PEOPLE AND WASTE: UNDERSTANDING THE REAL VALUE OF WASTE IN MORELOS, MEXICO

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SUMMARY: Despite the fact that Mexico has taken greater steps into improving its waste management, many of its smaller communities still face severe challenges associated with the collection and disposal of waste. In the state of Morelos, the number of problems related to waste is increasing as the population's density and standards of living is rising. Located south of Mexico City, this region comprises 33 municipalities in which the sustainable exploitation of waste is often overlooked or limited. This study is based on the assumption that waste is valuable in small and medium size communities in Latin America. An attempt to discern the real value of waste in Morelos will be undertaken by linking the social structure of the towns with their waste processes.

1. INTRODUCTION

Mexicans still face challenges in improving the collection and disposal of their solid waste. The regional assessment of waste management in 2000 reported that an estimated 86% of the waste generated in the country was collected. 60% thereof was disposed of appropriately. (Informe Analítico, 2002) Recent surveys indicate a per capita generation ranging from 0.350 kg/hab/da in rural communities to 1.400 kg/hab/da in more populated urban settlements. The Mexican population reached 103 million inhabitants in 2005, and produces over 35 millions of tons of waste annually. This volume is partly treated with partial applications of international regulations in 19,000 sanitary landfills and is also disposed of in 11,000 registered open waste dumps. There are almost 3,700 uncontrolled waste dumps identified in the country, which makes the discourses on waste issues urgent and necessary.(INEGI, 2005)
In Morelos, health problems reported in the town of Alcapuya result from the lack of adequate methods of disposal of solid waste. This town hosts the largest open waste dump operating since the late 80's. In adjacent municipalities, water and soil pollution have also been observed. The state of Morelos, with over 1.6 million inhabitants, is a small territory compared to other states in Mexico. However, it is extremely diverse and offers many advantages in terms of resources, varying from mountain areas with high altitude and cool temperature to warm, humid, sub-

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tropical regions. Located south of Mexico City, its average urban settlement comprises of a diversified group of towns in which the scope and magnitude of the problems of waste are increasing.

This paper is part of an ongoing research study on the exploration of the potential of waste in Morelos. It will be divided into two sections. First, an overview of Morelos will be established, demonstrating its relevance in the Central Mexican Region as well as its most important physical, infrastructural, social and political features. Secondly, the waste management of the municipality of Jiutepec is analyzed in order to further understand the dynamics of waste treatment in the region and identify its strengths and weaknesses for future proposals.

2. THE STATE OF MORELOS

2.1 The relation and importance of Morelos in the local regional context.

The state of Morelos, with 4,893 Km^2, is an integral part of the geographical demarcation known as the Center Region of Mexico, which comprises over 32 millions inhabitants. This region is known to be the most important economical and political center of the country. Morelos, which represents 0.2% of the total surface of the Mexican Republic, is one of Mexico's smallest entities. Its strategic location in the south of Mexico City connects the capital with the southern coast of the country.

Figure 1. Map of The Center Region of México. Source: Programa Estatal de desarrollo Urbano 2001-2006

Figure 2. Regional Map of Morelos . Source: INEGI

2.2 Physical structure of Morelos

In Morelos,1,612,899 inhabitants live in 33 municipalities. The state is divided in 7 regions, with distinct economical and developmental features.

- Cuernavaca Region: Cuernavaca[1], Temixco, Emiliano Zapata, Jiutepec, and Xochitepec.
- North Region: Huitzilac, Tepoztlán, Tlalnepantla and Totolapan.
- Cuautla Region: Atlatlahucan, Ayala, Cuautla, Tlayacapan, Yautepec and Yecapixtla.
- Northeast Region: Ocuituco, Temoac, Tetela del Volcán and Zacualpan de Amilpas.
- Southeast Region: Axochiapan, Jantetelco, Jonacatepec and Tepalcingo
- South Region: Amacuzac, Jojutla, Puente de Ixtla, Tlaltizapan Tlaquitenango and Zacatepec de Hidalgo
- West Region: Coatlán del Río, Mazatepec, Miacatlán and Tetecala.

Morelos, known for its biodiversity and privileged climate, is considered a hub of leisure and enjoyment in the Center Region. Residents of Mexico City and neighboring areas often travel to Morelos for weekend getaways. This state has an average temperature of 20˚C year-round. The climate fluctuates from cool to semi-warm and warm depending on the region.

2.2.2 Main characteristics of the land

Morelos is located partly in the hydrologic region of the Balsas River and is made of three basins with several intermediate water depressions. The state draws its water from water bodies and watersheds including rivers, lakes, dams and springs. The most important elevation is the Popocatépetl volcano with 5,500 meters located to the northeast. The Lagunas de Zempoala national park, the Chichinautzin Biological Corridor, and the Iztpa-Popo National park are a few of Morelos' reserved areas which comprise of one of the most extensive ecosystems in Mexico

[1] Cuernavaca, with 349,102 inhabitants is the capital of Morelos.

(Park-profile, 2002). There, studies have revealed the existence of a number of endemic animals, plants and types of vegetations. The state displays a complicated topography and contrasting altitudes, which creates a unique variety of eco-life. The land is used for agricultural purposes, stockbreeding and for the cultivation of flowers in greenhouses.

2.3 Infrastructure & services

2.3.1 Energy supply

In Mexico electricity is generated by means of various sources, the most common being hydroelectric and thermoelectric. Official documents have shown that close to 98% of Morelos has electric coverage. The communities not yet electrified are small and isolated. 60% of those without electricity are indigenous groups.[1]
Although a decentralized electrification program was undertaken in 1992, the quality of the service still needs improvement. Experts say that the Government has been more successful in finding large-scale solutions, which leave the poor communities "out of the development equation"(World bank, 2005). Power failures are common in Morelos. With a growing population, one can expect an increase in the number of non-electrified communities in the future.

2.3.2 Transportation

The state of Morelos comprises a network of roads connecting the municipalities. Several railroads serve to link the entity with other municipalities and a number of small airports. Local transportation is, however, more problematic. The number of cars continues to rise. Existing street networks are no longer adequate to meet the needs of the residents. This problem has been reported especially in the municipalities of Cuernavaca and Jiutepec where increasing traffics jams are frequently reported.

2.3.3 Housing

During the last decades, there has been a growing demand for social housing in Morelos due to the migration of dwellers to the main urban settlements. Morelos is mostly composed of single unit houses, typically constructed with brick or adobe walls and roof tiles with a small backyard and/or vegetable garden. Vertical residential units and apartments buildings are found in a small number of dense areas mostly in the Cuernavaca Region.

2.4 Economic and political overview

2.4.1 Economical activities

The sectors in which Morelos has a significant employment base are mainly commerce, services followed by industry. The primary sector (2%) is related to agriculture, silviculture and fishing; the secondary sector (24.9%) regroups mining, manufacture and construction; the tertiary sector (73.1%) includes commerce, transportation and financial services. Commercial activities in chemical, automobile and textile sectors are most common. Exports are pharmaceutical and agro-industrial products, handcrafts, ceramics, flowers and honey. The industrial parks CIVAC and PINC located in the Cuernavaca region have attracted national and foreign investments in the state. They have played a significant role in the demographic development of neighboring communities and the migration pattern of the locals. Another important aspect of Morelos'

[1] Data published by World bank/GEF/Sener integrated energy services for small localities of rural Mexico

economy is tourism. The numerous rivers and springs located in the area have attracted a growing number of visitors which consequently have stimulated the emergence of several spa, swimming and weekend clubs.

2.4.2 Governance of Morelos

The state of Morelos is a free and autonomous entity. Its political organization is based on a separation of powers in a congressional system. A governor heads the executive power. The municipalities, which are also administratively independent, form a second-level of executive division. Each municipality has a president who heads a municipal council, responsible for providing all the public services such as water and sewage, street lighting, public safety, traffic, cleaning and maintenance of public areas and waste management.

3. WASTE MANAGEMENT IN MORELOS: *CASE STUDY JIUTEPEC*

The state of Morelos produces 2,087Mg/da.[1] Three municipalities produced the greatest volume of waste: Cuernavaca with 450 Mg/da, Cuautla with 230Mg/da and Jiutepec with 200Mg/da. According to local authorities, waste in Morelos is commonly disposed of in 26 official open dumps and approximately 107 illegal dumps located in the state. In most localities, waste is collected by the municipality, transported to a designated transfer area and later disposed of in official dump areas. Official reports indicate that the municipalities located in the Cuernavaca Region produce 70 % of Morelos's waste. 50% of the municipal solid waste is considered organic, 30% are classified inorganic recyclable and 20% are inorganic non-recyclable. (Ayuntamiento-Cuernavaca 2003-2006).
The initiatives taken by the State Government towards improving waste management in the region can be summarized as followed:

- In Cuernavaca several drop-off Centres have been set up for residents who voluntarily bring and separate their waste. The secondary materials stored temporarily in those establishments are: paper, cardboard, pet, aluminum, glass and plastic.
- Educational programs have been established to motivate the locals and to improve their separation habits.
- Several municipal compost plant have been set up to treat organic waste resulting from green areas, parks and public gardens.

3.1 General description

With a population of 181,317 inhabitants, Jiutepec represents 1.42% of the state's total surface with an area of 70.45 km^2. This municipality has the highest density of the region with 2,421.42 inhabitants/km^2. 80% of the residents are concentrated in one sector. With an average temperature of 21.2˚ C. and an altitude of 1,350 meters above see level, its climate is classified as sub-humid warm. Located in the Rio Amacuzac basin, Jiutepec draws its water from springs and several water streams. The area, "el Texcal" an important aquifer of 408 ha., is an important natural feature of Jiutepec and was declared protected area in 1992.

7% of the land is designated for garden and farming activities and 23% of the territory is reserved. According to official records, electricity reaches 39,776 households and water is provided to 96.61% of the housing units. The rapid urbanization is evident through the construction of streets, bridges, tunnels and other transportation commodities planned for the

[1] Data obtained by the authorities of Morelos

near future.

With 6 sewage treatment plants, Jiutepec is largely urban. Industry and manufacture (25%) are the common activities. Commerce (17%) falls in second place and services (10%) in third place. A large portion of the population works in 250 industrial plants located in the area. The boosting industrial climate, the change of land use favoring the construction of housing units, and the affordable price of properties have attracted wealthy residents from Mexico City who have established their weekend homes in this town.

3.2 Waste management in Jiutepec

- Total waste generation: 271 Mg/d
- Domestic waste: 77.74 Mg/d (low 45.62 Mg/d, medium 15.45 Mg/d and high 16.67 Mg/d.)
- Total waste generation per capita: 1.4Kg

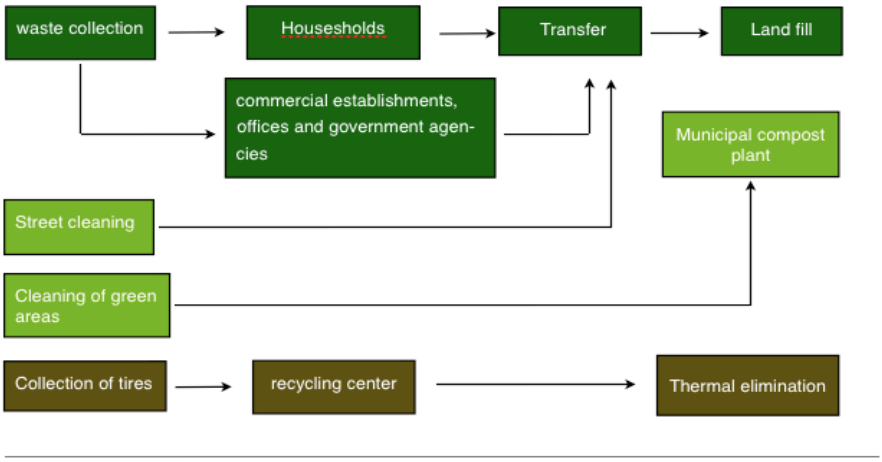

Figure 3. Waste management in Jiutepec. Source: Thesis Consulting

The town of Jiutepec is divided in three main sectors. In the first sector, which is the main area, the municipality and other private groups collect the domestic refuse twice a week. There, a private group of scavengers separate reusable fractions. The second (15%) and third sector (4%) are both attended by private collection groups. Open and closed vehicles are utilized for the collection and transportation of the waste. The municipality collects the waste from housing units, schools, offices and public entities by means of 10 waste trucks in the main sector. The private groups use 24 garbage vehicles to collect waste in other residential sectors. Lastly, the industrial area CIVAC relies on its own collection system.

After collection, the waste is consolidated into larger capacity vehicles in a transfer area. The management of the site is private. The operations take place in an area of 8,330 m^2 by means of 2 transfer-trucks with a capacity of 70m^3 each. The waste is then carried to a final disposal site know as the Tetlama Waste Dump, located in the neighboring municipality of Temixco and operated by local landowners. The municipality provides a monthly fee in order to use the site as a waste dump.

Street cleaning services are provided only in the main sector of Jiutepec. Eleven workers

(mainly senior citizens or disable persons) clean the streets manually. There are 8 street cleaning routes and a total of 66.98 km are swept weekly.

The organic waste collected from green public areas, fruits and vegetables from the local market and selected private housing units are taken to the municipal compost plant. The compost center receives between 1,500 and 2000 m^3 of organic waste. The compost produced is used by greenhouses' managers. Old tires are collected once a week and stored in a drop-off station. The stored tires are transported monthly to a private cement plant to be destroyed.

The municipality of Jiutepec supervises and coordinates the waste collection and final disposal occurs through the department of public services, which delegates the operational tasks to the department of sanitation. Both entities employ close to 60 individuals in charge of administrative and operational work. In addition to the monthly salary of all employees, the budget of the department of sanitation includes the costs necessary for collection, transfer, final disposition of waste and street cleaning.

4. SWOT ANALYSIS

The strengths, weaknesses, opportunities and threats of the waste management system in Jiutepec are presented as followed in relation with the diagnostic of the state of Morelos. A broader range of factors was taken into account in order to provide a holistic approach on the issues at hand.

Strengths

Jiutepec is one of the fastest-growing entities in the region with a boosting economy. The diversity of commercial and industrial activities being conducted and the potential for agriculture and tourism has created a suitable climate for investments and attracted many dwellers in the region. Additionally, weekend homes, spas, and other leisure/recreational establishments have proliferated in recent years. This means that the production of waste will continue to increase and the industrial waste stream will maintain greater than that of domestic waste.

The locality has valley regions and lakes which supply water to the residents. Like most parts of Morelos, the municipality is notorious for its mild climate and impressive natural surroundings, which stimulate a series of outdoors activities and ecotourism. The people of Jiutepec treasure these natural resources and water plays an important part of the recreational activities of the town's folks. Efforts by NGOs and other independent groups to secure the protected area, "el Texcal", have raised a certain level of environmental awareness among locals. The people of Jiutepec want to keep their town clean as demonstrated by the establishment of private initiatives of waste collection in areas not covered by the municipality. Locals are willing to pay additional fees for the collection service.

Weaknesses

The involvement of different actors in the waste collection and treatment as well as the lack of control of local authority make it difficult to obtain reliable data on the waste type and volume produced in Jiutepec. For example, the collection of residential waste, provided by public and private actors is difficult to systematize. Private groups offering services of waste collection act autonomously without the adequate supervision of the authorities. Furthermore the industrial sector has its own waste management system, which is not controlled by local authority.

Reports and testimonies obtained on waste management in Jiutepec show an inconsistency related to the frequency, time-schedule and routes of the collection system. The municipality collects domestic waste only in selected areas. The combination of remoteness and poor street

conditions make it difficult to collect waste in all sectors. The private groups who also provide waste collection services utilize open vehicles. This creates additional pollution and spread of waste particle. The evidence suggests that street cleaning is insufficient in Jiutepec. The transfer area is not adequate for the volume of waste being handled; its operation needs to be improved.

Concerns, related to the excessive administrative work involved with waste managing which have contrasted the low performance of waste collection operators have been raised. The most important aspect of the weaknesses of the waste management system in Jiutepec is the lack of joint efforts, continuity and coordination. As a result, the actors involved in the waste process act separately and common agreements are difficult to reach.

Opportunities. What could be a win – win situation?

There is a potential for an integrated waste management industry, considering the importance of commercial activities in the municipality. Waste with a market value could be put forward by implementing reuse systems through recycling centres or "Buy-back Centres" focusing on automotive waste, oil recycling, plastic products and all industries within packaging chains.

The opportunity to provide up to date information and monitoring services as well as guidance on regulatory compliance and good practice exists. This would then allow the public authority and private actors interested in waste management processes to achieve a reduction in environmental impacts and plan adequately for the future.

The motivation of the inhabitants and the talent and skills of the locals for commerce and tourism offer a potential to actively integrate the population in a lucrative secondary material occupation as well as eco-tourism. In fact, there is an increasing interest in community actions and training.

Threats

In Jiutepec springs and other water bodies have been turned into sewage or contaminated. The rapid urbanization process is reported to have negative effects on the natural resources of the area. The municipality relies on limited resources in order to prevent actions taken by corporate firms and other private groups in terms of land acquisition. It also lacks the ability to measure the level of its environmental footprint.

Another related threat to the growing urban character in the municipality is the slow response to the transportation needs. This failure could account for a major setback in future improvements of the waste management system.

The most important threat in Jiutepec is the lack of final waste disposal alternatives to the Tetlama waste dump. Last year, the neighboring communities challenged the use of the area, causing the rise of illegal waste dumps in the region. This situation indicates the need to find immediate solutions as where and how to handle waste in Jiutepec. Failure to address the issue efficiently may not only provoke severe environmental damages to the region but also instigate civil conflicts between the people of Morelos.

5. RECOMENDATIONS

There are several key points that run throughout the previous analysis and must be implemented in any actions in Jiutepec. One of the most feasible endeavors is to provide knowledge to the people of Jiutepec. With proper skills, the residents will be able to take more responsibility in the development of their town, find more efficient solutions to resolve their problems and have better access to business opportunities.

There are a number of success stories relative to alternative waste management in small

communities that can be shared. The mediatization of other positive approaches concerning waste and the impulse for community participation is key for building a good outlook towards waste. A strong public relations is crucial for the establishment of good practices. The underlying principle is that the shift from considering waste as a problem to understanding it as a valuable resource will be of great benefit to all members of the community of Jiutepec.

Finally further guidance regarding waste issues first involves differentiating the collection, treatment, and tariff of domestic and industrial waste stream. Next, there is a need to improve the collection of domestic waste provided by both public and private sectors and lastly to regulate private waste management services. When it comes to involving private sector in low or middle-income localities, planning appropriate strategies, knowing the real needs of the municipality as well as and the interests of all parties, and finally implementing strategies on how might the work be divided up to facilitate competition and the involvement of smaller local companies is crucial.

Where does the organisation compete well?

6. CONCLUSION

One important step toward improving waste management in small and medium scale municipalities in Mexico is to consider the value of local refuse as secondary material. As living standards in the communities of the state of Morelos are rising, management of waste becomes more critical. The strong participation of some private groups acting autonomously in the waste organization makes it difficult to modify bad habits associated with waste operations. In Jiutepec, evidence suggests the existence of a number of repetitive failures in terms of waste collection and separation. The weaknesses are mainly related to the changeability of the service. The lack of consistency and control in the collection of domestic waste has negative impacts on the waste retrieval economy and fails to stimulate the population towards more sustainable practices. Another important aspect is the absence of investments in adequate final disposal facilities for the town. The municipality has occupied the same open waste dump for many years and consequently a series of environmental and health hazards in neighboring communities have been observed.

Considering that Jiutepec is one of the fastest-growing entities in the region with a boosting economy, the potential for an integrated waste management industry does exist. One approach would be to provide knowledge to interested parties on proper policies for the recovery of secondary material. Also, regularizing and monitoring the actions of existing private groups is crucial; finally public relations and community participation is central for effective governance and must be emphasized in any sustainable waste management program.

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