

Urban solid waste management in the municipality of Benito Juárez, Quintana Roo, Mexico

Gestión de residuos sólidos urbanos en el municipio de Benito Juárez, Quintana Roo, México

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Abstract

The community of Benito Juárez, Quintana Roo, Mexico, has for decades faced deficiencies in waste management, with repercussions in public health, urban image and natural resource conservation. For this reason, the municipality's administration (2011-2013) created the decentralized public body "Integral Solution of Solid Waste" (SIRESOL). In order to measure the results of the strategies adopted, an evaluation of the agency's performance was carried out. The results identified deficiencies in the design of the SIRESOL.

Keywords: integral management of solid urban waste, policy evaluation, solid waste integral solutions.

Resumen

El municipio de Benito Juárez, Quintana Roo, México, desde hace décadas ha enfrentado deficiencias en el manejo de residuos, con repercusiones en materia de salud pública, imagen urbana y conservación de recursos naturales. Por ello, la administración del municipio (2011-2013) creó el organismo público descentralizado "Solución Integral de Residuos Sólidos" (SIRESOL). Con el objetivo de medir los resultados de las estrategias adoptadas, se llevó a cabo una evaluación del desempeño del organismo. Los resultados identificaron deficiencias en el diseño del SIRESOL.

Palabras clave: gestión integral de residuos sólidos urbanos, evaluación de políticas, solución integral de residuos sólidos.

1. Introduction

Cancun city, located in Benito Juárez municipality, is currently one of the most important tourist destinations in Mexico, commerce activities are the ones with a highest income contribution, some of them can be restaurants

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and hotels. However, the development of these activities also has negative impacts on social and environmental spheres.

The increase in the generation of Urban Solid Waste (USW) and its inadequate confinement is one of the problems associated with risk factors such as diseases transmission or soil's and water bodies contamination (SEMARNAT, 2015). According to the report: Statistics on the Purpose of World Environment Day, in Quintana Roo around 2,075 tons of solid urban waste are generated per day, that is, 1.35 kg of waste per capita (INEGI, 2016a), of which 1,095 tons come from Benito Juárez municipality (INEGI, 2017), which implies the need to provide collection, transportation and final disposal service to 222,072 homes (INEGI, 2016b)

Until the end of 2011, the service was directly administered by Benito Juárez city council, through the Municipal Secretariat of Services and Public Works, charging for it through treasury to the commercial sector. In October 2011, a decentralized public body was created with the power to carry out waste management provision service in the collection stages: transport, treatment and final disposal called Solid Waste Solution (SIRE SOL). Since its creation, it has operated with the following premises as its initial approach (POE 2011):

- The general cleaning service decentralization is a factor that allows its efficiency.
- The strategies designed for the generation, use, collection and final disposal areas, meet the objectives to achieve efficient, comprehensive waste management within Benito Juárez municipality.

In 2014, two years after SIRE SOL Cancun was created, an evaluation was proposed to determine whether strategies designed were directing the municipality towards an integral management of USW, following the current Mexican environmental regulatory framework, and if the main groups generated impact expected impact detected within the project design process (Ramírez, 2015).

1.1. Background on waste management in the municipality

As of the presidential decree in August 10, 1971, Cancun planning history formally begins. This decree formalized Cancun Master Development Plan prepared in 1974 by the Tourism Promotion and Infrastructure Fund (Infratur) and the Mexico Bank (SEDATU, 2014).

In 1985 the first Urban Development Plan was published, which remained in force for more than a decade (SEDATU, 2014). Since 2000, the creation of different planning instruments has regulated municipality growth. Table 1 presents a timeline of these instruments appearance.

Despite these instruments nature, whose objective pursues a territory planification in order where the inhabitants needs are satisfied, neither partial plans nor the Cancun Population Center Urban Development Program have considered for the medium or long term suitable areas for the final disposal sites establishment.

Table 2 presents, in chronological order, the final disposal sites where Benito Juárez municipality waste has been disposed.

Table 1
Timeline of the urban development planning instruments in Benito Juárez municipality

1974	1985	1993	2000	2005-2013
Cancun Master Development Plan	Urban Development Plan of the city of Cancun	Urban Development Master Plan for the city of Cancun	Expansion and modification of the North Reserve Partial Plan of Cancun city, 2000	Urban Development Program of Cancun Population Center, 2005
				Local Ecological Planning Program, 2005
			Puerto Cancun Master Plan, 2001	Partial Program of Urban Development of the South Urban Complex, 2006
			Malecón Cancun Partial Urban Development Program, 2006	
		Partial Plan of the South Reserve of Cancun city, 1998	Partial Program of Tourist Urban Reorganization of Punta Cancún, 2001	South Urban Complex Partial Program of Urban Development, 2006
			Partial Urban Development Program for Polygon 11, 2004	Modification of the Partial Urban Development Program for Polygon 11, 2008

Source: Prepared by authors based on information from Urban Development Program of the Cancun Population Center, Benito Juárez Municipality, Quintana Roo (2014-2030) (SEDATU, 2014)

Table 2
Chronological synthesis of the final disposal sites establishment in Benito Juárez municipality

1	1976-1994	The Cancun project begins as a thoroughly planned INFRATUR centre, currently FONATUR. Since the original master plan, a final disposal site is not contemplated, although garbage was not a problem due to the low population density. At that time the site known as Banco 5 began to be used.
2	1994-2006	North Sanitary Landfill. Located on Isla Mujeres land. It operated from August 2, 1994, to September 27, 2005; on July 23, 2006, it was necessary to open up and operated until September 19 of the same year. This final disposal site received approximately 2,400,000 tons of waste from Benito Juárez and Isla Mujeres municipalities.
3	2005-2006	Emergent Cell of Sufre and Calla Property. Located in Isla Mujeres territory. It has 2.6 hectares area. It operated from September 2005 to July 2006, just over 300,000 waste tons waste were received.
4	2006-2013	Parcel 1112 Final Disposal Site. Located in Benito Juárez land. It has 13 hectares area, was built in two stages and three subsequent extensions. The site started operations at the end of 2006 and ended in April 2013.
5	2013-2023	Intermunicipal Center for Solid Waste Integral Management (CIMIRS) of Benito Juárez and Isla Mujeres. Located in Isla Mujeres territory, started operations in April 2013.

Source: Own elaboration based on information from the Benito Juárez City Council, Quintana Roo

Regarding the regulatory framework on waste, Benito Juárez municipality has in recent years undergone a process of updating its regulations, following state and federal regulations; below is listed the municipal waste instruments:

- November 30, 1990. Regulation for Public Service Provision Collection, Transportation, Treatment and Final Disposal of Solid Waste in Benito Juárez municipality (TSJQR, 2011).
- June 30, 1994. Regulation of Ecology and Environmental Management of Benito Juárez municipality (SEGOB, 2008).
- December 20, 2012. Regulation for the Prevention and Comprehensive Management of Solid Waste in Benito Juárez municipality, Quintana Roo (SEGOB, 2012). This adjustment arises from a contravention in the Public Service of Collection, Transportation, Treatment and Final Disposal of Solid Waste Provision regulation of Benito Juárez municipality, generated by SIRE SOL Cancún creation.
- January 24, 2013. Municipal Program for the Prevention and Comprehensive Management of Waste (PMPGIR) of Benito Juárez municipality.

Since its creation, Benito Juárez administration provided directly both services: collection and waste disposal, until 1994 they granted both services to Triturados Basálticos S.A. de C.V. company. This concession, which was initially for 20 years, was terminated in 2006.

The service was provided again by public administration for two years since 2006, this with several deficiencies in coverage, compliance routes and schedules. On August 15, 2008, the legal entity named "Collection and Disposal of Waste", SA DE C.V. was chosen to be in charge of the Public Service for Cleaning and Final Disposal of Solid Waste to collect, transport and operate temporarily Benito Juárez sanitary landfills.

In November 2010, due to inefficiencies presented by the concession company, the municipal collection system was intervened by the State and the Federation. During January 2011 to March 2012 period, the Municipal Public Services Directorate directly provided collection and final disposal service, for it they hired three companies to collect and one more for sanitary landfill operation.

On October 20, 2011, it was created the Decentralized Public Organization called "Solid Waste Comprehensive Solution" (SIRE SOL), and from 2012 started to provide collection and final disposal service, continuing with the companies contracting scheme for collection and sanitary landfill operation.

On June 28, 2013, the 20-year concession was approved to SIRE SOL for providing general cleaning service in Benito Juárez municipality, which includes different stages activities from the reception, separation, recovery, compaction, transfer, formation and coverage of confined urban solid waste (POE, 2015).

1.2. The SIRE SOL design project

Using the methodology of Logical Framework Approach (Gómez, 2003) for designing a strategy to comply with campaign commitments: make Cancun the Peninsula cleanest city, build a new sanitary landfill, clean up and close Villas Otoch and develop this new site as a Technology Park, in addition to promoting a recycling culture in the municipality, and to establish waste public policy, the 2011-2013 administration carried out the process described below:

1) Main actors analysis: identification of 67 actors from political, private and public sectors, determining the "Housing Generators" as an utmost importance actor, as they beneficiate of an improvement in Comprehensive Management and the primary injured party since the service has deficiencies, a developing in urban typologies categorization to locate generators.

2) Problem description: The municipal public administration recognized as a central problem the "deficient comprehensive management of Urban Solid Waste (USW), in Benito Juárez municipality, Quintana Roo", whose leading causes are the inadequate municipal regulatory framework in UWS and SHW (Special

Handling Waste) and poor comprehensive management of USW, due to municipal regulations obsolescence on the matter, especially cleaning regulations. The actualization of regulations is not possible due to the short municipal administrative periods (three years), in addition to change reluctance on the Central Public Administration and Councilors part, this is because a diverse and complex sum of political, social, economic and cultural interests prevail.

Likewise, secondary causes were identified, such as a high generation of USW per capita, insufficient use of waste materials, failures in the USW collection system, non-compliance with NOM-083-SEMARNAT-2003 (SEMARNAT, 2003) and insufficient channelling of financial resources to USW integral management.

3) Activities description: The tree objectives designed is based on the problem description, which synthesizes root solutions to attack causes and not adverse effects. The initial proposal defined the municipal generation strategy towards waste reduce, reuse and recycle; later, a modification happened to establish a shared responsibility strategy the USW integral management in the municipality.

The strategy proposes the Housing Generator sensibilization concerning their responsibilities in waste management, through implementing a formal utilization methodology, which intention was to generate an economic structure based on recycling. Besides, a proposal to raise awareness of the Commercial Generator, by strengthening SIRESQL's powers, in terms of verification and monitoring compliance with generator responsibilities.

4) With the previous stages completed, Project Planning Matrices (PPM) was made, a critical tool that integrates the SIRESQL project essential components, from the Logical Framework Approach.

2. SIRESQL project evaluation methodology

The SIRESQL evaluation initially focused on results analysis and the strategies impact on the population by using the PPM information.

However, after identifying that SIRESQL had modifications regarding the objectives and activities approach, it was considered pertinent to evaluate SIRESQL design, for this, one of the instruments was used to carry out different evaluation types, that the National Council for Political Evaluation of Social Development proposes: the Reference Terms (ToR) for Design Evaluation (CONEVAL, 2007).

2.1. SIRESQL design evaluation methodology

The design evaluation seeks to identify findings and recommendations to improve the internal program logic from their design congruence analysis, in this case, SIRESQL, through a desk analysis based on each program regulations (CONEVAL, 2007), contains the following sections development:

- 1) Justification for the program creation and design.
- 2) Contribution to national goals and objectives.
- 3) Potential population, target and eligibility mechanisms.
- 4) Matrix of Indicators for Results (MIR).

For SIRESQL program evaluation, it was executed an analysis of existing information within the agency and public access information. Information gathering, organization and evaluation activities were carried out, concentrated in administrative records, databases, internal and/or external evaluations and public documentation. This analysis consisted of answering 21 specific questions, divided into four sections, using a binary scheme (yes/no) and supporting the answer with documentary evidence; in the cases in which the answer was "yes", also, one of four levels defined in each question was selected.

2.2. Methodology for evaluating SIRE SOL project strategies results

To evaluate the shared responsibility strategies, the SIRE SOL Project Planning Matrix was used, which contains indicators and verification sources for SIRE SOL objectives, one of these sources is the polls. In this way, a survey was applied to 934 municipality inhabitants, the questions were closed, and for the sample definition the non-probability sampling type was used.

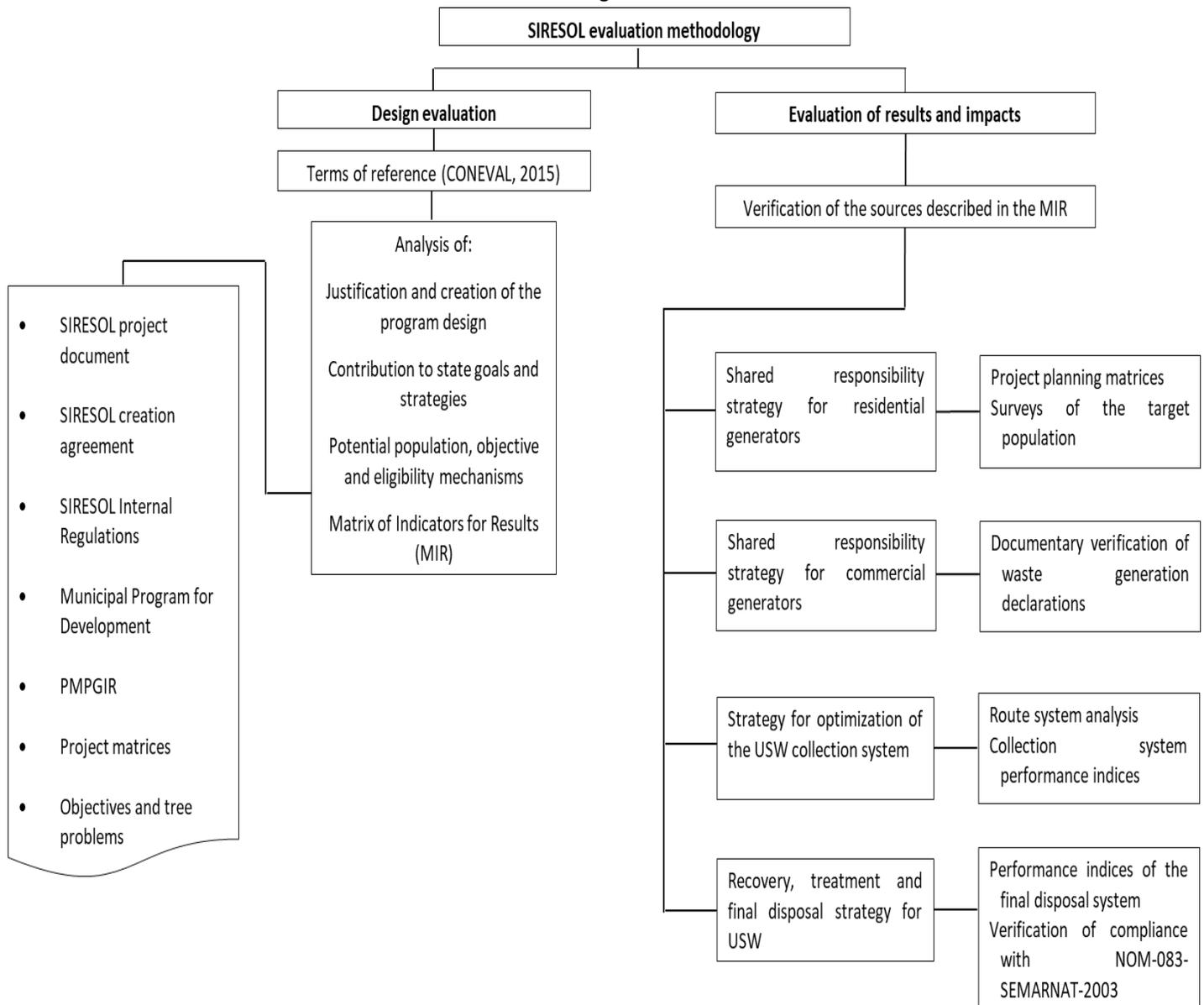
In the collection system performance evaluation, a stable waste collection coverage index was used. Besides, times and movements study was carried out, which consists in data collection at the study site, while following the waste collection vehicle.

This analysis was carried out covering all the processes of a complete work shift, that is, the entire period was covered, that elapses from leaving confinement to returning to it. The procedure for conducting the study was as follows:

1. Three of the routes of each company that currently provide the service in Benito Juárez municipality were selected.
2. The solid waste collection personnel activities of each company were coordinated, informing them of the study to be carried out, in order to avoid unnecessary conflicts during the study process.
3. It was designed a standard format for the collection of field data, the same ones that were used by each study group.
4. The departure time and each stop of the truck during the route was recorded, recording the reason for it.
5. Mileage was measured on each route, based on the car's odometer and with google earth program support, the distance travelled between two points was later calculated in the office.
6. The weighing of the garbage collection vehicles was checked for each trip made, on the scale sanitary landfill.

The NOM-083-SEMARNAT-2003 (SEMARNAT, 2003) was applied to evaluate the final disposal system stage. Likewise, final disposal coverage indices and comprehensive service cost indices were used. Figure 1 summarizes the methodologies used for the design evaluation and the results and SIRE SOL impacts evaluation.

Figure 1
Diagram of the methodologies used for the SIRESQL Cancun Program Evaluation



Source: Martínez-Rodríguez, M., Alvarado, M., Ramírez, O. and Campos, L. (2020)

3. SIRESQL evaluation results and discussion

3.1. SIRESQL design evaluation results

The design evaluation is based on Reference Terms, which are divided into four sections and 21 questions; the results of this evaluation are summarized in Table 3.

Table 3
Final result point sum according to ToR fulfilment proposed
by CONEVAL and selected according to the project nature

Section	Total of questions	Punctuation	Puntuación of the evaluation
Justification and creation of the program design	3	3	2
Contribution to state goals and strategies	3	3	3
Potential population, target and eligibility mechanisms	4	4	2
Matrix of Indicators for Results (MIR)	11	11	10
TOTAL		21	17

Source: Martínez-Rodríguez, M., Alvarado, M., Ramírez, O. and Campos, L. (2020)

As can be seen in the previous table, SIRE SOL obtained 17 out of 21 points in the evaluation, following compliance with ToR. Some of the most relevant terms of reference breach are:

- In the "justification for the program creation and design " section, it determined that in the SIRE SOL document, there is no theoretical or empirical justification that supports the agency's intervention.
- In the evaluation "contribution to state goals and strategies" section, the agency has optimal compliance, by properly linking the program purpose to the State Program objectives for the Prevention and Integral Management of Waste of Quintana Roo. Likewise, SIRE SOL goals and objectives are related to the Municipal Development Plan 2013-2016.
- In the "potential population, objective and eligibility mechanisms" section, it identified that the program does not have systematized information which allows knowing the total demand for support and applicant's characteristics, also all the records are protected in printed format and not in electronic format.
- The MIR section evaluation points to the inexistence of an official document that contains its narrative synthesis. Likewise, it identified that the program indicators do not have technical sheets with the following information: indicator name, definition, calculation method, unit of measurement, frequency of measurement, baseline, goals and indicator behaviour (ascending, descending, regular or nominal).

3.2. Results evaluation of shared responsibility strategy compliance in the municipality integral management of waste

The survey results carried out with 934 municipality citizens, clearly prove that traditional media (radio, television, newspaper) continue to be one of the primary sources of information that population use. SIRE SOL's strategy has been to disseminate responsibilities through electronic means, which is why information is directed to a small sector of Benito Juárez population.

The best-known responsibility by the inhabitants is not to litter in the street, with 80% identification, followed by sweeping in the house front. Some of the least known responsibilities are waste separation and reuse, participation in municipal programs, as well as complaints.

Regarding separation practices in homes, results showed that 85% of the surveyed population indicates that they deliver their waste to the collection vehicle without prior separation. The main reason why the population continues without carrying out the waste separation at home, is because there is no selective collection program. Lastly, they justify that their effort will be meaningless when it is stirred in the truck, 33% of the respondents answer that they do not have time to carry out the separation, so it is necessary to analyze if the classification

promotion is too complicated for people to adopt it quickly, 13% of those surveyed do not know how to carry out the separation.

The survey responses indicates that 69% of the population holds the public administration responsible for solving problems related to waste, 13% hold citizens responsible, and 18% believe that both are responsible. These results show that it continues to be necessary to generate a consciousness change in the population, concerning their shared responsibility, regarding the waste generation and management in the city.

3.3. Results evaluation of the Commercial Generator strategy compliance in its responsibilities regarding solid waste management

Following the SIRESQL internal regulations, the Utilization Directorate would be in charge of strengthening the recoverable materials collection, through programs aimed at citizens and final disposal site, since currently, no program complies with this. The main activity that this area would carry out is a USW generation verification in establishments to confirm that it coincides with the treasury declaration made and the waste generators compliance to present their waste management plan.

According to the indicator set out in the MIR, corresponding to this strategy, for 2014, the taxpayers rate who declared was 75% of the total; results show that only 53.7% of the total carried out this obligation. However, it is essential to take into account that currently SIRESQL does not have powers to carry out the payment fees for USW collection and disposal, nor to verify that taxpayers make their corresponding declarations.

3.4. Collection system optimization strategy results evaluation

After analyzing the waste records perception from the sanitary landfill and the waste generation projections, it was determined that in 2014 the collection service coverage index, which refers to USW collection service coverage, it was 93% concerning the total generated in the municipality.

It was determined that inconsistency in the collection frequency fulfilment prevents the public about collection routes and schedules. The lack of information about collection times in the population causes waste to remain on the streets for a longer time, with adverse effects that this entails.

The survey results conducted to evaluate quality waste collection system service, which indicates that 26% of the sample considers it with good quality, 60% qualify the service as fair, and 14 % think that the service quality is low.

The routing system analysis results carried out to the three waste collection companies (RUGA, Ecolimpia and SETASA), showed that unreported deviation of routes is not uncommon, and the deviation to serve other areas that have a lag in the garbage collection, which affects travel time and results in route parts being left unattended. Likewise, there was a trend of not complying with working hours, even if there are isolated areas of the route.

3.5. Results evaluation of the recovery and final disposal strategy for USW

The final disposal system evaluation, following the official Mexican standard NOM-083-SEMARNAT-2003 (SEMARNAT 2003), determined that the Inter-municipal Center for the Integral Management of Solid Waste (CIMIRS) operates within regulations. However, it is essential to aim at proper management and treatment of leachates, as these are considered hazardous waste and constitute a health risk factor, and the measures absence to eradicate scavenger practice in the landfill cells. Also, there is a need to integrate dynamic computer tools such as Geographic Information Systems (GIS), which allows visualizing final disposal sites over time (Cárdenas, 2016).

Regarding the collection index, in 2012, Quintana Roo generated 487, 280 USW tons, while 454,430 tons were collected, that is, 93.3% of the USW state (SEMARNAT, 2013).

In Benito Juárez municipality, there is no other site for final waste disposal, so the municipal collection system, private companies and the Isla Mujeres municipality deposits waste at CIMIR, that is, the total of the collected waste is confined there.

According to waste generation project, in 2014, this would have been 375,779 tons. The final collection system and private companies delivered 359,203 tons per year to the sanitary landfill, for which there is a difference of 16,576 tons, whose destination is unknown. One possible explanation is the rural areas existence, which do not deliver their waste to the system and carry out practices to eliminate them such as burning.

3.6. SIRE SOL design evaluation discussion

The creation of SIRE SOL Cancún was carried out during a period in which the municipality population perceived two problems, the first one related to the final disposal site of Plot 1113, now closed, and the second due to constant collection system deficiencies. It was during the 2011-2013 period, that the administration gave a primary place to waste management on the municipal agenda, and service administration decentralization was proposed as a policy, to improve the public service provision efficiency. However, the decentralization degree was carried out limits, to some extent, the agency's ability to achieve better results. Their ability to monitor compliance with the Regulation for Prevention and Comprehensive Management of Municipal Waste was restricted, granting to Public Services Directorate this power, which created an incoherence between the authority that defines rules and the one that monitors compliance. It is a priority to develop integration plans and joint work to harmonize appropriate laws, regulations and standards for proper USW management (Hernández, 2016).

The resources allocation for waste management within the municipality had always been a problem, which was resolved by giving the treasury obligation to lead resources received from waste collection and disposal concepts to SIRE SOL accounts. However, to date, the creation agreement has not been fulfilled so that it can be a fiscal body with capacity and charge directly for this service.

In 2013 the administration change, it was decided to keep the SIRE SOL model, recognizing its operability. It is in this new period that waste management loses a primary place on the municipal agenda, mainly because perceived problems by the population have been kept under control and new demands are prioritized. Efforts focused on maintaining a stable waste collection and the Intermunicipal Center for Integrated Solid Waste Management (CIMIRS) sanitary landfill operation.

The main objective to evaluate the SIRE SOL project was to know its results. However, changes were made in the strategies during the operation period, and it was considered necessary to review its design. Based on the CONEVAL reference terms, deficiencies were identified in the information collection for integrating the diagnosis situation; the project lacks updated data on waste generation on each route, as well as times and movements analysis, which is a consequence of information lack systematization. It is currently working based on the persone experience hired by the companies. This situation conditions the system to operate reactively, according to daily needs and prevents its efficiency; the Collection Directorate reports are not recorded in a database, which allows knowing the service evolution or failures in a historical context. At the same time, the Directorate of Final Disposal maintains the USW income records in printed ballots.

The creation of SIRE SOL Cancun was accompanied by the Regulation for the Prevention and Comprehensive Management of USW formation in the municipality (2012), as well as the State Program for the Prevention and Comprehensive Management of Waste in Quintana Roo publication and the first Municipal Program for the

Prevention and Comprehensive Management of Solid Waste of Benito Juárez municipaloty, Quintana Roo (2013). These three instruments are created following the Quintana Roo regulatory framework of, which corresponds to federal legislation on the matter. However, there is no relationship between instruments such as PMPGIR and SIRE SOL, which shows a deficiency in municipal planning that must be corrected, where SIRE SOL assumes a primary role in waste matters.

From the beginning, goals were set that are considered lax and do not encourage proactivity in the institution's staff. Based on a new diagnosis of the target population, it is necessary to set goals that reflect an intention to fulfil the SIRE SOL objectives.

It is necessary to carry out a SIRE SOL MIR restructuring, since objectives pursued by the Directorate of Generation, Use and Final Disposal have changed. Currently, the activities carried out by these areas are contributing minimally to fulfil SIRE SOL purpose, and the rest of the activities described in the MIR are not being carried out or do not contribute to achieving the purpose.

The municipal administration, as mentioned by Reynoso and Villafuente (2003), must be modernized and comply with points such as:

- Quality standards;
- Instances and procedures for citizen participation;
- Management evaluation;
- User satisfaction.

In this sense, SIRE SOL must establish systematized procedures that follows modernization, it intends to apply in terms of waste management, and that facilitate access to information at all times for monitoring and system evaluation.

3.7. Discussion of the SIRE SOL results evaluation

The directorates in charge of carrying out activities that lead to fulfilling SIRE SOL's objective have generally presented a poor performance. The MIR for evaluating SIRE SOL contemplates a few activities that contribute to fulfilling the purpose.

The proposal to carry out a complete system decentralization is not a process that is under SIRE SOL authority, for its fulfilment the council must approve the necessary modifications to the organism internal regulations.

The necessary steps must be taken at the direction board level, being the technical council or the SIRE SOL staff who generates a proposal, which the council promotes for approval. Technical analysis is necessary to demonstrate the need to grant SIRE SOL direct resources administration.

The recent collection method is not enough to cover the cost as it is currently managed. One of the first actions should be to evaluate its efficiency, in terms of service provision frequency, since collecting in city areas up to 2 times in a day is symptom of the problem and population ignorance. Also, it should be considered formally for citizens to pay for the waste collect service, because currently the commercial sector subsidize these service system for everyone.

The prevention of generation and promoting shared responsibility in the comprehensive management of waste with the public has not shown positive results. As there is no demand from an essential population sector, actions are carried out that pretend to show interest, but that set has lax goals and are not followed up. Public awareness is not a priority for the current administration, which puts the strategy permanence at risk, taking into account issues such as results-based budgeting.

The strategy to promote the waste generators responsibilities in the commercial sector should be analyzed to propose its rethinking. In this sense, SIRE SOL must only participate as a support entity so that they can comply with their obligations or obtain the organism complete economic decentralization so that it is granted powers for commercial sector complete surveillance and strengthened through legal compliance means with regulation for the Prevention and Comprehensive Management of Solid Waste in the Municipality of Benito Juárez, Quintana Roo.

4. Conclusions

The waste management in one way or another will be part of actions and decisions that continue to be taken in the future. However, the way to cope with it in the future is subject to change. The limitations imposed or decentralization scheme adopted may put at risk qualifying the model as a good option for waste management.

According to what has been observed, SIRE SOL's strategies are not generating the expected results to contribute an improvement in the municipality waste integral management. Efficiency is a condition that is not being sought in the system current administration since a considerable amount of the budget is used in collecting waste, but acceptable coverage and frequency is not reached. Although SIRE SOL's design was carried out following the Mexican regulatory framework on waste, strategies for the prevention and generation reduction are not privileged as indicated in the legislation. Optimization, as proposed by SIRE SOL, should focus on supervision formalize, and the information generated on the population behaviour in order to carry out planning for this data.

Based on the CONEVAL ToR, design deficiencies were identified in the system:

- SIRE SOL lacks up-to-date data on waste generation on each route, as well as time and movement analysis. It works based on the experience of personnel hired by the companies. This situation conditions the system to operate reactively under daily needs.
- There is no relationship between instruments such as PMPGIR and SIRE SOL, which shows a deficiency in municipality planning that must be corrected.
- The scheme for waste management that is proposed through SIRE SOL contains main concepts of state and national legislation on the matter. However, it is focused on collection and final disposal, leaving aside generation prevention and materials valorization, since there has been no awareness of these two activities importance.
- The Collection Directorate reports are not registered in a database that allows knowing the service evolution or failures in a historical context; the data systematization remains to be done. At the same time, the Final Disposal Directorate maintains the USW income records on printed ballots.
- It is necessary to carry out a restructuring of the SIRE SOL MIR since the objectives pursued by the Directorate of Generation, Use and Final Disposal have changed.

In this sense, SIRE SOL must establish systematized procedures that are following the modernization that it intends to apply in terms of waste management and that facilitate information access for monitoring and system evaluation at all times. On the other hand, it is necessary to sensitize the population towards generation prevention and the shared responsibility promotion in the waste integral management.

Another aspect to consider is the inclusion of private initiative in waste management in the collecting stages, treatment and final disposal. The service consideration is made for the tons waste collected and treated, so the participating companies do not see well campaigns that promote prevention or separation in homes; both of these activities are measures that can impact the waste management private sector interests.

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