained from household informants. Among the 27 households studied in the MCMA, Case No.s 17 and 26 (less affluent) and Case No.s 01 and 20 (more affluent) were selected.

The criteria for selecting these households is as follows:

- The type of dwellings in all cases is representative of the most dominant dwelling type in the urban context of MCMA
- The average occupant per dwelling is comparable to the average of 3.6 occupants per dwelling in the Federal District
- The average food waste production per capita per day in Case No.s 17 and 26 featuring 0.16kg/d.ca and 0.15 kg/d.ca respectively is close to the average of less affluent cases of 0.20kg/d.ca

[8] For more information on the data collected from all fieldwork cases, see annexed CD-Rom

- The average food waste production per capita per day in Case No.s 1 and 20 featuring 0.17 kg/d.ca and 0.21 kg/d.ca respectively is close to the average of more affluent cases of 0.14 kg/d.ca

6.4.1 Food waste composition analysis fieldwork Case No. 17

Portrait of the household

Figure 6-9 Street view picture Case No. 17

This household comprises a couple without children. A male informant in the age group 25-34 was responsible for keeping the food waste diary. He reported sharing a five bedroom detached unit with his a female partner in the peripheral north of the Federal District in the State of Mexico. (See genogram Figure 6-10). The household's daily food consumption style was 'home-cooked meal' which was commonly shared at dinner time. The food was usually purchased at the supermarket and prepared by both household members. The informant reported that the food purchased was relatively package-intensive and some excess cooked food occurs after each meal preparation. The diary matrix (Table 6-7) summarizes the food waste reported by the household and shows the general kitchen bin as the preferred disposal location followed by the kitchen drain (Figure 6-11). The food waste description includes several bones and pork sausages entries which revealed that more raw food and meat scraps were produced followed by fruit and vegetables (Figure 6-12). Day 2 and Day 7 were not registered suggesting that no meals were consumed inside the house that day. The informant revealed that food waste was not separated from other types of

waste, this implies that any separation prior to disposal (which consists mainly of recycling items) would be conducted by collectors or sweepers at different stages of the waste management flow.

A transect walk in the neighborhood revealed bustling streets with narrow sidewalks, filled with parked vehicles. The area comprises a mix of small businesses and compact two-story residential dwellings. Buses and private automobiles are the main transportation options for residents. (See street view picture Figure 6-9).

Table 6-7 Food waste diary matrix case 17

Entry No.	Day	Type of meal	No. persons sharing meal	Food waste category	Food waste description	Location of disposal
1	D1	Breakfast	5	beverage	atole	kitchen drain
2				spoiled cooked food/ excess food	soup	kitchen drain
3				fruit/ vegetable peelings	garlic	general kitchen bin
4				fruit/ vegetable peelings	tomatoes	general kitchen bin
5				fruit/ vegetable peelings	limes	general kitchen bin
6	D2	-	-	-	-	-
7	D3	Dinner	1	raw food/meat scraps	bones	general kitchen bin
8						kitchen drain
9	D4	Dinner	15	spoiled cooked food/ excess food	tortillas	general kitchen bin
10				beverage	beer	kitchen drain
11	D5	Dinner	1	raw food/meat scraps	bones	general kitchen bin
12				raw food/meat scraps	pork sausage	general kitchen bin
13	D6	Dinner	1	raw food/meat scraps	pork sausage	general kitchen bin
14				raw food/meat scraps	bones	general kitchen bin
15	D7	-	-	-	-	-

Some food categories were edited for clarity purposes. The most often registered food waste category is raw food/meat scraps with 5 entries, followed by fruit/ vegetable peelings with 3 entries. In this household food waste is mostly disposed of in the general kitchen bin (9 entries) or the kitchen drain (4 entries).

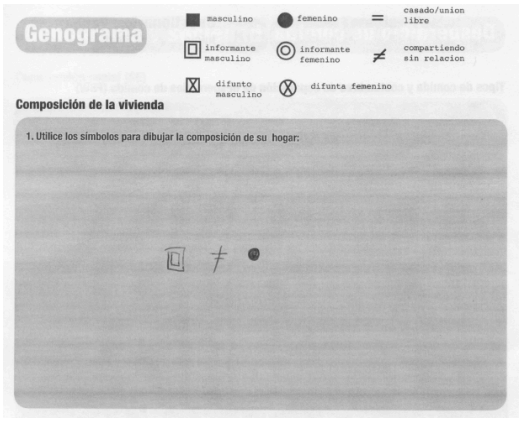


Figure 6.10 Genogram Case No. 17

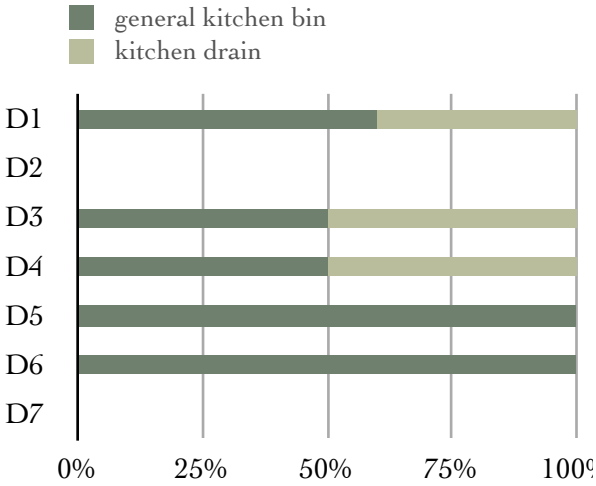


Figure 6-11 Food waste disposal patterns

Note: the percentage in Figures 6-11 and 6-12 refers to the number of entries registered in the food diary

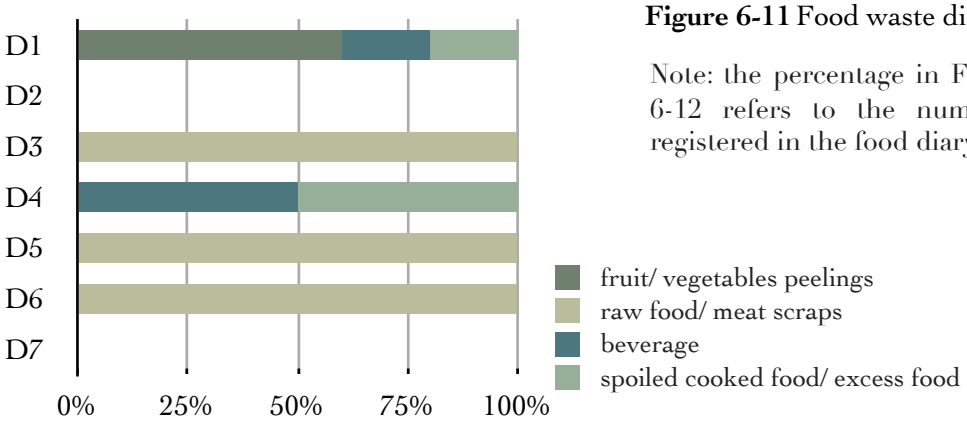


Figure 6-12 Food waste category

Table 6-8 Food waste separation, composting and community perception

Most common shared meal	Existing food waste separation habits	Collection service frequency	Composting experience	Community participation	Community trust
dinner	no	twice a week	no	medium	don't know

Table 6-9 Food waste weighing record matrix

		Marginal notes
Weight entry No.1 (kg)	2.22	An empty bin type Santul (0.217 kg) was provided along with a Onn-E20 digital scale with a max. capacity of 5 kg. One entry was registered. The number of persons sharing the meal on Day 3 suggests that a particular event (gathering/celebration) took place that day.
Total weight registered (kg) per week	**2.22**	
Average weight food waste (kg) per week, per capita	1.11	The number of household occupants (two members) was taken into account
Average weight food waste (kg) per day, per capita	0.16	7 days were considered

6.4.2 Food waste composition analysis fieldwork Case No. 26

Portrait of the household

Figure 6-13 View of adjacent plot and neighboring dwellings of Case No. 26

The family - a married couple and two dependent children under the age of 12 - shares a three bedroom detached unit located in the peripheral west of the Federal District, on a crowded and sloped plot as shown in Figure 6-13. The female household head, in the age group 25-34, was the main contact person. She was responsible for keeping the food waste diary and contributed distinctly to the empirical work. Although she indicated 4 household members in the Genogram (Figure 6-14), she specified later that her mother in law who lived in separate quarters within the same compound, shares some of the meals with her family. This was a case of an extended household with intertwined housing dynamics but retaining however some spatial barriers. The household's daily food consumption style was 'home-cooked meal' which was commonly shared by household members at dinner time. The food was usually purchased at the supermarket and at local markets known locally as *mercado sobre ruedas.*[9] The food was prepared by two adults. The food purchased was relatively package-intensive and excess cooked food usually occurred after each meal preparation. The household's dairy summarized as a matrix in Table 6-10 shows that fruit and vegetable peelings were separated from the main food waste stream as by-products for plant and animal feed. This suggests

[9] These are markets on wheels which set up weekly on a specific street in neighborhoods.

ongoing organic waste separation practices in the household. Figure 6-16 shows four main food waste disposal locations: plants, compost, animals and the general kitchen bin. The food waste description includes items such as egg shells, tomato seeds, bones and tortillas, which reveals mixed food waste categories with a prevalence of fruit and vegetable peelings (Figure 6-15). The informant mentioned lacking space for food waste storage, which perhaps explains why vegetable peelings are directly disposed of onto plants and pots in a small green patch. Composting was considered a common practice in this household.

Table 6-10 Food waste diary matrix: fieldwork Case No. 26

Entry No.	Day	Type of meal	No. persons sharing meal	Food waste category	Food waste description	Location of disposal
1	D1	Dinner	3	nothing	nothing	nothing
2	D2	Dinner	5	nothing	nothing	nothing
3	D3	Dinner	4	raw food/ meat scraps	chicken bones	animal
4				fruit/vegetable peelings	tomatoes seeds	plants
5			1	beverage	leftover coffee	plants
6	D4	Dinner	3	fruit/vegetable peelings	coffee grain	plants
7				fruit/vegetable peelings	eggs shells	plants
8				fruit/vegetable peelings	tomato peelings	compost
9	D5	Lunch	2	fruit/vegetable peelings	eggs shells	plants
10				fruit/vegetable peelings	onions peelings	general kitchen bin
11	D6	Lunch	3	raw food/ meat scraps	beef bones and grease	animal
12				spoiled cooked food/ excess food	tortillas	animal
13				spoiled cooked food/ excess food	food stock	animal
14	D7	Dinner	5	fruit/vegetable peelings	habas peelings	plants
15				fruit/vegetable peelings	eggs shells	plants
16				fruit/vegetable peelings	coffee grain	plants

Coffee grains and egg shells were regrouped as vegetable/ fruit peelings. The most often registered food waste category is fruit/vegetable peelings with 8 entries followed by spoiled cooked food/excess food with 2 entries. Excess cooked food represents remnants of cooked food thrown away during or after a meal. This type of food waste is not necessarily spoiled, however interviews with residents suggest that this type of food waste caused particular concerns in the household. Vegetable and fruit waste items were directly disposed of onto plants and excess cooked food waste was mostly utilized as pet feed.

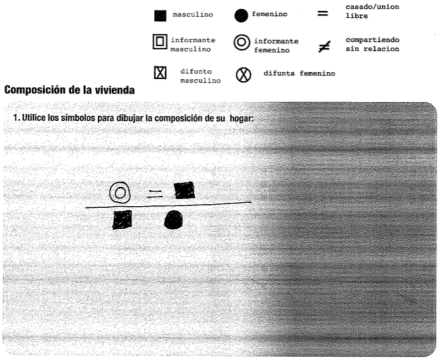


Figure 6-14 Genogram Case No.26

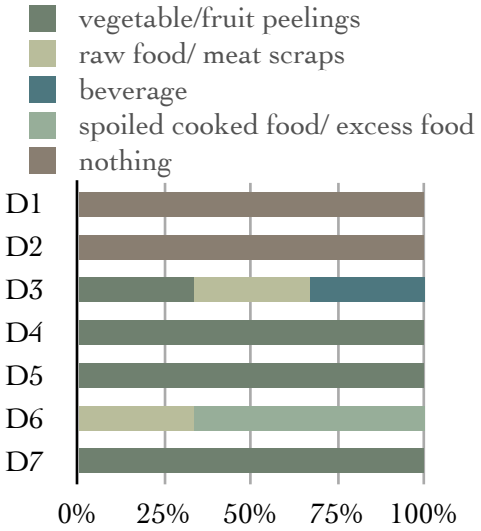


Figure 6-15 Food waste category

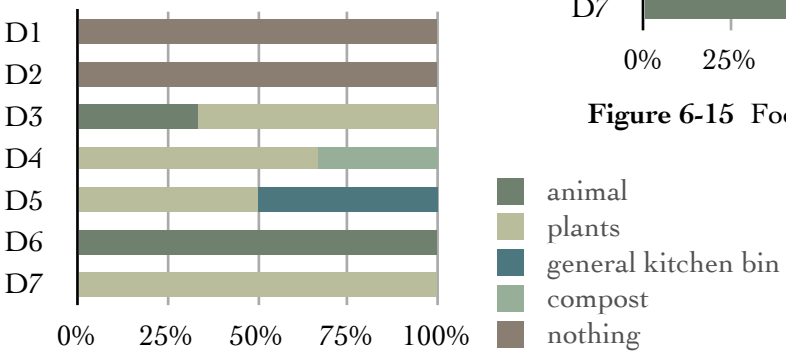


Figure 6-16 Food waste disposal patterns

Table 6-11 Food waste separation, composting and community perception

Most common shared meal	Existing food waste separation habits	Collection service frequency	Composting experience	Community participation	Community trust
dinner	yes	three times a week	yes	low	yes

Table 6-12 Food waste weighing record matrix

		Marginal notes
Weight entry Nr.1 (Kg)	3.15	An empty bin type Santul (0.217 kg) with a Beurer KS58 digital scale with a max. capacity of 5 kg was provided. Two entries were registered
Weight entry Nr.2 (Kg)	1.01	
Total weight registered (kg) per week	**4.16**	A high level of moisture was observed during the weighing procedure. The informant wrote "*Deshechos húmedos cáscaras de frutas, huesos de pollo, grano de cafe, tortilla, cáscaras de tamal, cascarones de huevo, huesos de aguacate y cascaras*"
Average weight food waste (kg) per week, per capita	1.04	The number of household occupants (four members) was taken into account. However, the amount obtained might be lower considering that another household member occasionally shares the meals and that the weighed waste was moist during the time of weighing
Average weight food waste (kg) per day, per capita	0.15	7 days weighing

6.4.3 Food waste composition analysis fieldwork Case No. 01

Portrait of the household

Figure 6-17 view of neighboring house in the same estate as Case No. 01

This family lives in a large property located in Mexico City's mountainous south-west area characterized by pine-oak forests and high mountain grassland (Figure 6-17). The household consists of four members, a married couple and two dependent grown-up daughters between the ages of 17 and 21 as indicated in the genogram (Figure 6-18). The oldest daughter was responsible for keeping the food waste diary and contributed greatly to the empirical work by further applying the tools to other neighboring households. The household's daily food consumption style is 'home-cooked meal' which was commonly shared by household members during breakfast, lunch and dinner. The food was usually purchased at the supermarket and at local markets and is relatively package-intensive. The food is prepared by all four adult members with some excess cooked food after each meal preparation. The household's matrix from Table 6-13 shows that fruit and vegetable peelings were separated from the main food waste stream for animal feed and pet food. Indeed, most food waste produced was given to animals (Figure 6-20). The family raises approximately a dozen animals including chicken, rabbits, pigs and deer. The food waste description includes items such as lettuce, cucumber peelings, liquid shake excess, chicken bones, bread crusts among other items revealing mixed food waste categories with a prevalence of fruit and vegetable peelings (Figure 6-19). Also see Appendix A-9.

Table 6-13 Food waste diary matrix: fieldwork Case No. 01

Entry No.	Day	Type of meal	No. persons sharing meal	Food waste category	Food waste description	Location of disposal
1	D1	Dinner	3	fruit/vegetable peelings	onion	animals
2				fruit/vegetable peelings	lime	animals
3				fruit/vegetable peelings	lettuce	animals
4				fruit/vegetable peelings	cucumber peelings	animals
5				beverage	milk	kitchen drain
6	D2	Breakfast	4	fruit/vegetable peelings	apple peels	animals
7				fruit/vegetable peelings	kiwi peelings	animals
8				fruit/vegetable peelings	carrot	animals
9				spoiled cooked food/ excess food	tortilla	animals
10				beverage	liquid shake excess	kitchen drain
11	D3	Lunch	-	fruit/vegetable peelings	apple peelings	animals
12				spoiled cooked food/ excess food	bread rest	animals
13				fruit/vegetable peelings	watercress stems	animals
14	D4	-	-	-	-	-
15	D5	Dinner	-	fruit/vegetable peelings	cucumber peelings	animals
16				fruit/vegetable peelings	yam bean (jícama)	animals
17				spoiled cooked food/ excess food	bread rest	animals
18				fruit/vegetable peelings	lime	animals
19				beverage	milk	kitchen drain
20	D6	Breakfast	2	spoiled cooked food/ excess food	excess of enchiladas	animals
21				fruit/vegetable peelings	lime peelings	animals
22				raw food/ meat scraps	chicken bones	general waste bin
23				spoiled cooked food/ excess food	soup rest	kitchen drain
24	D7	Breakfast	0	nothing	nothing	nothing

Some food waste items described have been edited for legibility purposes. The most often registered food waste category is fruit/vegetable peelings with 13 entries followed by spoiled cooked food/ excess food with 5 entries. In this household food waste is mostly utilized as livestock feed product. Entries of location of disposal are: Animals (17) - Kitchen drain (4) - General waste (1).

Figure 6-18 Genogram from Case No.01

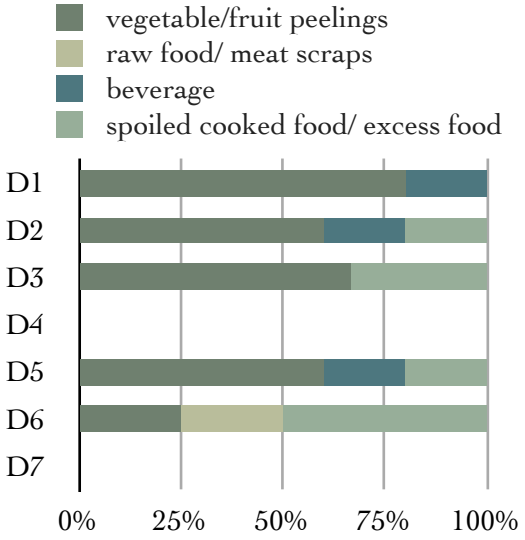


Figure 6-19 Food waste category

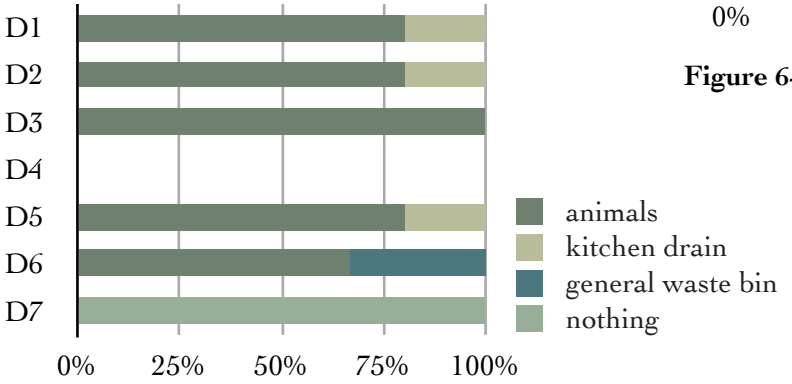


Figure 6-20 Food waste disposal patterns

Table 6-14 Food waste separation, composting and community perception

Most common shared meal	Existing food waste separation habits	Collection service frequency	Composting experience	Community participation	Community trust
breakfast, lunch, dinner	yes	never	no	medium	yes

Table 6-15 Food waste weighing record matrix

		Marginal notes
Weight entry Nr.1 (kg)	2.43	An empty bin type Santul (0.217 kg) with a Beurer KS58 digital scale with a maximum capacity of 5 kg was provided. Two entries were registered.
Weight entry Nr.2 (kg)	2.37	
Total weight registered (kg) per week	**4.80**	
Average weight food waste (kg) per week, per capita	1.20	The number of household occupants (four members) was taken into account
Average weight food waste (kg) per week, per capita	0.17	7 day weighing

6.4.4 Food waste composition analysis fieldwork Case No. 20

Portrait of the household

Figure 6-21 Street view picture Case No. 20

This household comprises two members without family ties; one of them is the informant who is a retired woman over 65 years of age. Figure 6-21 shows a street view of the residential area, a quiet secondary street located south of the Federal District. The informant shares a three bedroom detached unit with another female housemate as shown in Figure 6-22. The household's daily food consumption style iwas'home-cooked meal' which was eaten separately. The food was usually purchased at the supermarket and prepared by the informant. She mentioned there was always excess cooked food after each meal preparation. The diary matrix (Table 6-16) reveals predominantly fruit and vegetable peelings which are then separated from the main household waste. The food waste description includes items such as bananas, broccoli, celery and rice among others, the category of fruit and vegetable peelings appears as the predominant food waste produced according to Figure 6-23. Compost appears to be the main food waste disposal destination in the household (Figure 6-24). In this household, food waste separation was reported to have been practiced for over five years.

Table 6-16 Food waste diary matrix: fieldwork Case No. 20

Entry No.	Day	Type of meal	No. persons sharing meal	Food waste category	Food waste description	Location of disposal
1	D1	Breakfast	1	fruit/ vegetable peelings	banana	compost
2	D2	-	-	fruit/ vegetable peelings	carrot	compost
3				fruit/ vegetable peelings	broccoli	compost
4				fruit/ vegetable peelings	celery	compost
5				fruit/ vegetable peelings	apple	compost
6	D2	Lunch	1	fruit/ vegetable peelings	cabbage	compost
7				fruit/ vegetable peelings	lettuce	compost
8				fruit/ vegetable peelings	apple	compost
9				fruit/ vegetable peelings	radish	compost
10				fruit/ vegetable peelings	poro	compost
11	D3	Lunch	2	fruit/ vegetable peelings	rice	compost
12				fruit/ vegetable peelings	Guava	compost
13				liquid/ beverage	oil	kitchen drain
14				beverage/ liquid	soda	kitchen drain
15				fruit/ vegetable peelings	pear	compost
16	D4	Breakfast	0	fruit/ vegetable peelings	eggs shells	compost
17				fruit/ vegetable peelings	nopal	compost
18				spoiled cooked food/ excess food	old cheese	compost
19				spoiled cooked food/ excess food	sauce	compost
20				spoiled cooked food/ excess food	cereal	compost
21	D5	Lunch	4	raw food/meat scraps	fish skin	compost
22				fruit/ vegetable peelings	coriander	compost

Entry No.	Day	Type of meal	No. persons sharing meal	Food waste category	Food waste description	Location of disposal
23				fruit/ vegetable peelings	aubergine	compost
24				fruit/ vegetable peelings	paprika skin	compost
25				fruit/ vegetable peelings	cucumber skin	compost
26	D6	-	2	fruit/ vegetable peelings	old tortilla	compost
27				fruit/ vegetable peelings	bacon	compost
28				fruit/ vegetable peelings	pear skin	compost
29				fruit/ vegetable peelings	guava	compost
30				fruit/ vegetable peelings	tamarin seeds	compost
31	D7	Lunch	3	fruit/ vegetable peelings	lentils	compost
32				fruit/ vegetable peelings	watermelon skin	general kitchen bin
33				raw food/meat scraps	meat	general kitchen bin
34				fruit/ vegetable peelings	eggs	compost
35				beverage/ liquid	juice	kitchen drain

Some food waste items described have been edited for legibility purposes. Some inconsistencies were observed between the food waste category and food waste description. Also there is an inconsistency between the statement offered in the questionnaire on 'no composting experience' and the compost entries reported in the diary. The most registered food waste category is fruit/vegetable peelings with 27 entries followed by spoiled cooked food/ excess food and beverage/liquid with 3 entries each. In this household food waste appears to be mostly composted. Entries of location of disposal are: Compost (30) - Kitchen drain (3) - General waste bin (2).

Note: Although the response obtained in the questionnaire for composting experience was negative, it appears however that some composting does occur as stipulated in the food waste diary and was confirmed through further exchange with the informant.

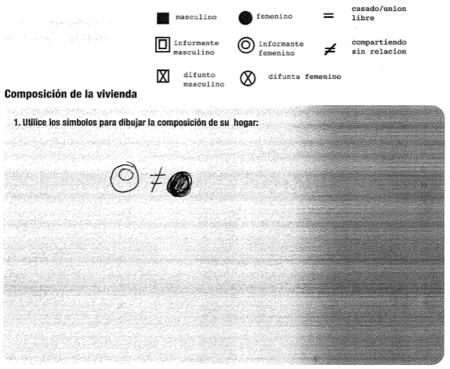


Figure 6-22 Genogram Case No. 20

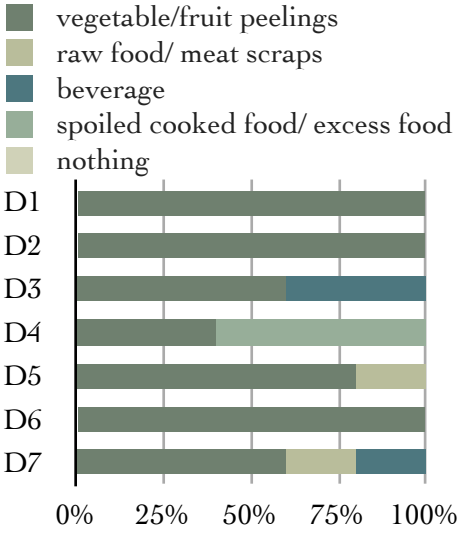


Figure 6-23 food waste category

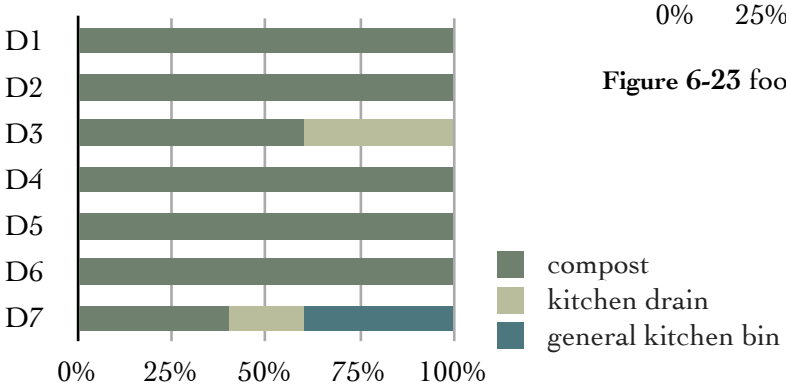


Figure 6-24 food waste disposal patterns

Table 6-17 Food waste separation, composting and community perception

Most common shared meal	Existing food waste separation habits	Collection service frequency	Composting experience	Community participation	Community trust
none	yes	twice a week	yes/no	low	yes

Table 6-18 Food waste weighing record matrix

		Observation
Weight entry Nr.1 (Kg)	3.00	An empty bin type Santul (0.217 kg) with a Beurer KS58 digital scale with a maximum capacity of 5 kg was provided. One entry was registered.
Total weight registered (kg) per week	3	
Average weight food waste (kg) per week, per capita	1.50	Although meals were consumed separately, two household occupants were taken into account
Average weight food waste (kg) per day, per capita	0.21	7 day weighing

The conclusion that can be made after analyzing the composition of the food waste in the above cases is that edible excess food is the least discarded category of food waste. In contrast, a rather large portion of fruit and vegetable peelings, bones, and meat trimmings was observed in the matrices. It is important to note that the dominant food consumption style was home cooked meals for which inedible ingredients were employed for meal preparation. This is closely related to the culture of Mexican cuisine which is based on mixes of raw organic goods. The families that took part in the food waste diary produced mostly unavoidable organic by-products. Food was overall valued and preserved. Further discussions with different household members showed that there was a general attitude in which food commodities were considered in monetary terms. Therefore there was an inherent food waste awareness and avoidance attitude derived more from economic considerations than from environmental/waste reflection. Animal feed plays a role in the daily separation of household food waste and is prioritized above plant feed. As recycling and waste separation is becoming mandatory in primary and secondary schools, households with small children may be more prone to friendly environmental behaviors, however these households remain those where the most food waste was produced. With regard to composing activities, it was observed that composting practices stemmed from two sources. On the one hand composting was perceived as a natural process of handling organic waste, on the other hand composting food waste responded to the lack urban services. It was also observed that composting seemed natural in some in less affluent cases as it derived to some extent from the reproduction of rural habits.

While the above analysis derives from a more in-depth examination of household food waste composition and habits, the next segment attempts to respond to the way in which the urban context influence food waste management in the cases of the study. To achieve this, an influence model connects identified external and internal determinants in both less and more affluent cases.

6.5 Diagnostic of urban contextual dimensions and factors that influence food waste management in less and more affluent cases

In addition to the dwelling units' physical attributes, a number of factors particular to the urban context within which both less and more affluent cases are embedded were identified. These factors vary in dimension and in scope and are regrouped under three main overarching contextual clusters:

(1) the urban natural refers to the physical arrangement and geographical features of the urban environment

(2) the urban built relates to the human-made or altered spaces particularly regarding the parallels between buildings and services

(3) the urban socio-cultural implies questions of lifestyle and practices proper to the culture

Figure 6-25 shows an influence model that highlights how less and more affluent cases are embedded in an urban ecosystem in which the natural context, human socio-cultural factors and the built structure interact to different degrees. This interaction, although not entirely linear, shapes the contextual circumstances of urban dwellers who - in the case of Mexico - need to restore the urban structure in order to conserve the natural environment which sustains it. The assumption here is that the built environment often expands in ways that compromises natural systems. For instance transformed lifestyles and social structure play a role in the selection of goods and the production of waste, hence influencing the natural conditions of cities. Similarly, our individual and collective behavior has an impact on how cities perform. There is a growing concern regarding how Mexico City will develop, how much land needs to be occupied and how resources are used. All in all, the urban sphere is both a consumer and digester of resources which ultimately affects the livelihood and lives of those with more or less capacities.

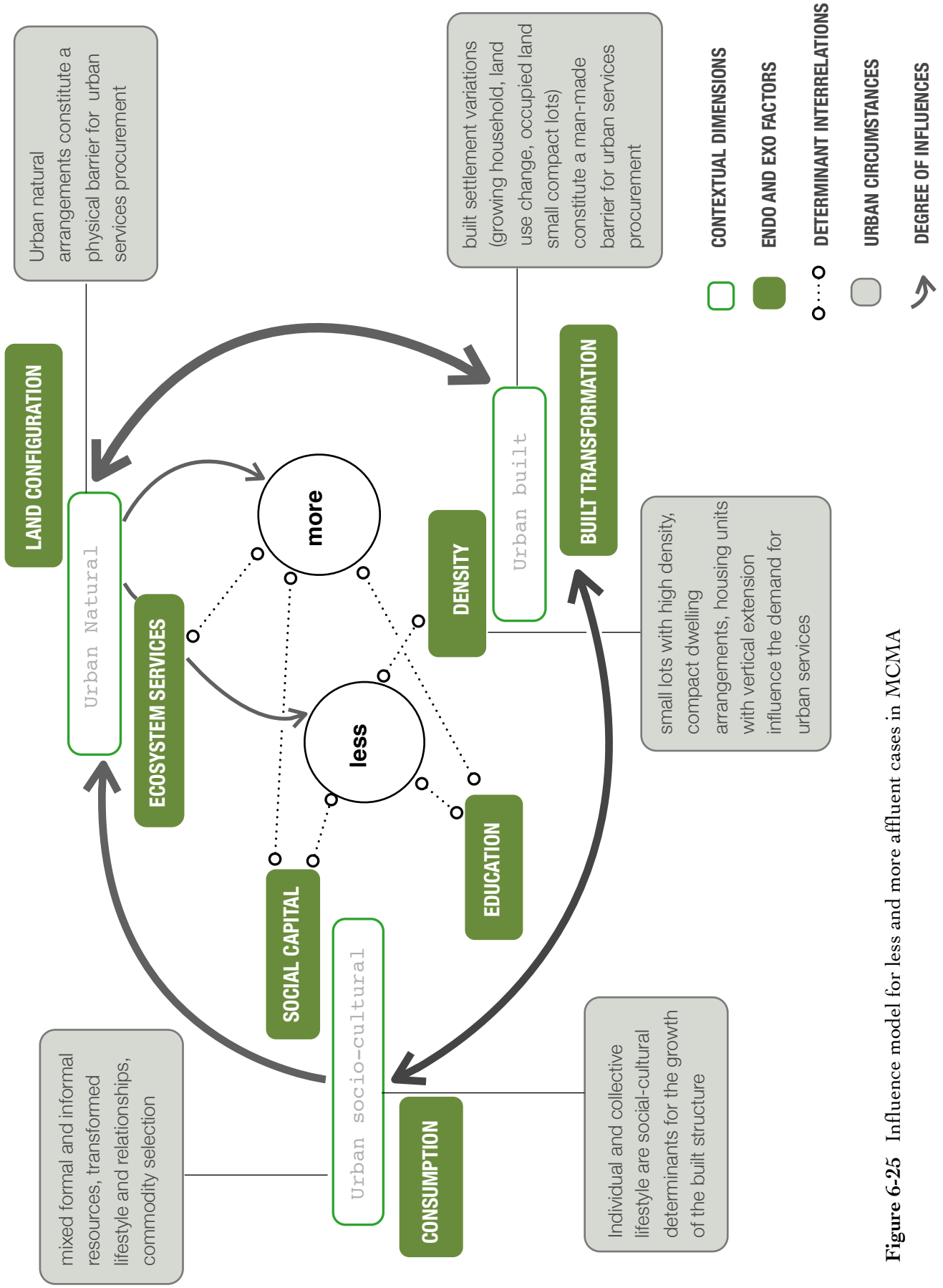


Figure 6-25 Influence model for less and more affluent cases in MCMA

Restrictions of the land configuration: Hazard prone location and conservation zone

In the particular case of the Federal District, the natural area in which many buildings are located interfere with the implementation of the infrastructure needed to provide urban services such as food waste collection. In Case No.s 25, 26, 27 and 28, topographic conditions such as pronounced slopes, steep up-land plots or low-lying flat lake beds complicate the delivery of water and sewer services. Indeed, settlements located in hazard prone areas are not only subject to landslides and flooding but are also more likely to suffer from water restrictions and inadequate drainage due to the fact that the infrastructure necessary to service these areas may be costly and slower to be implemented.

The southern area of Mexico City, is subjected to land conservation restrictions, which also plays a role in the expansion of the urban infrastructure. In the 1980s Mexico City was provided with a preservation zone, which aimed at conserving the ecological characteristics of large portions of mountain slopes and forests, such as those of in *Chichinatzin*, *Las Cruces* and *Ajusco*. These areas which comprise specific ecosystems and provide environmental services to the Federal District are subject to two main regulatory frameworks: one restrictive with a biodiversity and ecological perspective, *Programa de planeación ecológica del Distrito Federal* and the other rather historical and socially oriented *Programa General de Desarrollo Urbano del Distrito Federal* (Aguilar, 2008). Despite these initiatives, the conservation area of the South has been partly urbanized through land use changes, legalization of plots and occupied land. Case No.s 1, 18 and 19 located in *Ajusco* have been consolidated through diverse urbanization paths and due to their location lack one or more urban services.

Built transformation and basic service access

Urban growth manifest in part by the diversity of building structures exceeds the rate of urban service procurement in peripheral areas. These areas host a growing number of settlements which not only vary in land tenure and land use but also

present multiple structures to accommodate different needs. A typical block would vary between 39 to 40 meters and would include a variety of dwelling types and uses. It is clear that the rate at which constructions emerge and evolve at the outskirts of the Federal District exceeds the rate of urban service procurement. The mix of building conditions that characterized Case No.s 25, 26, 27 and 28 for instance, stems from a tradition of self-help construction *autoconstrucción* in which both permanent and disposable materials are used. Even though urban conditions (legalization of plots, road pavements, consolidation of main buildings, social infrastructure procurement) have improved in these areas in the past 40 years, the dynamic consolidation of the dwellings continues to exert pressure on local government demanding more and better services.

Density and settlement compactness

Homogeneous and compact lots with a high density level demand more urban services and occupy land in a way that restricts access to immediate green areas. This is particularly evident in Case No.s 11 and 14 located in the peripheral north and are embedded in settlements where two to three dwellings may incorporate one lot. The norm is that the whole lot would be occupied by one or more constructions on one or two levels, depending on the use residential, commercial or both.

The peripheral north-east area presents therefore a built structure composed of uniformed lots in a grid layout with a high density level. This is partly due to resettlement programs, the emergence of large low-income housing estates and industrial activities. Housing units in these areas lack green structure and only offer vertical extension options. These settlements present a nuclear internal structure while retaining a strong administrative, political and social connection with other districts of the State of México. The spatial restrictions within which they are embedded particularly influences street cleaning services and collection services.

Social capital and commodity access

All the households investigated have different levels of social capital.[10] In less affluent cases social capital represents an asset that has a direct impact on householders' livelihood and contribute to accumulate goods and incrementally upgrade living conditions. [11] For instance, in the Case No. 26 progressive network building and the inherent ability that the female head of household has to relate to others may have allowed this family to differentiate itself from other households living in the area and under similar contextual circumstances. The ability to make use of human resources is a skill that was observed in most of the cases investigated, as it represents a characteristic of the Mexican society. These human assets are utilized vertically or horizontally to different degrees. For instance social capital seems to opens economic opportunities in less affluent cases despite the fact that a lower level of trust has been reported among them. These findings confirm to some extent the idea that reciprocity in waste management is more important then trust (Pargal et al., 1990). At individual levels, it may well be that the ability to relate to others also builds a certain sense of cohesion and acceptance between groups. In more affluent groups, social capital is observed rather in terms of shared interest, a sense of trust in the ability of collective action to obtain something.

Summary of what was obtained from measuring food waste from residential areas:

The welfare of each household stems from factors that vary depending on the historical and social development of its occupants, thus the research design focused less on the socio-economic differences and more on the building and infrastructural characteristics that may indicate a certain level of wellbeing. Based on these features, a broader grouping was established considering two main categories: Less affluent and more affluent fieldwork cases.

[10] Social capital is understood here as the sense of trust and the ability to network and promote cooperation between two or more individuals. For more information on social capital see: (Coleman, 1988; Woolcock, & Narayan, 2000).

[11] For more references on social capital as an asset accumulation See: Caroline Moser's (2009) contribution titled 'Ordinary families, Extraordinary lives' which provides a detailed account on asset within a livelihood framework approach.

Less affluent cases are households located in perceived economically challenged settlements and were found at the outskirts of the Federal District. Some of these cases lack basic service provision and also feature endemic vulnerabilities such as lack of human resources (education) affecting their living conditions. The average food waste weight registered per capita per day is 0.20kg/d.ca which represents approximately 20% of household waste production registered in the Capital.

Less affluent cases featured buildings with various states of consolidation mostly involving vertical extension (second floor) and improvement in lavatory and kitchen facilities. These gradual improvements in living conditions are mostly self-help initiatives which can last several years. The informal sector (particularly informal waste collectors and street cleaners) is most likely to service less affluent settlements due to the limited access that formal operators have in peripheral areas. These limitations are a combination of remoteness, which complicates the delivery of services, economical means and security. The practice of food waste recycling is more likely to be found among less affluent cases partly due to inherited rural practices and the need to find alternatives to restricted collection services.

More affluent cases have a certain degree of heterogeneity are more economically stable, financially healthy and are characterized by some autonomy or resilience when faced with shortcomings in service provision. These households feature some internal capacities in terms of networks from which they derive benefits that in turn affect their life conditions. The average food waste weight registered per capita per day is 0.14kg/d.ca which represents approximately 14% of household waste production. More affluent cases live in more central and wealthier dwelling units with access to better infrastructure and more frequent urban services provided by both formal and informal sectors. The sense of communal trust is perceived as high in affluent contexts.

In both less and more affluent cases, food is preserved as it is valued in monetary terms. Animal feed plays a role in the daily separation of household food waste and is prioritized above plant feed. Food waste awareness and avoidance attitude stem from economic considerations above environmental/waste reflections. Since 2003, as recycling and waste separation was promoted in local institutions, households with children in primary and secondary schools appear to be subjected to environmental education. The selection of goods and the increase in packaging waste is a reflection of transformed lifestyles across all households investigated.

The limited number of cases researched does not allow for generalization. Instead the findings provide elements for drawing parallels between the household structure, contextual circumstances and the food waste weight reported in each case. Understandably the results vary across the 30 cases researched. In fact each household represents a unique case that exemplifies how food waste is produced at the local level.

- The less affluent cases produce on average 0.20 kg/d.ca food waste. These households appeared to be are more affected by external environment stressors (lack of infrastructure), They also feature a strong place attachment (average 14 years), respondents appear to trust less, and are more inclined to micro-scale food waste treatment

  Implication: **Better education & training, promotion of environmental values and incentives to alternative techniques**

- The more affluent cases have access to more goods, produce on average 0.14 kg/d.ca food waste. These households appear to be more resilient to external stressors (have resources and therefor access to services), have also place attachment, respondents appear to trust more, and are less inclined to micro-scale food waste treatment

  Implication: **More effective/demand driven service delivery**

The influence model suggests that the city should be considered as a tripartite interconnected system in which less and more affluent groups consume resources and produce waste at different rate and are serviced in various forms. A planning implication is that effort and investment in educating planners, architects, social workers, waste practitioners, community stakeholders are likely to have a multiplying effect in the organization and structure of local neighborhoods and future Mexican settlements. The focus of the next chapter addresses the distinction between the planning strategies envisioned in MCMA and the instrumentations and actions that results from these. It also considers how can food waste management enhance urban design and planning. What do urban planners, designers and scholars need to know?

7. Urban planning & design implementation

The emphasis in this chapter is on urban planning and urban design. The disparity between the strategies envisioned in the Mexico Metropolitan Area and the instrumentation and action that results from them, resides in ideological and operational development barriers. This chapter examines aspects of food waste management that can be associated or should be considered in urban design and planning. Seven criteria for better practice are put forward.

7.1 Urban Planning in the Mexico City Metropolitan Area

Despite the fact that great efforts are currently made towards urban sustainability in the Mexican capital, the links between food waste management and urban planning is yet to be well defined and implemented. While there is a significant number of local contributions on environmental policies, land use and urban development in a broader sense, there are few concrete and specific links or recommendations on the extent to which a sustainable food waste management can contribute to better land management particularly with regard to issues such as land occupation and land conservation. These two concepts are central in the current environmental policy and urban development landscape as well as planning debates in the Mexican central region. There are two main types of zoning in the region: *suelo urbano* which can be broadly interpreted as 'urban land' and *suelo de conservation* which stands for 'conservation land' (Ciudad de México, 2010).[1] The contrast between implementations focusing on growth and productivity and those aiming at ecosystem integrity can be observed when reviewing different actions taken from the perspective of 'planning', which historically aims at reinforcing social and political processes. However, those taken from the perspective of the 'environment' are rather linked to protection, conservation and rationalization of the use of natural resources based on overarching principles of sustainability. The Mexican capital is not exempt from contemporary debates over how the city should be reformed and developed to accommodate visions of progress and development and environmental sustainability. In the local planning milieu efforts to reverse urban sprawl, tackle traffic congestion and alleviate the conditions of impoverished neighborhoods are present and stem from planning endeavors stretching from the early 1930s (Ribbeck, 2002). For the last 50 years, the Central Region planning objective has been to control urban densification, to contain the expansion of urban land, to improve the condition of peripheral settlements and to increase environmental

[1] These two main types of zoning were enacted in 2003 by the Urban Development Law of the Federal District *Ley de Desarrollo Urbano para el Distrito Federal*. 'Urban land' includes land use categories such as residential, commercial services, industrial open spaces and green spaces. 'Urban conservation' incorporates land use types such as touristic, recreational, forest, rural land, agriculture, fish and livestock farming, areas with environmental values and protected natural areas.

protection. The urban planning challenges the capital faces are well-identified and are for the most part:

- different political interest and agenda of the private sector
- political-administrative fragmentation
- discontinuity in programs and instrumentations
- lack of resources and tools
- pervasive land transformation

In the Mexican capital the landscape for urban development and planning incorporates a number of different commissions and institutions with different planning objectives and tools. Local planning programs generally stem from the MCMA's regional development goals, which in turn follow the nation's vision of growth and progress. This vision is expressed in the National Development Plan which is linked with the current federal political agenda for Mexico. Table 7-1 offers an overview of Mexico City's planning system and incorporates national, regional and local planning institutions as well as current programs to which planning actions are subjected. At the national level, the functions of urban planning are conducted by a sub-secretary of the Ministry of Social Development SEDESOL known as *Subsecretaria de Desarrollo Urbano y Planeación del Territorio*. SEDESOL's objectives reside under the overarching development goals of the National Development Plan known as *Plan Nacional de Desarrollo 2007-2012*. This institution seeks to design, regulate and coordinate urban development, regional planning and land use policies at a national level as well as to implement the Habitat program.[2] A development approach that is more regional is proposed by the Metropolitan Commission for Human Settlements whose goal is to incorporate the different goals of the 76 entities in the Metropolitan area into a single spatial strategy and to provide a framework for programs and actions from both public

[2] The Habitat program articulates the social policy objectives of the SEDESOL with the urban development vision of the federal government. The program aims to reduce urban poverty and to improve living standards in impoverished communities. The program finances among other proposals, infrastructure related projects such as road access, street paving, drainage systems and deals with expanding the coverage of services, including electricity, drinking water, sewerage, public lighting and solid waste disposal. For more information see: http://www.sedesol.gob.mx/es/SEDESOL/Programa_Habitat

Table 7-1 National, regional and local institutions and planning tools in the central region of Mexico

	National	Regional (MCMA)			Local	
		Metropolitan Zone	State of Mexico	Federal District	Municipalities	Boroughs
Institutions	Presidency of the United States of the Mexican Republic	Metrolopitan Comission for human settlements -*Comision Metropolitana de Asentamiento Humano*	Ministry of Urban Development - *Secretaría de Desarrollo Urbano*	Ministry of Urban Development and Housing SEDUVI - Secretaría de Desarrollo Urbano y Vivienda	Town halls *ayuntamientos*	Department of Public Works and Urban Development - *Dirección General de Obras y Desarrollo Urbano*
	Ministry of Social Development SEDESOL - *Secretaria de Desarrollo Social*					
Planning tools	Plan Nacional de Desarrollo 2007-2012	**Programa de Ordenación de la Zona Metropolitana del Valle de México 2008**	State of Mexico Development Plan 2005-2011 - Plan de Desarrollo del Estado de México 2005-2011	General Development Program of the Federal District 2007-2012 - Programa General de Desarrollo del Distrito Federal 2007-2012	Municipal Urban Development Plans - *Planes Municipales de Desarrollo Urbano*	Local Urban Development Programs - *Programas Delegacionales de Desarrollo Urbano (PDDUs)*
	Programa Sectorial de Desarrollo Social 2007-2012		**State Plan for Urban Development 2008 - *Plan Estatal de Desarrollo Urbano 2008***	**General Urban Development Program of the Federal District 2003 - *Programa General de Desarrollo Urbano del Distrito Federal (PGDU-GODF) 2003***		Partial Urban Development Programs - *Programas Parciales de Desarrollo Urbano (PPDUs)*
	National Urban Development and Planning Program PNDU-OT 2001-2006 *Programa Nacional de Desarrollo Urbano y Ordenación del Territorio PNDU-OT 2001-2006*					

and private actors. All of these intertwined technical and political processes influence the way settlements are planned and play a dominant role in the establishment of basic infrastructure services in these settlements. The control of the use of land and the conceptual framework to ensure the orderly development of communities traditionally incorporates research, analysis, diagnostics, recommendations, and implementation of two forms of land previously mentioned. The State of Mexico as well as the Federal District have developed their own urban planning strategies. The State of Mexico's Urban Development Plan is an instrument governing land use dating from 1983 and which has been modified and refined to meet new goals and a planning horizon reaching 2030. In January 2008, the State's planning system consisted of a state urban plan, two regional plans, 118 municipal plans and 5 partial plans targeted at specific actions in policy and regulation areas. Appendix A-10 includes the State's current urban development goals, policies and planning strategies, for which the main focus is the improvement of human settlements, competitiveness of urban centers, re-densification of specific areas and increasing urban sustainability.

Different tools that fit and suit the particular land use needs of the Federal District are used in urban planning. They are intended to promote a better use of the existing infrastructure and to respond more adequately to the social and economic requirements of Mexico City dwellers. The Federal District's urban development program is reviewed every six years and is based on its strategies from identifying problems facing the city and then defining its necessities. Approximately 49 interim local programs complement the General Urban Development Program from which a number of projects are executed. Urban design specific to the overarching strategic planning goals of the Federal District include projects such as: the rescue and rehabilitation of public spaces using existing infrastructure and improving the urban image, the protection of green areas and the implementation of policies aimed at improving pedestrian areas and the strengthening of social networks through coexistence in the city.

As in other urban territories, the Mexican planning process has a normative hierarchical character in which a general plan regulates detailed plans of an urban area that is more limited. In practice, it is the interaction of millions of individuals, the interest of private and public actors as well as globalized markets that influence the

shape of Mexican cities; as these factors exert pressure on the decision made when planning urban areas. In the Federal District the gap between normative land use scenarios and instrumentation and the fluid urban appropriation shape the existence, use and efficiency of urban amenities. In short, people do and the authorities amend. The core problem has less to do with planning and more with economic, political and environmental issues that foster the implementation of top down palliative design and solutions versus collaborative bottom up contributions.

7.2 Food waste management guideline for better practice in urban design

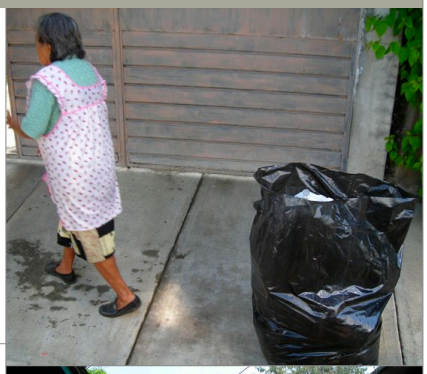
The ideas presented below are not exhaustive. They merely highlight some design barriers that may be solved through interdisciplinary knowledge exchanges on urban amenities planning combined with waste management practices. Seven criteria are proposed as a baseline for more efficient community management. The questions that guided this set of criteria investigate practical ways in which food waste storage and collection contribute positively to local urban planning. What needs to be considered in food waste management to influence sustainable urban design? How can food waste management contribute to the planning and design of more equitable and healthy communities? How can waste management initiatives help to improve self organization processes in urban planning, especially when taking into account threats such as unemployment/urban poverty, inequalities between less and more affluent groups, precarious urban services procurement in specific areas and weak ecological resources? Exploiting the following identified opportunities may support a more dynamic relationships between the built, natural and socio-cultural urban systems and help craft better urban management protocols:

1. Opportunities to improve the quality of living spaces in urban dwelling units
2. Opportunities promote sustainable environmental behavior in open spaces
3. Opportunities to improve urban aesthetics through adequate communal storage
4. Opportunities to improve traffic flow and neighborhood amenities
5. Opportunities to promote a more equitable urban environment
6. Opportunities to promote urban land conservation
7. Opportunity to improve human health and urban safety

Table 7-2 Guideline No.1

1	Opportunities to improve the quality of living spaces in urban dwelling units

- Residential unit planning and design should consider the fact that food preparation by-products (fruit and vegetables) and inedible residues of food (vegetable peelings) make up a large portion of the type of waste produced in residential areas. These types of organic waste are unavoidable. Design needs to incorporate the expansion and contraction of waste volume based on the dynamics of households
- Q: Is there an identifiable need in terms of waste space in dwelling units?



- Animal feed plays a role in daily diversion of food waste and should be prioritized and /or considered among other local waste diversion activities.
- Q: What other animals or livestock besides pets rely on food waste in the dwelling estate / community?

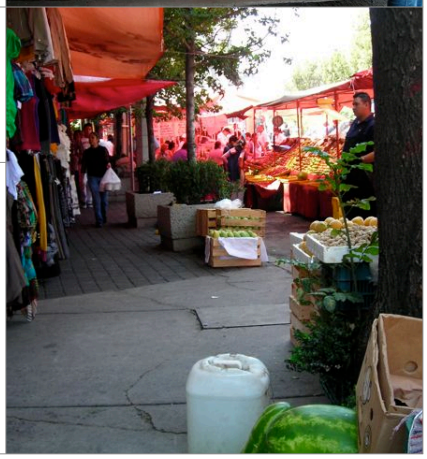
- Space inside dwelling units should allow for separate storage of organic and non organic waste according to the Waste Management Federal Law of the Federal District of 2003 in compliance with the Federal District environmental impact and risk regulatory frameworks of 2004

Table 7-3 Guideline No.2

2	Opportunities promote sustainable environmental behavior in open spaces

- Embracing density and diversity through design calls for using the dynamics of open spaces to enhance better waste management practices.
- Q: How can communities best combine the social and ecological functions of public spaces?

- Effective food waste recycling activities in open spaces can act as a carrier for enhancing conservation values, facilitating contact and communication and improving the livelihood of those interacting and using public spaces.



- Community planning and design should support and motivate local authorities into using open spaces as platforms for environmental reflections. Green areas, parks, plazas can be used to display and share best practices
- Market places (such as markets on wheels) play a role in the amount of household commodity input and output. Community design and planning should consider integrating markets and incorporating them as an urban instrument for recycling organic waste.
- Q: To what extent can the promotion of small-scale community composting in collective green areas/gardens be integrated into planning policies?

Table 7-4 Guideline No.3

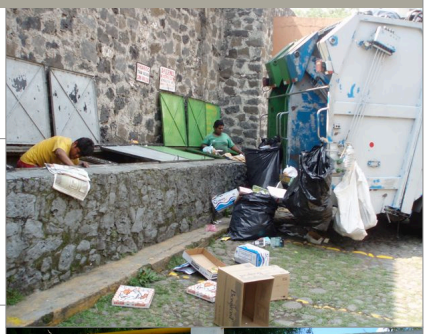
3	Opportunities to improve urban aesthetics through adequate communal storage
▸ Appropriate space for communal storage in combination with trees and shrubs design may help articulate and link urban spaces and may also provide the legibility of an area	
▸ Planners and designers should consider sufficient space for communal waste storage in multi-unit dwellings based on a household waste generation estimated between 0.9-1kg per person per day	
▸ Community design should provide sufficient space for interim storage location, within dwelling units of at least two days' worth of garbage and recycling (according to international standards).	
▸ Residential buildings/ *fraccionamientos*/ social housing design needs to incorporate sufficient space within the property boundary to store household waste in separate bins or containers	
▸ Multi-unit dwellings require adequate storage space for easy maneuvering of waste bags and bins within the dwelling estate in onsite collection areas. ▸ Q: Do new dwelling designs plan for internal maneuvering of waste collection vehicles and waste containers to be uploaded?	
▸ When possible the design of residential areas should provide the opportunity for slow composting of garden and food waste into a useful soil amendment to be reused within the compound. ▸ Q: how can food waste recycling as well as separate storage requirements be best integrated into internal buildings management regulations?	
▸ Solving waste issues at a ground level includes considering context-relevant communal particularities to clear potential obstacles that could influence the operation and use of waste storage facilities ▸ Q: Do stakeholder consultations include all important multipliers, and community leaders?	
▸ Proposals for communal waste storage should balance the following aspects: • convenience of location based on residents needs • space availability • noise sensitive • protected from potential vandalism • integration to urban surroundings	

Table 7-5 Guideline No.4

4	Opportunities to improve traffic flow and neighborhood amenities
▸ Consideration should be given to identifying suitable waste collection points and to minimizing current corner collection practices.	
▸ The design and implementation of collection points should avoid and/or minimize: • stopping at intersection • the use of busy arterial roads • collection during peak hours • entering in narrow streets • stopping near obstructions (trees, power lines, construction sites, parked cars)	
▸ The collection points should enable waste collectors to operate at a flat level surface away from vehicle ramps to ensure efficient collection and to avoid amenity issues for residents, pedestrian access and traffic hazards.	
▸ Urban planners, designers and developers should discuss collection requirement with local councils and search for alternative collection points, particularly for settlements built in dense areas with a reticular grid and small blocks and those located on slopes with steep gradients, to enable safe collection.	
▸ Smart onsite collection solutions for household food waste complement currently separate organic waste collection and incorporate solutions that promote the aesthetics of neighborhoods. ▸ Q: What context-relevant communal solutions can be implemented to complement organic waste collection services in less accessible residential areas?	
▸ To reduce traffic hazards the distance for maneuvering bins and waste bags to collection vehicle should be considered as follows: • the distance should not exceed 75 m in any circumstances • the distance should be reduced and/or limited to 50m for aged persons and person with disability • communal drums of bins should nor exceed 1.5 m^3	
▸ Design of nature strip footpaths, sidewalk design and front building design should provide adequate clearance for waste collection and maneuvering space.	
▸ Given the size and volume of waste collection vehicles, collection services should be implemented in a forward direction with no necessity to reverse.	
▸ Street and pathways design should include street furniture such as separate bins that should be located in ways that are adequate to pedestrian flows and to ensure sufficient space for collection activities.	
▸ Providing the opportunity for decentralized waste management amenities reduces the distance that waste collection vehicles have to travel to separation plants.	

Table 7-6 Guideline No.5

5	Opportunities to promote a more equitable urban environment
▸ Human-focused waste management practices incorporate informal waste workers in areas where they can best serve local populations. ▸ Q: What areas of involvement, appropriate distribution of responsibilities and a corresponding distribution of powers and capacities exist with regards to the informal sector?	
▸ Street design should facilitate the use of manual hand-carts in remote or difficult access areas such as small streets, steep roads, and unpaved neighborhoods.	
▸ Flexibility in the design of service provision allows the incorporation of alternative solutions such as integration of the informal sector to support waste collection services in congested and dense neighborhoods, traffic hazard areas and less accessible settlements.	

Table 7-7 Guideline No.6

6	Opportunities to promote urban land conservation
▸ Planners and designers should consider linking organic waste end product to agriculture practices in peri-urban areas. Planning in favor of such practices promote: • land conservation • improvement of the soil condition • bond/ attachment to certain rural practices • livelihood support • diversion of organic waste to landfill.	
▸ Planning and design should support entrepreneurial composting activities at different scales: household, communal and regional. • Household scale refers to organic waste recycling through family compost bins, worm compost or other household-based techniques • Communal scale refers to organic waste recycling initiatives launched within a residential development or neighborhood committee • Regional scale involves large communal composting practices involving local authorities and farmers	
▸ Urban agriculture that is embedded in, and interacting with the urban ecosystem offers several benefits namely labor for urban residents, the use of urban resources such as organic waste as compost and wastewater for irrigation.	

Table 7-8 Guideline No.7

7	Opportunities to improve human health and urban safety
▸ The health and safety of residents, the waste management workforce and urban flora and fauna can be positively influenced in in the following manner: • reduce the emission of toxic air pollutant which may affect human health • reduce the potential for soil contamination that affects plant health and the condition of the land • reduce potential accidents and occupational health incidents of the workforce especially collecting and separating waste	
▸ Efficient urban service procurement enhances tenure security. Increased tenure influences positive environmental behavior, failure in tenure security leads to exposure to health problems as well as crime and violence. Integrated infrastructure and tenure security planning implies exploring a different range of tenure types for less affluent dwellers which may increased security of tenure and break vicious cycles caused by insecurity.	

In addition to the above guidelines, planning urban spaces implies outlining design proposals to provide simultaneously ecosystem services, recovery of underused areas and exploitation of local resources. The many forms of available food waste treatment techniques support sustainable planning endeavors. The examples provided in Table 7-9 are indicative only, as there is no single strategy for diverting food waste in urban areas. They are selected among a number of organic recycling options for different kinds and sources of food waste as well as different users and markets. At household levels, worm farms can contribute to recycling food waste in multi unit dwellings, and compact living environments where green patches are scarce. This simple technique is found useful to immediately dispose of food waste produced at household scale.

In estates or blocks where there are already communal collection or disposal facilities, communal composting systems can be implemented to complement sanitary services. These techniques can also be implemented in appropriate nearby areas to accommodate green and food waste suitable for compost. Composting facilities with capacities of 500 Mg can be integrated into neighborhood planning, providing local employment and triggering community participation.

Table 7-9 Examples of organic waste treatment at different scales

Composting scale	advantages	barriers
 Household scale worm farming	• household system practical for multi unit dwellings with limited green spaces • functions indoor as well as outdoor • convenient in proximity to kitchen • odorless	• not suitable to recycle all types of food waste • cannot support alone the waste produced by large families • may attract other unpleasant insects (ants, cockroaches)
 communal scale composting	• system practical for single dwelling units with gardens or *condominios* with communal green spaces • functions outdoor in sunny settings on the ground • affordable and easy to set up	• rodents can be an issue when proper maintenance fails • failure to maintain nitrogen and carbon balance as well as high temperature leads to a longer period of compost production • lack of aeration slows down the decomposition process
 city/regional scale green waste treatment	• production of mulch serving as soil coverage material • serve as additive to compost • convenient in proximity to kitchen • odorless	• failure in the distribution of the end product may cause plant to reach its maximum capacity • requires machinery and trained personal • requires institutional and community support as well as a regional agricultural market

Regional scale organic waste treatment remains a challenge in the central region of Mexico. The lack of continuity in municipal programs, failure in long-term planning and legal limitations to market compost derived products are some of the barriers identified (Jean-Baptiste, 2008a). Findings obtained from field observations and exchanges with composting promoters show that there is a need to harmonize institutional processes, long term financing and encourage the involvement of other stakeholders (i.e. NGOs, universities and community based environmental groups).

7.3 Transferability: Regional and global perspectives

The proposed practice-orientated guidelines offer some design-relevant suggestions that are not only applicable to one context but also may well be suited to other urban contexts. It is important to signal that the idea of research transferability does not involve broad and/or general claims but rather invites readers to make connections between what has been presented here their own context. With this in mind, the guidelines proposed above may well be fitting for other cities which face similar practice-orientated barriers in urban planning and design. Other Latin American metropolitan areas such as São Paulo, Lima, Buenos Aires, and Bogota face similar circumstances with regard to household source separation, operational roles of the informal sector and policy gaps. Emergent economies similar to Mexico are found to be often overwhelmed by technology. On one hand, they are not poor enough, which means that they cannot undermine environmental issues within their development goals. On the other hand they have not yet reached continuous and self-sustaining economic growth which implies that there is still a wide discrepancy in living and environmental standards. In short they are not wealthy enough to implement sustained control measures to prevent problems associated with food waste in their cities.

On a scale that is regional, a commonality in latin american territories is the lack of qualified experts and well-trained professionals at local or municipal scale, which makes planning implementations difficult. The following transferable practice-relevant findings can be drawn:

- Training and capacity building of both formal and informal waste management workforce: includes strengthening the local-based knowledge of waste operators and moving from swift palliative actions to sustainable, efficient and environmentally-sound operations.
- Sustaining good and successful programs: refers to sustaining efficient programs and ensuring continuity in their implementations. This requires preserving some key waste management functions despite political reshuffling functions. this provides more autonomy to waste management practices that operate at local levels.
- Waste education campaigns that reach people on a continuous basis.

On a scale that is more global, traditional urban planning and design practices require a shift in the current understanding of what constitutes a wholesome city. This shift needs to effectively meet the needs of those living in dense populations, to improve green infrastructure and to protect threatened natural resources. Figure 7-1 illustrates waste management actions that have the potential to influence positively the urban environment and respond to specific urban threats. They are:

- Human health
- Transit
- Human livelihood
- Natural infrastructure

Figure 7-1 attempts to highlight the urban impact of waste management practices and to bridge the gap between sanitary actions and planning visions. The colored lines represent the links between waste management processes, multi-scale actions and the impact on the urban realm. These connections imply that actions related to maintaining efficiency in waste management systems contribute to positive reactions with regards to the habitability of urban settlements. For instance, waste reduction through waste education has an impact on human health and enhance the quality of urban life. The reduction of food waste in particular contribute to prolong the operative life of sanitary facilities, resulting in economic savings and benefits. Source separation leading to more efficient waste collection helps reduce traffic congestion. More particularly, food waste control measures contributes to more trustworthy and authoritative dat, which in turn allows decision making that reflect cultural shifts and the pursuit of more egalitarian communities. Further, food waste treatment systems that divert food residual from landfill is transit supportive. In other words alternative techniques to convert food waste into and an organic stable material reduce the frequency of travel time of waste collection vehicles which in large growing communities represent a step forward for more efficient city movement. Lastly, efficient urban sanitary services can contribute to enhancing consistent aspirations that appear to pervade among large cities. They are for the most part, quality of life, good accessibility, diversity and productivity as well as natural assets conservation.

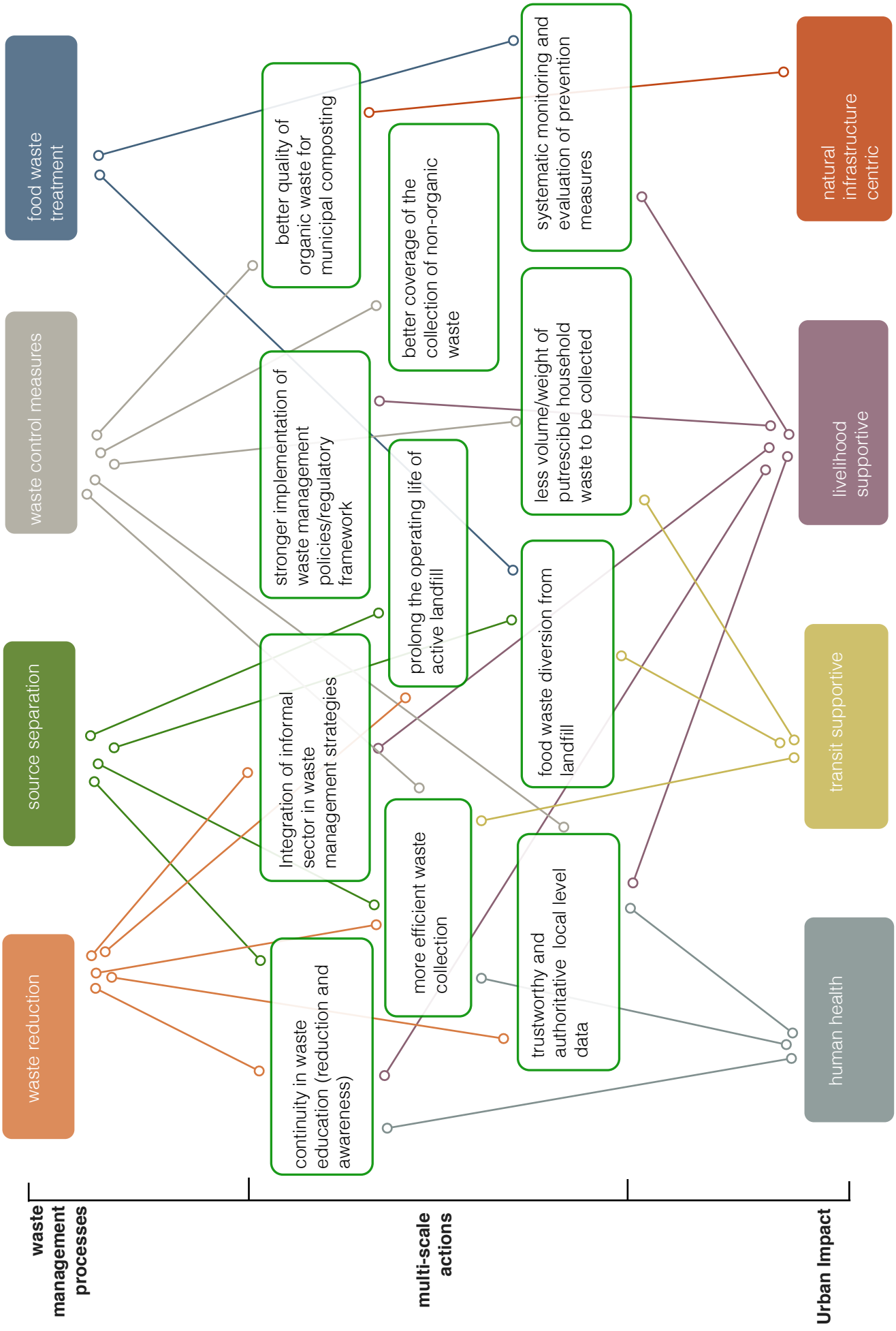


Figure 7-1 waste management processes and urban impact

7.4 Further research implications

The needs for further interdisciplinary research research in waste management and urban study disciplines, should be considered in the field of integration in education due to the different ontological roots of the conceptual metaphors defining constructs such as the environment, urban ecosystems and waste. There is a need to create common understanding among technical and social oriented disciplines to best represent the dimensions of material, temporal and causal dimensions in the urban realm. Meaningful interdisciplinary research frameworks and models are found essential in the following aspects:

- Bridging the gap between normative planning theory and waste management implementations
- Better exploitation of the already well-covered and conceptually substantiated knowledge of the economic and political realm in large cities in Latin america
- A rigorous review and critical analysis of the status quo in environmental studies
- Strengthening inductive approaches that can be applied in urban studies and promoting the understanding of implication for researchers, practitioners and policy makers in local level studies.

8. Conclusion

The conclusion responds to the specific research questions. It summarizes the logic of the study, discusses the findings more broadly and presents the implications of these findings. The lessons learned from researching food waste management in the urban environment in Mexico are revealed and suggestions are made for future research

The overall intention of the research is to signal links between the organization of individuals, the built environment and food waste management. This is based on the idea that sustainable cities require a constellation of processes, which implies a dialectical action between a society, the natural context in which it is embedded and sanitary services. One driving notion was understanding the processes by which food waste disposal takes place in the urban environment taking into account different scales (global, regional and local) and viewing waste issues from different fields (environmental sciences, behavioral sciences and urban studies).

In many large Mexican cities the problem of sanitation pervades. The capital alone, produces over 12,000 Mg. of waste daily disposed of in one official sanitary landfill and several other waste disposal sites. Food waste is of particular importance in the debates surrounding sustainable waste management given that organic losses make for a considerable amount of refuse disposed of in landfill. Food waste mixed with other types of waste has multidimensional local and global consequences. In cities, the impact of food waste has shifted from being a distinctly ecologically-related issue to a problem foregrounded in political arenas, urban debates and public attention. The amount of municipal solid waste to be collected, transported, separated and disposed of is now perceived as a resource-demanding commodity with social consequences especially within the informal sector.

In 2011, debates on final disposal of solid waste fueled environmental discourses due to uncertainties regarding the closing down of Mexico City's main official landfill. Mexico City's waste management system remains at large one that is transfer-intensive and landfill based. Sanitary efforts at local levels consist to a greater extent in collection, separation, and recycling as well as final disposal tasks. Less attention is given to more effective diversions of the organic fraction that is estimated at more than half of the solid waste generated in households. Additionally, little incentive exists to successfully divert food waste in households. The political-administrative fragmentation within the central region and the lack of resources in local municipalities are partial structural impediments for better waste education, and the implementation of organized continuous and targeted efforts to guide public awareness. In short, despite substantial

environmental policy effort the organizational conditions for sustainable waste management remain challenging especially at local levels.

The contextual urban dimension of the problems associated with organic waste management has not been systematically researched in Mexico. Research on household food waste production is limited and studies that deal with solid waste composition generally incorporate food waste within a larger organic waste framework. Little is known about what type of food waste is produced at the source and most importantly how and what the factors are that influence its production and separation at the source, and city management. In addition to this perceived scientific gap in research, the data shortage about waste production at the source, debilitates implementation processes. Uncertainty in food waste composition and source generation restrains urban amenity planning and urban service procurement programs. Further, interdisciplinary knowledge is required to better grasp organic waste issues in large cities. Indeed, the problems faced by growing urban entities require solutions beyond those solely associated with urban infrastructure and/or environmental engineering. The discussion of environmental problems connected with household waste has been mainly concerned with the volume of waste due to the many implications of the final disposal of household waste in landfill. Sustainable concepts about how societies could best manage their waste require understanding patterns of urban life and also requires recognizing the multi-layer dimensions affecting waste.

As the research progressed, a lack of synergy between knowledge related to waste management and urban planning was observed. The separation of these two fields contributes to the uncoordinated effort to understand and improve urban services through which other urban thematics such as health and livelihood issues can be addressed. The gap between these two disciplines is not only applicable to the Mexican context but is also relevant to other Latin American cities. A failure to tackle the techniques to combine scientific effort between them constrains the pursuit of knowledge on current changes in urban structures and functions and ultimately hinders new interpretations of cities.

This research confronts the above mentioned gaps. The notion that guides this study is that sustainable food waste management requires an integrated approach which takes into account a practice-based framework combining urban, technical and social factors of food waste production. The research therefore proposes a guiding multi-scalar model which integrates constructs from global, national, local and individual scales of waste that allow a more comprehensive assessment of critical issues in waste management practices in cities. By interlinking these constructs, it was found that there is a necessity to draw more from local knowledge to respond to organic waste management challenges at household levels.

Based on the assumptions that external and internal determinants influence the manner in which waste is managed at household levels and that in some contexts sustainable practices may be more easily achievable through local-based solutions; the research focuses on waste behavior and habits in different settlements as well as the structural impediments to waste management in the Mexico City Metropolitan Area. An influence model was proposed to explain the interrelations observed between the urban natural, socio-cultural and built environments. It was found that the expansion of the built context exceeds urban regeneration rates and compromises natural systems.

Household food waste is an organic by-product that emerges from the preparation and consumption of food in different types of dwelling units. This consists of all edible items found in the household with the purpose of being consumed. Food waste incorporates entire food items remaining and discarded prior to, during and post consumption. To better grasp the concept of food waste in the context of Mexico, two criteria are proposed: 1) Framing food waste within the broader household waste legislative directive and; 2) Diverting mechanisms at local levels: source reduction, food relief, animal feeding and composting before final disposal. To better situate food waste from households a categorization was proposed: 1) Spoiled Cooked Food and/or Excess Cooked Food, and 2) Fruit and/or Vegetable Peelings, 3) Beverages and 4) Raw food and /or meat scraps.

The empirical approach of the research included a tripartite tool. A questionnaire was developed to test the relevance of household-based indicators in order to identify endo- and exo- determinants of food waste. A food waste diary and food waste weighing recording system investigated the composition and weight of the food waste discarded in dwelling units. These instruments were developed as part of an overall data collection strategy that considered the role of participants in the collection of data as a central feature of this research and put particular emphasis on the contextualization of each tool.

The results obtained from the questionnaire, food waste diary and weighing recording system responded to research questions RQ-1, which aimed at identifying the significant features of the urban built environment; RQ-2 that explored how food waste disposal practices in dwelling units take place; and RQ-3 which asked what contextual determinants may impact food waste management at local levels. The questionnaire focused particularly on the most prevalent/predominant features of the built environment. Indicators associated with housing characteristics were found useful to pin point the structural in situ barriers that affect source separation in the dwelling units investigated. Through the food waste diary a deeper insight about the type of food waste produced in selected households was obtained. The weighing procedure included a kitchen scale that participants used to measure the amount of food waste produced at different intervals over seven days. There were 27 fieldwork cases (families) investigated in the Mexico City Metropolitan Area and three cases were researched in Jiutepec, Morelos. The limited number of cases researched do not allow for generalization nor representativeness of determinants of food waste production in Mexico City; each household represents a unique case that exemplifies how food waste is produced at a local level.

The empirical work showed that both external (exo-) urban morphology features and internal (endo-) building features play a role in food waste management processes. External urban features, such as small lots with high density, compact dwelling arrangements, housing units with vertical extensions influence directly in the demand for urban services such as waste collection of organic and non organic waste. Another

feature found was that modes of urban transformation and built settlement variations (growing households, land transformation, occupied vulnerable settlements, and small compact lots) constituted a man-made barrier for urban services procurement such as waste collection. These findings respond to the research question RQ-1 which searches for the most significant features of the urban built environment with regard to food waste management.

Common elements and parallels were found in the set of households investigated. These findings supported the assumptions about the influence of the built environment and respond to RQ-2 which seeks answers related to food waste disposal practice. The 30 households investigated were regrouped into two main categories: Less affluent and more affluent fieldwork cases.

Less affluent cases were households located in identified economically challenged settlements that were found in peripheral agglomerations. Some of these housing units lacked basic service provisions and also featured endemic vulnerabilities such as lack of human resources (education) affecting their living conditions. The buildings comprised various states of consolidation which are undertaken gradually over several years, mostly through self-help initiatives. The informal sector (i.e. informal waste collectors and street cleaners) was most likely to service less affluent settlements due to the limited access that formal operators have in peripheral areas. These limitations are a combination of remoteness, which complicated the delivery of services, economical means and security.

The practice of food waste recycling was more likely to be found among less affluent cases partly due to inherited rural practices and the need to find alternatives to restricted collection services. The average food waste weight registered per capita per day was 0.20 kg. which represents approximately 20% of household waste production.

More affluent cases had a certain degree of heterogeneity, were more economically stable, financially healthy and were characterized by some autonomy or resilience when faced with shortcomings with regards to service provision. These households featured some internal capacities in terms of networks from which service benefits were derived. More affluent cases live in more central and wealthier dwelling units with access to better infrastructure and more frequent urban services provided by the formal

as well as the informal sector. The sense of communal trust was perceived high in affluent contexts. The average food waste weight registered per capita per day was 0.14 kg. which represents approximately 14% of household waste production.

In all cases, food is preserved as it is valued in monetary terms. There is an inherent food waste awareness and avoidance attitude derived more from economic concerns than from environmental/waste considerations. Edible excess food waste is least discarded compared with other types of food waste. The culture of Mexican cuisine is based on mixes of raw organic goods and the dominant food consumption style - for which inedible ingredients are employed - is 'home cooked meals'. This partly explains why food waste found in households is composed of unavoidable organic by-products. In some cases, it was observed that animal feed plays a role in the daily separation of household food waste and is prioritized above plant feed. As recycling and waste separation is becoming mandatory in primary and secondary schools, households with small children may be more prone to friendly environmental behaviors, however these households remain those where food waste is produced the most.

In response to RQ-3 the findings show that different contextual determinants may impact the composition and volume of food waste at the source, in summary:

The cases in the less affluent group consume less goods, and are more affected by external environment stressors (i.e. the natural arrangement of the immediate context and the built environment), they have a strong place attachment and are more inclined to micro-scale food waste treatment.

In contrast, the cases from the more affluent group consume more goods, are more resilient to external stressors, also have place attachment, and are less inclined to micro-scale food waste treatment.

In addition to exploring external conditions surrounding food waste production and management, this dissertation argues that understanding the processes by which waste disposal takes place, and viewing it from an urban planning perspective, helps to ensure continuity of environmentally-sound practices in developing communities. Indeed

urban planning implies to some extent giving a sense of direction to current realities, in other words, offering a long term perspective to the transformation of cities. Many short term decisions or solutions have a bearing on long-term developments. Consequently, this research seeks to bridge the gap between the planning strategies and efforts envisioned in Mexico City and the instrumentations and actions that result from these.

More concretely, two propositions for organizational changes are put forward. They stem from triangulating the results from the empirical work and exchanges with local experts and practitioners. These statements respond to RQ-4 which was formulated to identify changes in operational processes that could sustain environmentally-sound practices in food waste management.

The first proposition refers to better waste education and training and the promotion of environmental values as well as multiplying incentives to participate in alternative waste management techniques at local scales. The set of conditions of the less affluent, which in the case of Mexico represents the vast majority of urban dwellers needs to be recognized. Waste education is of paramount importance given that local authorities rely on residents to separate waste. The promotion of environmental values and incentives to use alternative techniques should be put at the forefront of strategic planning to increase public awareness alongside other more targeted actions. Although it is recognized that interventions focusing solely on behavioral changes have their limitations, the urban context in which less affluent residents live and function would benefit from education programs.

The second proposition refers to more effective demand-driven service delivery. The research findings show that the informal workforce does not necessarily hinder local practices but rather reconfigure the ways in which formal urban service procurements take place. The informal workforce is permanent, pervasive and less peripheral than some would assume. By rethinking the utility of informal practices as a basic component of waste management at local levels, service delivery takes a broader spectrum. Through informal exchanges with waste practitioners and observations in the field, it was found that the circumstance of informal workers allow them to move with varying ease at different points and time of the waste management process. The

informal sector sustains links with formal institutions through relations of distribution and service supplies. The formal and informal waste management services are therefore intrinsically linked, but the question remains as to how to promote more equitable linkage and thus to reduce the economic and social divide between these groups. One organizational challenge is to decrease the environmental burdens of working informally and to increase the social benefits of working formally.

Urban design and planning can respond to waste organizational challenges as well as to the environmental pressure that cities face. Similarly sustainable waste management can help shape healthy cities. In Mexico, urban designers need to draw out proposals that best combine the routines of waste collection with the current rhythms of everyday life. In the case of urban planners, perhaps it is necessary to multiply cross-disciplinary and participatory approaches that can acknowledge conflict and work out solutions that allow streets, neighborhoods, and cities to be clean. The guidelines identify opportunities from a set of seven principles for better planning and design practices. The guidelines respond to RQ-5 which asks how can better food waste management practices contribute positively to local urban planning and design and can be summarized as follows:

- Opportunities to improve dwelling unit environments exist through design that incorporates behavioral aspects of waste production at household levels and appropriate waste storage spaces.
- Opportunities to promote sustainable environmental behavior in open spaces stem from solving waste issues at ground level: market places and customs, communal gardens and public spaces can be used to trigger organic waste recycling
- Opportunities to improve urban aesthetics exist through adequate individual and communal interim storage locations
- Opportunities to improve traffic flow and neighborhood amenities stem from improving waste maneuvering practices and participatory solutions that incorporates the interests of residents

- Opportunities for a more equitable urban environment exist through design proposals that recognize the supportive role of the informal workforce and considers an appropriate distribution of their responsibilities
- Opportunities to promote urban land conservation and to foster optimal soil regeneration exist through the inclusion of urban agriculture practices in planning and design in peri-urban areas
- Opportunities to improve urban health and urban safety exist through functioning urban procurement services that positively influence tenure security.

More research is required on urban service procurement to determine the fundamental characteristics of the urban physical and social environment and what interventions could improve the urban built structure and consequently to reduce the human impact on the natural environment. Future research could benefit from comparison studies, as well as further research on food waste composition and targeted inquiries in peri-urban areas. Additionally, there is a need for more useful disaggregated statistics for cities such as Mexico City which need to document the volume of waste produced at household levels among many widely differentiated sub-populations in different boroughs. More exploration is needed on organizational changes, questions such as what best practice exists in environmental education, how they can be multiplied or how more effective service delivery can be promoted at local levels should be further investigated. There is also a need for more effective interdisciplinary research in waste management and urban studies. Further joint investigation is critical to better identify constructs, ideas, and theories that better suit the urban environment. Opportunities exist for urban and environmental scholars and practitioners to combine their efforts. This dissertation draws from the idea of overlapping layers of a system to meet the demands of growing urban populations. It bases it argument on a non-linear dynamic thinking that requires cross-disciplinary and interactive consciousness and focuses particularly on food waste management as an element for reciprocal actions between progress and ecological prudence.

The research draws from evidence which have allowed an understanding of the practice of waste management in the central region of Mexico. These initial explorative efforts served as a platform for first understanding the culture of waste management and second developing a methodological strategy that undertakes a more in-depth examination at household levels. The lessons of researching food waste management in the urban environment is that food waste production at the source needs to be researched with rigor and sustainable urban planning approaches depend upon managing the built and the natural environment along with local communities in light of their interdependence. Planners must acknowledge that both individual and collective behaviors have an impact on how cities perform. Environmentally healthy cities have a circular motion rather than a linear structure.

Waste management in Mexico has improved considerably over the past decades. Managing the waste produced by over eight million individuals exhibit challenges that have been only critically overviewed in this work. Some would argue that the system that currently operates in the Mexican capital and other large cities is functional despite its contested qualities. This dissertation simply seeks to contribute to the current research palette of environmentally-sound cities and the management of organic waste. It is written with the vision of building stronger, more resilient and environmentally dominant urban territories. My experience as a practitioner, researcher and former Mexico City dweller is that large urban agglomerations for all their pervasiveness have limited resources. The much needed constructive vision is one where risks are taken, discussions are stimulated, divergent ideas are confronted and experiments are welcomed to reconstruct the urban fabric in ways that match its complex configuration.

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