



# *Environmental Audit of Solid Waste Management in Granada City, Nicaragua*

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## **ABSTRACT**

The study focuses on conducting an environmental audit that will contribute to the improvement of environmental practices in the solid waste collection service offered by the mayor of Granada city, diagnosing the entire process of collection, treatment and final disposal of the non-hazardous solid waste generated, which will allow to implement an action plan and strengthen the management of solid waste, through a follow-up guide to actions to comply with environmental improvement and an objective evaluation of the elements of the collection, treatment and final disposition of them to minimize the risks of environmental contamination due to the realization of activities that by their nature constitute a potential risk to the environment.

## **INTRODUCTION**

One of the main factors that influence the success of a tourist place is the cleanliness of the site. The natural, cultural or historical elements that are a main part of the tourist attractions,

can be diminished or disadvantaged when situations of carelessness or lack of cleanliness occur, which can even put at risk the health of the visitors and inhabitants of the place.

From the above, the importance of conducting an environmental audit in the management of solid waste in the city of Granada arose; for which a diagnosis was made, in order to know the current status of processing, handling and the ability to protect the environment and public health. This helped to propose necessary and adequate actions for the management of solid waste, which on the one hand ensure cleaning efficiency and on the other hand do not interfere with the day-to-day activities of the city.

## **MATERIALS AND METHODS**

For the execution of the environmental audit, three general stages were carried out which in turn were divided into sub stages. The main stages were:

1. Stage: Data Collection and Systematization

This stage consisted of the gathering of information regarding the management of solid waste in the city based on the indicators: Generation, Separation, Storage, Collection, Transportation, Sweeping and Final Disposal.

The information was collected in three sub stages:

- a. Collection of Primary Information

For the primary compilation, interviews were carried out with the actors involved, such as: Director of Municipal Services, Epidemiologist of the Japan-Nicaragua Hospital, Watchman of the transfer post “El Plantelito” and Watchman of the “La Joya” landfill. In the interviews, questionnaires with open and closed questions were used.

- b. Secondary Information Review

The review of secondary information involved the search and bibliographic compilation of the aforementioned research.

- c. Verification in situ

In this sub-stage, the audit team made visits to the different locations where waste generation is involved, such as: hospital, transfer posts, market, beach, parks, public squares, tourism sector, landfills, neighborhoods and wastewater channels.

2. Stage: Identification and Discussion of Findings

With the information obtained as a result of stage I, an analysis of it was carried out and as a consequence the identification of findings for further discussion by the audit team.

### 3. Stage: Preparation of Final Report

As a result of Stage II, a final report was prepared to propose possible recommendations that lead to improved management of non-hazardous solid waste.

## RESULTS AND DISCUSSION

### Integral Management of Solid Waste

For the analysis of solid waste management in the city of Granada, the two types of service were analyzed: ordinary or regular cleaning, extraordinary cleaning service or special service, in addition to the management of “La Joya” landfill in the city.

#### *Ordinary or regular cleaning*

##### *Municipal market*

At present, the market is made up of a land area of 11,700 m<sup>2</sup> and the built area of 9,192 m<sup>2</sup>, it has 1850 formal merchants and 480 informal merchants, the latter vary depending on the time of the year, approximately 2,000 people pass throughout the market and its surroundings daily.

The market management has its own waste collector staff, which are divided into 7 zones: Patio 1 and 2, Fish, Clothing and footwear, Commerce, Paises bajos, Campana and Mombacho.

On the outskirts of the municipal market there is a solid waste transfer post called “El Plantelito”, which has an area of 746 m<sup>2</sup>, which receives the solid waste collected from the market cleaning and the streets near it. According to the site’s records, 7.8 tons of solid waste were received a week five years ago and currently, there are more than eight tons.

The frequency of waste transfer to the La Joya landfill is twice a day (7:15 am and 4:00 pm). During the collection of the waste at the transfer post the assistants of the waste collection trucks carry out the separation and classification of the waste, in order to sell it later and distribute the profits among the workers of the truck, it is a way to get more economic support for themselves.

“El Plantelito” has the necessary infrastructure conditions such as: access gate, perimeter wall, cobbled access, hygienic services, electricity and drinking water; In addition to functioning as a transfer post, it also functions as a storage warehouse for garbage collector trucks and structural maintenance materials of the market building.

### *Japan-Nicaragua Hospital*

In the hospital there are two types of solid waste that are classified as dangerous or biological infectious and non-hazardous or common. The management of these is in charge of an epidemiologist at the Hospital.

The waste that is generated by the users, workers, cafeterias and kitchen of the hospital are: papers, plastic bottles, bags and fruit peels. This waste is collected twice a day in the different garbage dumps located in the Hospital and taken to the storage area, being in this place they are placed in containers waiting for the city waste truck to collect them.

### *House to House Collection*

House-to-house collection is currently covering 100% of the urban area (97941 inhabitants). From May 2015, the collection was extended to the rural area with 50% coverage and with a frequency of one day a week. Waste collection in rural areas is in: Posintepe, El Pochote, El Fortín, El Hormigón, Tepeyac and El Mamón, La Prusia, Kauloa, El Guayabo, Los Cocos, Osagay, Camino Real and El Paso.

The information obtained by municipal services of Granada indicates that the population payment for this service is low because it barely covers 20.57% of the total expenses of the garbage collection service, the level of subsidy to the population provided by the municipality reaches 80%. So solving this problem is crucial to curb the economic expense of investing in an activity that can sustain itself.

On the other hand, within the home system, the service for the collection of waste produced by supermarkets: La Colonia, La Unión and dos Pali is also provided. Companies such as: Chamorro, Ceguel, Free Zones, among others; they themselves are responsible for transporting their waste to the landfill, where there is a supervisor of the municipal services from the City Hall whose function is to keep track of how many times companies arrive to deposit garbage, according to this record they are charged to the company for the final disposal service of waste.

It is important to mention that the supervisor only keeps track of the entrances and exits but does not have a record of the physical or chemical classification of the waste that companies leave.

### *Street Sweeping*

Street sweeping is prioritized primarily for the central or tourist area with two shifts from 6:00 am to 12:00 md and 12:00 md to 6:00 pm, street sweeping coverage is 93% in relation to the streets covered (pavement and cobblestone), this because citizens take the commitment to clean their streets as they benefit from the program "Streets for the People" (cobblestone) of

their access roads to their homes. In 2016, the street sweeping service was expanded from 600 to 828 blocks / day (23 km extension).

### ***Extraordinary cleaning service or special service***

#### *Channel and Drainage Cleaning*

The cleaning strategy is performed before winter with a coverage of 17 km of the main channels that run through the city; After this day it has a maintenance plan for the critical points, this is carried out depending on the frequencies and ravages of the rains. This activity is carried out with 19 workers and a supervisor.

In addition, along with the cleaning of channels, maintenance of 360 drainages and rainwater manholes is performed. It should be mentioned that in the last three years more than 250 metal grills and / or concrete slabs have been installed.

#### *Beach Plan*

The Mayor's Office is responsible for cleaning the access roads to the Tourist Center, the small illegal dumps generated by the sale of coconuts and other food, and the 400 m of the lake coast in front of the Blue Park to where the boardwalk ends.

#### *Holidays*

Granada is a participant of great festivities with national and international activities such as: The international poetry festival, the traditional processions of Holy Week, Agostine Festivities, Celebration of La Purísima, among others.

The strategy taken for these eventualities is the immediate cleaning of the place after the event, the number of staff available for these occasions depends on the area covered by the festivities, but on average there are three to ten street sweepers.

At present, the only industrial sector that the municipality provides the garbage collection service is to the textile zones located in the perimeter of the city, the waste from the Textile Zone is included in the route from house to house; payment for the service is depending on the amount of trips requested.

### **Garbage Increase Analysis**

Municipal services works with projections of a study carried out in 1997, by the Japanese Agency for International Cooperation (JAIC), in which they establish that the annual increase in urban solid waste is 1% as can be seen in Table 1.

Table 1. Increase in the per capita rate of solid waste generation

Source	Unit	2013	2014	2015	2016	2017
Home	kg/inhab./day	0.84	0.85	0.86	0.87	0.88
Municipal market	kg/inhab./day	3.52	3.55	3.59	3.62	3.66
Street Sweeping	kg/inhab./day	39.92	40.32	40.72	41.13	41.54
Commerce	kg/inhab./day	2.09	2.11	2.13	2.15	2.18
Restaurants	kg/inhab./day	18.80	18.99	19.18	19.37	19.57
Institutional	kg/inhab./day	0.11	0.12	0.12	0.12	0.12

Source: Municipal Services; Report "Achievements and Difficulties 2015".

For the above, in 2015 a pilot sampling of the amount of waste generated in the household collection was carried out, which generated a result of 0.874 kg/inhabitant/day; This was achieved with the financial support of the Funds for Research Projects (FRP) of UNAN-Managua.


### Action plan

The City's Solid Waste Management Program was designed to benefit the municipality. For its proper execution, the joint action of the different social sectors, both private and public, is required, with the Mayor being the coordinating body of it.

The actions of the Management Plan can be classified according to the planning period in short-term actions: from 0 to 3 years (2017-2019), medium term: from 3 to 5 years (2020-2023), long term: from 6 to 10 years (2024-2027).

The deadlines were chosen according to the priority of action and the possible economic amount that they have to have for their execution. The short-term actions correspond to the implementation activities of the plan, which are of vital importance as the starting point and basis for medium and long-term actions.

Table 2. Strengthening Institutional Management.

	<b>SOLID WASTE MANAGEMENT ACTION PLAN GRANADA-NICARAGUA 2017-2027</b>		<b>Code: 1.1</b>
			<b>Date: December 2016</b>
<b>Strengthening Institutional Management.</b>			
<b>Objectives</b>	<ul style="list-style-type: none"> <li>• Strengthen the management and administrative management of the Municipality related to the management of urban solid waste.</li> </ul>		
<b>Goals</b>	<ul style="list-style-type: none"> <li>• Develop an urban cleaning system.</li> <li>• Stop pollution caused by the mishandling of solid waste.</li> <li>• Create a formal procedure for registration and control of all documentation related to the management of urban solid waste.</li> <li>• Improve communication and internal cooperation mechanisms related to solid waste management.</li> <li>• Create incentive policies for operators to ensure greater efficiency in the service.</li> </ul>		

No	Action	Term	Indicator	Responsible
1	Update and implement the Environmental Management Plan, with an assigned budget.	2017-2023	Documentation approved and disclosed	Environmental Directorate Directorate of Municipal Services
2	Update the registry of users of the collection and cleaning service	2018 and every two years	Registry documents updated	Collection Personnel Finance Department, Municipal Services


No	Action	Term	Indicator	Responsible
3	Prepare a contingency plan against the public cleaning service	2020-2027	Documentation approved and disclosed	Environmental Directorate Directorate of Municipal Services
4	Update and create database of the physical characterization and weight of solid waste	Every two years	Updated Documentation	Environmental Directorate Directorate of Municipal Services
5	Install a gate and perimeter fence of the landfill	2020-2023	Contrition	Directorate of Municipal Services
6	Prepare Sectorial Plans for Solid Waste Management mainly in the Commercial, tourism and industrial sector	2018-2023	Documents of elaborated Sector Plans	Municipal Services and Environment Staff, Private Sector
7	Create and apply indicators for monitoring and control of solid waste management	2020-2023	Number of indicators created	Directorate of Municipal Services
8	Place containers where passersby deposit their waste	2017-2019	Study Approval	Mayor, Director of Municipal Services, Head of Decoration and Cleaning
9	Digitize macros and micro collection routes and street sweeps	2024-2027	Digital Maps	Directorate of Municipal Services
10	Acquire tents to cover the waste on the collection trucks.	2018-2023	7 tents (for each of the collection vehicles)	Director of Municipal Services, Head of Decoration and Cleaning



No	Action	Term	Indicator	Responsible
11	Develop a Feasibility study of new transfer posts in the city.	2020-2027	Approved and disclosed documentation	Directorate of Municipal Services and Environmental Management
12	Conduct a technical-operational study for the update of urban and rural waste collection routes.	2017-2019	Study Document	City Council, Directorate of Municipal Services Head of Decoration and Cleaning
13	Build a security booth that provides basic services (electricity, water, telephone) at the municipal landfill.	2020-2023	Inauguration of the booth	Directorate of Municipal Services
14	Develop a technical-economic and environmental pre-feasibility study for the construction of a new landfill.	2018-2023	Approved and disclosed documentation	Directorate of Municipal Services
15	Develop a comprehensive management plan for special handling waste	2024-2027	Management Plan	Directorate of Municipal Services, Environmental Management, MINSA and Market Management
16	Prepare a landfill closure plan, with the implementation of practices aimed at the use of by-products, to reduce the environmental and social impact.	2020-2023	Documentation Approved and disclosed.	Municipal Services Directorate and Environmental Directorate

No	Action	Term	Indicator	Responsible
17	Update the collection rates and final disposal of waste that allows economic sustainability of the service.	2020-2023	Approved and disclosed documentation	Accounting and Environmental Management Area
18	Equip the trucks with a first aid kit	2017-2019	Annual delivery	Municipal Services Directorate
19	Buy and deliver the protective equipment to the workers of collection, transport and final disposal of solid waste	Annual	Equipment delivery receipts	Municipal Council, Municipal Services Personnel
20	Acquire and install a scale at the municipal landfill	2017-2019	Weighing machine	Municipal Services Directorate


Table 3. Strengthening the Legal Framework

	<b>SOLID WASTE MANAGEMENT ACTION PLAN GRANADA-NICARAGUA 2017-2027</b>	<b>Code: 1.2.</b>
		<b>Date: December 2016</b>
<b>Strengthening the Legal Framework</b>		
<b>Objetives</b>	<ul style="list-style-type: none"> <li>• Formulate and implement legal instruments to strengthen the municipal legal framework linked to the management of urban solid waste.</li> </ul>	
<b>Goals</b>	<ul style="list-style-type: none"> <li>• Develop a formal procedure to identify and keep up-to-date information regarding legal provisions related to the management of urban solid waste.</li> </ul>	

No	Action	Term	Indicator	Responsible
1	Review, update and apply the Municipal Ordinances that regulate the integral management of urban solid waste	2017 - 2027	Number of existing and revised ordinances	Mayor, Directorate of Legal Counsel, Department of Environment, Directorate of Municipal Services, and MARENA
2	Prepare and implement ordinance to regulate the safe handling of non-hazardous waste at the municipal level.	2017-2027	Ordinance Approval	Directorate of Municipal Services, Environmental Management, MINSA


No	Action	Term	Indicator	Responsible
3	Develop and apply instruments for fines and penalties	2017 - 2027	Number of fines per month; number of penalties issued per month	Directorate of Legal Advice, Department of Environment
4	Develop new legal instruments related to solid waste management that in turn consider incentives for the population and workers	2017-2027	Number of legal instruments approved	Mayor, Directorate of Legal Counsel, Department of Environment, Directorate of Municipal Services and MARENA

Table 4. Economic Strengthening

	<b>SOLID WASTE MANAGEMENT ACTION PLAN GRANADA-NICARAGUA 2017-2027</b>		<b>Code: 1.3.</b>
			<b>Date: December 2016</b>
<b>Economic Strengthening</b>			
<b>Objectives</b>	<ul style="list-style-type: none"> <li>Apply strategies aimed at the economic strengthening of the Municipality in relation to the management of urban solid waste.</li> </ul>		
<b>Goals</b>	<ul style="list-style-type: none"> <li>Reduce the subsidy for the provision of the collection and cleaning service.</li> <li>Obtain a profit margin for the collection of urban solid waste.</li> </ul>		

No	Action	Term	Indicator	Responsible
1	Study of the existing real need of street sweeping, in order to determine the number of workers	Every two years	Documentation disclosed	Directorate of Municipal Services
2	Perform performance evaluations of collectors	Annual	Evaluation Information	Human Resources and Accounting Area
3	Submit the Action Plan to the cooperation table with NGOs and institutions present in the municipality or in the region	2020-2023	Number of cooperation agency supporting the Action Plan	Mayor, Director of Municipal Services, Department of Environment, NGOs, Institutions, Private Sector
4	Develop a differentiated rate study that is intended to cover 100% of expenses. As well as the incorporation of it in the payment of other services.	2018-2019 and biannual update	Subsidy Reduction	Mayor, Director of Municipal Services, Collection staff


Table 5. Training and Technical Assistance

	<b>SOLID WASTE MANAGEMENT ACTION PLAN GRANADA-NICARAGUA 2017-2027</b>		<b>Code: 1.4.</b>
			<b>Date: December 2016</b>
<b>Training and Technical Assistance</b>			
<b>Objectives</b>	<ul style="list-style-type: none"> <li>• Formulate activities aimed at strengthening the technical-operational capabilities of staff</li> </ul>		
<b>Goals</b>	<ul style="list-style-type: none"> <li>• Develop a procedure to determine training needs, offer them, monitor and identify new needs.</li> <li>• Ensure that all personnel are aware of the importance of shaping their activities in order to comply with the policies and perform the actions provided for in the Management Plan.</li> <li>• Apply safety, health, ergonomics and occupational hygiene measures aimed at the people involved</li> </ul>		

No	Action	Term	Indicator	Responsible
1	Advice for the closure of the hospital waste dump.	2018-2020	Closing plan	Environmental Directorate
2	Train in the handling and good practices of special waste	Anual	Attendance	Directorate of Municipal Services, Environmental Management, MINSA and Market Management
3	Train collectors in human relationships	Anual	Participation List	Human Resources

No	Action	Term	Indicator	Responsible
4	Implement 5-minute talks before starting the workday on issues of improvement, Occupational Health and Safety.	2017-2019	Participation List	Directorate of Municipal Services
5	Train in safety, health, hygiene and ergonomics at work	Annual	Participation List	Directorate of Municipal Services
6	Request advice on occupational safety, health, hygiene and ergonomics	2017-2019	Number of trainings	Mayor, Director of Municipal Services, MITRAB, MINSA
7	Provide technical-operational training related to solid waste management	2017- 2027	Training provided (at least 1 every 6 months)	Directorate of Municipal Services

Table 6. Environmental Education and Citizen Participation

	<b>SOLID WASTE MANAGEMENT ACTION PLAN GRANADA-NICARAGUA 2017-2027</b>	<b>Code: 1.5.</b>
		<b>Date: December 2016</b>
<b>Environmental Education and Citizen Participation</b>		
<b>Objectives</b>	<ul style="list-style-type: none"> <li>• Promote an environmental awareness in the population of the different social, economic and political strata, thus promoting their participation in the management of solid waste.</li> </ul>	
<b>Goals</b>	<ul style="list-style-type: none"> <li>• Develop a formal procedure to communicate information related to the management of urban solid waste to the population.</li> <li>• Promote separation at the source, reuse and recycling of various types of urban solid waste.</li> <li>• Incorporate the population in the solution of the problems associated with the bad management of solid waste</li> </ul>	

No	Action	Term	Indicator	Responsible
1	Information sessions on the type of waste that can be deposited, the conditions and schedules established.	2017-2027	Approved and disclosed documentation	Directorate of Municipal Services and Environmental Management
2	Plan awareness and minimization campaigns at the source, aimed at citizens that include good environmental practices and waste handling.	2017-2027	Approved and disclosed documentation	Directorate of Municipal Services and Environmental Management



No	Action	Term	Indicator	Responsible
3	Convene the industrial, commercial and tourism sector for training of good environmental practices and proper management of the waste they generate.	2017-2027	Approved and disclosed documentation	Directorate of Municipal Services and Environmental Management

## CONCLUSIONS

The results of the analysis of solid waste management, indicates that the municipality of Granada has been improved in the management of solid waste, its streets, squares and parks are clean; but the municipality does not have the development of studies, work proposals to reactivate and promote the development of the integral management of solid waste.

There is political will for the application of the Solid Waste Management Program but there is a lack of better articulation in local government and civil society, it is also necessary to improve the levels of environmental awareness through environmental education for the management of solid waste.

The public cleaning service has problems to achieve optimal coverage, due to financing factors. What can be seen is the existence of human capabilities, both at the level of the Municipality and in the community that being empowered can improve the situation.

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