

# A Sustainable Urban Solid Waste Management System

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## ABSTRACT

Currently, in many localities of Argentina, Urban Solid Waste (USW) <sup>1</sup> Management consists in privilege the use of landfills over other way of final disposal. However, in most of these cities, USW are collected, transported and deposited at sites not very far from the city center. These sites are increasingly becoming open dumps, without any measures to prevent environmental, social and in health impacts, transforming the activity unsustainable.

Navarro is a small community of 17,000 people in the province of Buenos Aires, with traditional habits and characteristics, because of its strong rural economy. It presents serious historical shortcomings regarding USW and its management has lacked any planning. At present, they use an open dump with waste burning that generates various environmental liabilities.

This paper, presents the environmental feasibility of the implementation of a sustainable USW Management System in Navarro, Argentina. The new strategy includes the installation of a treatment plant for USW, the selection of the proposed site, new method and circuit of collection, community involvement, the construction of a small landfill for fraction of rejection, compost production, sale of material for recycling, etc.

**Key words:** Sustainability – Urban Solid Waste - EIA

## 1. INTRODUCTION

### 1.1 Neighborhood Union of Navarro (UVEN)

The community of Navarro participates in this project since the Neighborhood Union of Navarro (UVEN) seeks advice to the Center for Environmental Studies (CESAM). Subsequently, it was performed the first participatory workshop, where it was presented the proposal. Interviews were also conducted with stakeholders. The municipal authorities were always consulted throughout the process.

### 1.2 City of Navarro

County of Navarro is 100 km west of City of Buenos Aires, with a populations of 17.024 people and an area of 1.630 Km<sup>2</sup>.

The head of the County is the City of Navarro which concentrates 73% of the population. The city is located on the shores of “Laguna de Navarro”. It is divided into four locations and borders with Lobos, Chivilcoy, 25 de Mayo, General Las Heras, Suipacha and Mercedes counties. Access is through National Routes n.40 and n.200 and the Provincial Route n.41, 44 and 47. (Municipalidad de Navarro, 2011).

### 1.3 Current USW System

As in most localities of Argentina, the city of Navarro in the Province of Buenos Aires, the management of Urban Solid Waste (USW) has serious historical shortcomings, its management planning has lacked and the few decisions that have been taken in this regard have been only palliative for that moment. Currently, waste is deposited in an open dump and periodically burned.

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<sup>1</sup> Also known as Municipal Solid Waste (MSW)

## **1.4 Collection and Transport**

In the City of Navarro, USW are collected six days a week in two shifts, one from 10:00 p.m. to 5:00 a.m. and another one from 6:00 am to 13:00 am. The Municipality has one compactor truck (currently out of service), so that harvesting is done in a truck with Dump Bed

Circuit Collection I, covers the old center and the two main streets. Circuit Collection II covers the rest of the city. If rain does not collect waste in the unpaved road because are inaccessible. (Municipio de Navarro, 2011).

## **1.5 Final Destination**

The USW taken have to two possible destinations: an open dump "official" and a casual open dump "informal". (Tauber *et al.* 1998).

## **1.6 Municipal Dump (official)**

The Municipal Dump is an area of about 12 has in a rural area. It is located 8 km from the city limits and 2 km for land access from 200 route.

It lacks of any signaling, perimeter fence or tree curtain and is only identifiable by the amount of waste found there. It has not had planning, EIA, monitoring, infrastructure, etc.

Currently there are two large ditches where waste is dumped haphazardly and not compacted. Residues are burned periodically. Once filled, the ditches are covered with land, and open new ditches.

The landfill, obviously, does not meet the Resolution 1143/02 of the Provincial Agency for Sustainable Development (OPDS), on disposal of USW Landfill. (OPDS, 2002)

Since there is no perimeter fence, animals are often found at the site. To 500 m. of this site there is a tributary of Las Garzas stream that flows into the Laguna de Navarro.

## **1.7 Informal Dump**

The access to this site is at the intersection of 1 and 42 Streets directly bordering the urban area, and only 100 m from the Lagoon of Navarro.

The site is a depression and flood. It began to be used as landfill with the intention of land use change.

In 2009, was closed by Ordinance 591/2009, because it is framed within the Municipal Nature Reserve area. It has been used as a receiver of garden waste, USW and scrap, thrown there by the authorities and neighbors. It also verified the practice of burning.

The site has a perimeter fence in disrepair, no signaling and any health and safety measure. Also, informal waste is taken by disadvantaged neighbors.

## **1.8 Regulatory Frame**

Act 25.675 Environmental General Law.

Act 25.916 Minimum Requirements of Environmental Protection for the Urban Waste Management.

Act 24.051 Hazardous Waste Regime.

Act 25.612 Industrial Waste Management System.

Act 11.723 Environmental Law. Province of Buenos Ares (PBA)

Act 11.720 Generation, Handling, Storage, Transportation, Treatment and Disposal of Hazardous Waste. PBA

Act 11.347 Pathogenic Waste. PBA.

Act 13,592 "Integrated Management of Municipal Solid Waste" (Act GIRSU) of the Province of Buenos Aires, presents the requirement for all municipalities, to implement in a methodological, systematic and rational way an Integrated Solid Waste Management System, with total elimination of open dumps with burns.

Resolution 1.143/02 Provincial Agency for Sustainable Development (OPDS), determines the guidelines to follow to locate a landfill.

Resolution 40/2011. Management Program of USW Procedure. (OPDS, 2011).  
 Ordinance 591/09 Dump of 1 and 42 streets closure.  
 Land Management Plan of Navarro.

## 2. MATERIALS Y METHODS

The regulatory frame, relating to plans GIRSU, urges to plan to a medium and / or long term, in order to give a sustainable solution to the management of USW (National Strategy GIRSU, 2005 and GIRSU National Observatory, 2011). Therefore it was adopted a project duration of 20 years, beginning in 2013 and operating from 2014 until 2033.

Since there is no database on waste generation, were used data from similar locations, in terms of population, consumption habits, lifestyle and economic activity, to Navarro. The initial population value was considered the number of inhabitants of Navarro surveyed in the 2010 Census (INDEC, 2010) and for the generation of USW it was took the estimated value of current generation USW = 0.86 kg / capita / day.

Extreme scenarios, one optimistic and one pessimistic were taken. Average projection was adopted: population variation 21%, Daily Generation USW (kg/day) 53% and Daily per capita Generation (kg/day/p) 32%.

In this scenario, and with the assumptions mentioned above, in 2033 it will generate a total of 16,324 kg / day of waste, 53% more than in 2014. It is also estimated an increase in population of 21% and a variation of the *per capita* generation rate of 32%, generating 1.12 kg / capita / day waste in 2033.

The 5 most suited alternatives to the reality of Navarro were selected, *a priori*. For subsequent selection of the most appropriate technology option, we used a decision matrix, which takes into account technical, environmental, economic and social sectors.

The magnitude of the impact scale is -5/+5 and it was assigned a weight for each sector (total 100) and each parameter included in them. Regarding localization, five alternatives were evaluated (Table 1) and an EIA to the selected option was made (Pirillo, E. 2011).

## 3. RESULTS AND Y DISCUSION

### 3.1. Technologic choice selection (5 choices)

From many possible alternatives were selected, *a priori*, the 5 most suited to the reality of Navarro (Table 1).

**Table 1: Technologic choice selection**

PARAMETER	TECHNOLOGIC ALTERNATIVES													
	Landfill		Incineration		Incineration + Energy Recovery		Separation Plant + Biogas		Separation Plant + Compost					
	1	2	3	4	5	6	7	8	9	10				
<b>TECHNIC</b>														
Optimal production volume	70	5	3,5	-5	-3,5	-5	-3,5	2	1,4	5	3,5			
Flexibility for future expansion	10	4	0,4	-3	-0,3	-3	-0,3	-1	-0,1	3	0,3			
Energy recovery	20	-5	-1	-5	-1	5	1	5	1	0	0			
Technic Subtotal			<b>2,9</b>		<b>-4,8</b>		<b>-2,8</b>		<b>2,3</b>		<b>3,8</b>			
<b>ENVIRONMENTAL</b>														
Environmental Impact	30	-4	-1,2	1	0,3	1	0,3	3	0,9	2	0,6			
Regulatory Compliance	50	-5	-2,5	2	1	3	1,5	5	2,5	5	2,5			
Waste Revaluation	20	-5	-1	-5	-1	5	1	4	0,8	4	0,8			
Environmental Subtotal			<b>-4,7</b>		<b>0,3</b>		<b>2,8</b>		<b>4,2</b>		<b>3,9</b>			
<b>ECONOMIC</b>														
Investment Costs	30	-1	-0,3	-4	-1,2	-5	-1,5	-3	-0,9	-2	-0,6			
Cost of Additional Resources	30	0	0	-4	-1,2	-4	-1,2	-3	-0,9	0	0			
Operating and maintenance costs	40	-1	-0,4	-4	-1,6	-5	-2	-3	-1,2	-2	-0,8			
Economic Subtotal			<b>-0,7</b>		<b>-4</b>		<b>-4,7</b>		<b>-3</b>		<b>-1,4</b>			
<b>SOCIAL</b>														
Jobs Generation	50	1	0,5	3	1,5	3	1,5	4	2	4	2			
Academic Staff Need	20	3	0,6	-1	-0,2	-1	-0,2	2	0,4	4	0,8			
Social Acceptability	30	-5	-1,5	-3	-0,9	-3	-0,9	5	1,5	5	1,5			
Social Subtotal			<b>-0,4</b>		<b>0,4</b>		<b>0,4</b>		<b>3,9</b>		<b>4,3</b>			

The waste separation plants are the most recommended solution from the environmental point of view (3.9) only surpassed by the alternative with the production of biogas, not viable for production volumes in this case. Alternative 5, meets all the objectives of the Act GRSU, in particular promote the increase of the amount of recovered material and, therefore, decrease the fraction intended for disposal. Furthermore, manual jobs without much qualification are generated (2).

Also, this alternative may be accompanied by the source separation, thereby encouraging greater community involvement, as well as expressed in the meetings of community participation (1.5). Choosing this option ensures a long-term solution, as it is framed in a plan to minimize the volume of USW disposal.

### 3.2. Selection of localization

The current Municipal Landfill is selected as a location of the new plant. (alternative n. 2 in the Table 2). It has 12ha and located 10 kilometers from the center of Navarro which is currently used as open dump "official". Thus, it would be remedied and put into production a place with great environmental liabilities, at present (Table 2).

**Table 2:** Alternative locations of the Project. Advantages and disadvantages

	LOCALIZATION	ADVANTAGES	DISADVANTAGES
1	Informal Dump	Damaged site	Located in the Municipal Natural Reserve Zone. It is prohibited by Ordinance
2	Municipal Dump	Land damaged. Optimization in remediation and site preparation for landfill. Located in rural area. Low incidence of possible odors.	Higher logistics costs. Need to pave the access. Near the stream "El Pescado"
3	Plant site near sewage treatment	Infrastructure for the treatment of landfill leachate. Municipal land in suitable area.	Close to the urban area. Less than 1500 m. to aerodrome. Less than 1000 m. to "Laguna de Navarro" and their effluents. Flood area.
4	Planned Industrial Zone (EPZ) and Industrial Plant Zone (ZI)	Access to essential services: pavement, electricity, gas, etc.	Located in the Complementary Zone, close to future urban expansion area. Possible involvement of odors.
5	Old Municipal Landfill "El Churrinche"	Damaged land. Near paved roads. Far from human settlement	Close to "Arroyo Las Garzas". Flood area. No services.

### 3.3. Environmental analysis of the chosen location

The main negative impacts are circumscribed primarily to the construction stage, in the landfill and in the classification plant for the indicator soil erosion, and in the parameter wash water of the plant, for the DBO, pH and consumption indicators.

The operation stage manifests negative impacts for noise parameter for the actions of material classification, of low magnitude and punctual. Soundproofing measures and landscape and forestation activities are planned to reduce the impact on these parameters. With regard to the loss of value of the property, due to develop in there a landfill, and considering that currently the site presents already a significant environmental liabilities, in the long-term balance, where a program of conversion into a recreational area is included, could be considered slightly positive. However, the construction of a landfill is always obviously a cost to society.

Environmental management programs for the construction phase are planned, on site preparation and construction of the cells. In the operational phase of the landfill, are planned programs in the management of plant classification and separation, such as, program optimization water consumption, land preparation to prevent leaks, continuous training of personnel, etc.

The project is participatory from the design stages, through a process of free, prior and informed consent of the community (FPIC). Training programs are planned for students and teachers of schools, open talks with debate, media campaigns, guided tours of the plant, etc.

In summary, the environmental impacts of the project are reduced, local and mitigated using best available techniques (BAT) of production and management. This project, certainly, from the point of view of the environment, is positive and tends to the Sustainability of the Management of USW.

In regard to the collection and disposal a mixed solution was adopted, in order to promote citizen participation with a small impact in their habits and customs and avoid the loss of value of the recycled. Will be requested a basic separation into two fractions, "wet and dry", with a total daily collection of waste, as is currently practiced.

The project involves the use of two garbage trucks, bi-compartmented, that will run covering all inhabited areas of the town of Navarro in a single night service, from 10:00 pm to 5:00 am, to reduce the time of waste on the street. The route of each truck will average about 75 km a day.

### **3.4. Processing Plant**

The USW plant is divided into four main sectors: organic, inorganic, hazardous and pathogenic and rejection. A layout and machinery for a separation plant were sized, according to the current generation of 10 tons daily and projected over the life of the project..

The infrastructure involved in the plant mainly consist of two barns and sheds, for separation tasks, sorting, baling and wrapping, storage and sale and a shed for the processing and treatment of organic.

The main equipment, consist of tapes for lifting, sorting and rejection of USW, balers, pyrolytic oven, process equipment and treatment of compost, soil movement, etc. A total of 32 people will work there, with an average productivity rate of 333 kg / worker / day.

## **4. CONCLUSIONS**

This paper presents the environmental feasibility of the implementation of a Sustainable USW Management System, in Navarro, Argentina. The new strategy includes the installation of a treatment plan of USW, the selection of the proposed site, new method and circuit of collection, community involvement, the construction of a small landfill for fraction of rejection, compost production, sale of material for recycling, etc.

A key of the project is the generation and classification stage of the USW. It should develop education programs to reduce the total volume of waste produced individually (changing consumer habits, for example), as well as their separation, so go reducing gradually the fraction "rejection".

Currently, they are given the optimum conditions for the implementation of this project in the town of Navarro that, in fact, is who is claiming. The adoption and implementation of this project will involve directly the compliance with current legislation, remediation of environmental liabilities, the creation of decent work, reducing the time of presence of USW on the streets, environmental and social awareness etc.

**Acknowledgements:** Lucía Carpinetti and her family.

**Parcially Supported by:** "Unión Vecinal de Navarro" (UVEN).

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