1. **CASE STUDY OF MEXICO CITY**

6.1. Geography and climate

Mexico City is located in the south central part of Mexico. The country is situated between North America and Central America and it shares borders with USA, Guatemala and Belize. Mexico City, the capital of Mexico, lies in the Valley of Mexico, a basin at an altitude averaging 2,240m. The Valley is ringed by a series of mountain ranges and it is an old lake. At the colonial time, when the Spanish came they decided to enlarge the city and convey water away from the lake. Mexico City is the center of the Federal District, which was created around the capital city in 1824 (Avila 2001, Mexico City 2001c, Mexico City 2001d).

Mexico City is located in a tropical climatic zone but because of the high altitude, there is only narrow range of temperatures. The average temperature in the city is relatively low, 16° C. The city has three main seasons: mild (October to March), dry and hot (April to late May) and rainy season (June to September). The annual rainfall in the city is 850 mm and during the rainy season 80 per cent of this rainfall occurs (Climate information 2001, Mexico City 2001c).

*Picture 6. 1. View of Mexico City.*
6.2. Economy

Mexico City dominates the whole country’s economy. The Federal District of Mexico City produces a significant portion of the total GDP of the country, for example, 12 percent in the year 1998. Mexico City is the center of manufacturing, and contains about 45 percent of the nation's industrial production. Manufactures include textiles, chemicals and pharmaceuticals, electrical and electronic items, steel, and transportation equipment. In addition, foodstuffs and light consumer goods are produced. The city is also important in Mexico's banking and finance industries (Mexico City 2001b).

6.3. Population

Since 1950 the population growth in Mexico City has been rapid. The city grew 4.2 percent a year, which was due to migration from the provinces and a high birth rate in the city. During 1980 to 1990 the annual growth rate decreased in the city to only 0.9 percent which hit the brakes for the rapid population growth. This was mainly due to government’s population control policy (Mexico City 2001e).

![Population in Mexico City](image)

**Figure 6.1.** Population in Mexico City.

The population of Mexico City proper was 9.8 million in 1995 and the population in the whole metropolitan area reached 16.9 million at that time. The population density in the city is more than 6,600 persons per km². In the past, the city center was by far the most densely settled part of the city. However, since the 1940s the outlying areas have absorbed most of the population increase (Mexico City 2001e).

6.3.1. Urbanization

Land in Mexico City is being urbanized in a rapid rate and nowadays Mexico City contains 20 per cent of the population in Mexico. The urban population in the city is still increasing due to migration and natural increase. During 1950 to 1970 the big part of the city’s population growth was caused by rural migration. The reason for this migration was industrialization and need for employees in the city. Since 1980 the population growth has been increasing both by migration and natural increase (Avila 2001, DESIPAPD 1995).
6.3.2. Migration

About 70 per cent of the Mexico City’s family heads are originally from rural areas. They have moved to Mexico City metropolitan area from places with less than 5,000 inhabitants. The rest of the population is born in the Federal District, either as sons or daughters of rural migrants, or they are inhabitants of the small towns, which are now part of the southern residential area of the city. About 70 percent of the migrants moved with they families and the rest, 30 per cent, were single (Avila 2001).

6.3.2.1. Push and pull factors

The primary push factors for people in Mexico are lack of arable land, land deterioration and diminution of the land area per farmer. Also the lack of education and unqualification for non-agricultural works decrease the employment opportunities in the rural areas and force people to move to the cities and work in factories or informal sector (Avila 2001, Mexico City 2001b).

Pull factors are high in Mexico. Many people come to Mexico City in the search of better live, better services and health care. Usually these people end up working in factories or in informal sector because they are often unskilled workers. Many migrants follow the pull of their relatives who already live in the shanty towns. The first-aid housing is commonly arranged with their relatives and sometimes they already have work for their relative migrants (Avila 2001, Mexico City 2001b).

6.4. Water resources

6.4.1. Water supply

The population in Mexico City is now about 18 million so the consumed amount of water in the city is enormous. Mexico City’s catchment area is not big enough to supply the demand and the city has to supplement the ground water supplies by bringing water from more distant river systems and pump it to the Valley of Mexico. Only 70 per cent of the water supply is taken from Mexico City area groundwater and springs. The rest, 30 per cent, of the used water is pumped from the other catchment areas. Because of the hills, that surround the city, water has to be pumped to the city. This needs a lot of energy and causes leaking problems (Avila 2001, HABITAT 1996).

Mexico City relies currently on groundwater sources for more than 80 per cent of its supplies. The pumping of groundwater exceeds the natural recharge by 50 to 80 per cent. This overuse has led to falling groundwater levels, compaction of aquifer, subsidence of the land, and damage to surface structures. Having outstripped the limits of local groundwater, the city now meets 17 percent of its demand by bringing water from the Cutzamala river system, 127 kilometers away and lifting it 1,200 meters in elevation (Postel 1992).
6.4.1.1. Water leaking

About 30 per cent of the water supply in Mexico City is lost in the pumping and conveyance of waters. This is the same percentage that is pumped from the other river basins. By repairing the old pipes and conveyance methods, significant amounts of water and energy could be saved and the use of other river basin’s resources would be smaller or even non-existing (Avila 2001).

6.4.2. Demand of water

Water consumption in Mexico City is 364 liters per capita per day, which is 1.4 times higher than the water consumption in the whole country. This means that the total annual consumption of the city is 2.4 billion m$^3$. About 94 percent of residents in MCMA is served by either a piped water connection or a standpipe. In the Federal District the service level, is even higher, 97 per cent. The residents without service must obtain their water from tank trucks, which are supplied either by government or private vendors. The water demand is biggest for domestic use in Mexico City and it takes 67 per cent of the whole water usage. Industries consume 17 percent and commercial and urban services 16 per cent of the total (WSTB 1995, Harday et.al.2001).

6.4.3. Waste water treatment and sanitation

About 82 per cent of the residents in the MCMA are connected to the sewer system and six per cent use septic tanks. In MCRA over nine per cent of the population are not served by any kind of drainage system and 3 million people in the peripheral areas lack sewer system.

Currently, 90 percent of the municipal wastewater from MCMA remains untreated and is diverted out of the Basin of Mexico through the general drainage system. Industries generate annually an estimated 3 million metric tons of hazardous wastes, of which more than 95 percent are discharged directly into the municipal sewage system. Corruption is very high and the decontamination limitations are low. Even a company has a certification of clean action, the certifications can be bought illegally and the clean discharge is not actually clean (DESIPAPD 1995, Avila 2001).

The collected wastewater is mainly pumped and discharged to other river basins and river beds. The water management is Mexico City has caused many of conflicts between near regions and the city. Mexico City as a richer city uses all the available water and gives back wastewater with harmful substances (Avila 2001).

6.4.3.1. Water quality

The State of Mexico has reported that 23 per cent of its 242 water supply wells do not meet the standards for coliform bacteria, and 11 per cent do not meet the standard for inorganic constituents. An increase in concentration of hydrogen sulfide has also been reported from 21 wells. The main source of surface water in Mexico City, Cutzamala River, has a too high amount of faecal coliform. Although, surface water sources undergo chemical coagulation, filtration, and chlorination, the quality of served water is not often proper. Ground water is normally treated only by chlorination (WSTB 1995).
Many irrigation areas outside the Mexico City apply raw sewage channeled from the city to their fields. One district in the southwestern state of Hidalgo receives about 3.5 million m$^3$ of raw sewage every day. Although farmers are prohibited from using this water to irrigate crops that are consumed raw, the prohibition is apparently not always respected or enforced. Some vegetables have found to be highly contaminated with fecal coliforms, posing a direct threat to human health (Postel 1992).

6.4.4. Flooding

The city is also especially vulnerable to flooding. Because of the valley location city lacks natural outlets for surface water and water gets easily locked to the city streets. Although many expensive drainage channels have been built, flooding remains a problem during heavy rainfall (UN 1995).

6.4.5. Subsidence

Nowadays the use of groundwater in the city is 40 per cent of the total water use, although, this percentage will probably decrease in the future due to overuse of resources. Because of the city’s location on the old lake, groundwater level in Mexico City has been very high. The city has used a lot of groundwater resources and now the groundwater supplies are starting to run low. Due to the unsustainable pumping, the groundwater level in the city has started to decrease, and it is sinking by 1 meter each year (Avila 2001).

Mexico City is an extreme case. During the past 70 years the city has sunk 10.7 meters into the filled lake, on which it was built. In the central area subsidence have also been as much as 8-10 meters. Since the soil is mostly clay, the subsidence is even more rapid than with other soil-type. Land subsidence causes structural damage to buildings, roads, railways, and underground pipelines (Postel 1992, Kasarda and Parnell 1993).

6.4.6. Water resources management

Mexico City has tried to save water and solve water problems in many ways. The goal of the activities in the city has been cutting of the used water amount per person by pricing, education, retrofitting and efficiency standards. For example, one effort was to replace 350,000 toilets with 6-liter models. This saved enough water to meet the needs of 250,000 residents (Postel 1992).

6.5. Environment

6.5.1. Solid wastes

More than 10,000 tons of solid waste is generated daily in Mexico City. Over one quarter of these solid wastes is dumped illegally or remains in the streets. Due to this pollutants are accumulation to the back streets and back yards causing health risk for many people, groundwater pollution and unaesthetic look. The health problem is obvious for the people who live in the near dumping places or even in them. Many poor people live in the dumping sites finding accommodation and things to sell from there. (DESIPAP 1995).
6.5.2. Housing

Lack of adequate housing has long been a problem in Mexico City, although the situation is better than in other study regions. The average occupation of room in the city is 1.1 persons. About 75 percent of private homes in the Federal District have 3 or more rooms. Housing in the Federal District ranks higher than other parts of the country in terms of qualitative services, such as water and sewage (Mexico City 2001a).

6.5.2.1. Slums

Housing standards in Federal District are currently quite high by international standards but on the edge of urbanized area problems start. Housing is substandard, roads are unpaved, electricity hook-ups are illegal, water supply, sanitation and waste collection are not sufficient. The general economic setting of Mexico City’s slums is extreme poverty (Gugler 1997).

Because the price of the land in the central city area is so high, only the high and middle class people can afford to buy land for houses and proper settlements. Poor people have no other choice than to rent a house from slum area or even build their own poor house in the outer city. In the outer city the land is cheaper but it is not often that poor people have an opportunity to buy land even from there. Because of uncertainty and lack of money poor people live in very poor houses and they don’t even want to build formal house before they have secure feeling. The houses are commonly made of cardboard, sheet metal or from other available waste materials (Avila 2001).

A typical dwelling consist of a small single room, containing one or two beds shared by the members of the family. The facilities are only gas or petroleum stove and sometimes television. There are few public water taps in the area, which are shared. Public sanitation and drainage are served to some of the people, but more than 80 per cent of the population use the bottom of gully for a latrine. The lack of electricity is normal and roads are usually unpaved (DESIPAPD 1995).
6.5.2.1.1. Slum areas in outer Mexico City (Avila 2001)

Need of land
Many poor people cannot afford houses, so they have to content themselves with bad settlements. Still they want to get rid of the insecurity and buy cheap land. Because buyable land is not often available at low price, people have to join with different political groups to be able to buy land. These groups sell land to their supporters with small service in return. Poor people have to support the leader and the political group to get the license to buy the land. With the political group poor people also have some voice to demand rights, housing and services. Some people may lose their money to the swindler but the risk has to be taken.

Organization with leader
During 1960 to 1980 it was typical to have group of poor people with this kind of political leader. The leader was in favor of the government when taking care of the poor people. He also enjoyed the power and support from people. He bought the land from poor farmers, sold the land to the other poor and got also some extra money from government. Even the price that poor people paid was higher than it should be (one third of the prices in the city area) it was the only choice for them. Some of these bad settlements had water service and poor sanitation, but they were often controlled by the leader. People lived under pressure of cheating but this served an opportunity to them. Sexual abuse was not uncommon either.

Organization nowadays
Nowadays, since 1990, the groups of poor people have started to impugn against these leaders and form groups with themselves. With the group they more easily can have their voice heard. They do not need the leader anymore to get attention from the government. Still even nowadays government doesn’t want to see the poor people and their needs. This is why social and urban movements are getting broader in Mexico City.

Environmental problems
This government’s undervaluation of poor people and their problems are very harmful also for the environment. The bad settlements do not have any water service; the potable water is bought with very high prices from the dwellers and the wastewater is discharged through the open canals to the rivers. Because the bought water is so expensive the used amount is usually too low compared to the recommendations. This results easily to malnutrition and diseases. The open, polluted channels are also a serious health problem.
6.5.3. Traffic

Mexico City, like so many metropolitan areas worldwide, faces problems with traffic and air pollution. Traffic problems are big, despite of large metro and bus services. Even the excellent subway system is extended, it is inadequate to growing demand of daily commuters. Metro is fully used and crowded most hours of the day. In addition, the freeway system has not kept pace with the increased use of automobiles (Mexico City 2001b).

6.5.3.1. Air pollution

Comparing to other developing countries mega-cities Mexico City is generally clean. Except the air pollution, which is one of the most serious problems in Mexico City. Metropolitan Mexico City is regarded as one of the cities with the worst air pollution problem on the earth. It is six times higher than the acceptable limit by World Health Authority standards and it reaches harmful levels more than half of the days each year (DESIPAPD 1995, Mexico City 2001a).

Traffic problems and industry are the main reasons for air pollution. Automobile pollution accounts 67 per cent of all air pollution in the city. It has reduced visibility for more than 12 km in 30 years. Part of this pollution is also due to the location of the city. City is surrounded by mountains so the smog often remains trapped in the valley basin. Almost 90 per cent of the respiratory infection and illnesses in the city originate from air pollution (Mexico City 2001a, Girardet 1996).