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Evaluation of the waste management plan at the Veracruz state public health laboratory 2020.

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Abstract - The State Public Health Laboratory of Veracruz (LESP) is committed to minimize waste and maximize its valorization. In the year 2020, due to the COVID-19 sanitary contingency, it was necessary to carry out the evaluation of its Environmental Management Plan in compliance with Mexican regulations and the needs of the LESP-Laboratory. The method was centered on a quasi-experimental study with complementary design (DICO). The methodology involved the training of 170 workers that make up the LESP staff; the process was focused on the development of performance indicators for the management, identification and characterization of special, municipal, hazardous waste with CRETIB and radioactive characteristics; as well as delivery volumes for service providers, suppliers and treatments. The evaluation processes considered the application of pretests and posttests, checklists, rubrics and the elaboration of topological triangles, graphs and flow charts. The performance indicators were evaluated in the following phases: pretest for the entry level, checklists and rubrics for the appropriation level, and posttest for the empowerment level. The data were complemented with the construction of topological triangles to relate the indicators, performance and learning in the LESP staff. The results were conclusive with values of input levels=50%; appropriation=70%-80% empowerment=100% for the management, identification and characterization of RPBI-CRIT waste (Infectious Biological Hazardous Waste - Corrosive, Reactive, Inflammable and Toxic), respectively and for compliance with staff training in a substantial manner in all their activities. The topological triangles presented a direct relationship between situated, collaborative and meaningful learning all with respect to competencies and performance indicators and environmental, technological, social and economic effectiveness. As a result, the Environmental Management Plan for the COVID-19 sanitary contingency showed that workers approved the valorization of waste management and its correct delivery to suppliers, have environmental awareness, decision making, problem solving to provide opportunities for improvement, commitment to sustainable development issues, care for the environment and social responsibility. With respect to the LESP's commitment to Mexican regulations, the results showed that waste increased 1%, which meant no impact on the environment in the environment and without generating more than 10 tons, thus complying with the LESP.

Index Terms - Environmental management plan, CRIT waste, RPBI.

I. INTRODUCTION

The State Public Health Laboratory of Veracruz (LESP) was created in February 2001 [2], with the mission of contributing to the sanitary, epidemiological and radiological surveillance system, with analytical procedures that comply with the current regulations and allow decision making to prevent and improve the health of Veracruz citizens.

The commitments to achieve a level of awareness in favor of the environment is an objective that goes together with the activities that the State Public Health Laboratory (LESP), decentralized organ of Servicios de Salud de Veracruz, has as main responsibility among which stand out the diagnostic ones and it is necessary to carry out environmental strategies, as well as the development of management procedures that allow to achieve to be a sustainable laboratory.

Therefore, the meaning of pro-environmental awareness strengthens the commitment to advance and detect future potential problems in the growth of an institution such as the LESP and it is essential to carry it out through an environmental management plan that covers from all angles the development, implementation and evaluation of all actors, in the specific issue of hazardous and non-hazardous waste.

The Waste Management Plan implemented and described below has been a very useful supervisory tool that has made it possible to demonstrate and control sustainable actions for the LESP, establishing operating, administrative, and contingency procedures for compliance with regulations, assigning responsibilities to

all personnel, the purpose was to identify and, where appropriate, mitigate the risk to the population and the environmental environment [12].

The research questions were:

What are the criteria for quantifying and managing hazardous waste in the LESP?

How to implement performance indicators to optimize the quantification and management of hazardous waste. ?

How to implement the culture of the 3 R's in the

LESP? General Objective:
Evaluate the Waste Management Plan at the State Public Health Laboratory of Veracruz, 2020.

Specific objectives

- Establish and apply the criteria to manage and quantify hazardous waste under criteria of social, environmental, technological, and economic efficiency.
- Implement performance indicators in LESP workers in the quantification and management of hazardous waste.
- Store waste safely, with good safety practices and in a controlled manner.
- Promote the culture of Recycling in a holistic way, for the application of the 3 R's reduce, reuse and recycle.

II. THEORETICAL BASIS

The concepts used for the implementation of the Plan are described below.

a. Sustainable Development: It is the process of continuous change of local, regional or global application that responds to universal objectives and goals of appropriate social transformation, to meet the needs of goods and services of a population or set of populations, indefinitely, without degrading irreversibly the productive capacity of the land, the natural heritage and its ability to maintain the population of a place. [1]
b. Environmental Education: Learning process that should facilitate the understanding of the realities of the environment, of the socio-historical process that has led to its current deterioration, considering that the individual is able to become socially aware, of dependence and belonging to his environment.[9]
c. Performance and Learning Indicators: An indicator can be defined as the measurement of an objective to be pursued, of a resource to be mobilized, of an effect achieved, of a quality estimate, or a context variable. An indicator quantifies an element that is considered relevant to the monitoring or evaluation of a program. Indicators are just one tool that can support decision-making. [5]
d. Environmental Management Plan: It is an instrument that aims to minimize the generation of waste and maximize the valorization of those generated, under criteria of environmental, technological, economic and social efficiency. [11]
e. Environmental Regulations: The Ministry of Environment and Natural Resources (SEMARNAT) establishes applicable standards such as NOM-052-SEMARNAT-2005, NOM-087-SEMARNAT-2002, NOM-161-SEMARNAT-2013, for waste and has very clear objectives oriented to the conservation of biodiversity, the protection of the environment and natural resources, as well as the promotion of sustainable development. [6]
f. Waste and its Classification: They are formally defined as materials or products that are discarded either in solid state, semi-solid gaseous that are contained in containers or deposits and that need to be subject to treatments or final disposal based on the provisions of the General Law for Prevention and Management Integ The waste is classified according to its characteristics and origins into three groups: municipal solid waste (MSW), special management waste (SMR) and hazardous waste (PR). [11]

III. MATERIALS AND METHODS

3.1 LESP infrastructure.

The LESP is an organization with a high rate of analysis in the epidemiological, sanitary and radiological areas, classifying itself as a small generator, it is in the possibility of becoming a great generator since it presented an annual rate in 2020 of 9335.1 kg.

In the year 2020 before the health contingency of COVID-19, the attention a the community Was Increasing their methods of analysis, their coverage, the demand for analysis and human resources equal and be the only one in the State of Veracruz of Public Health and that has a system of management of assurance of the quality established low Guidelines competence technique [4] Generates one great amount of waste in all its classes such as: waste Dangerous Biological Infectious (RPBI), Radioactive y CRY (Corrosive, Reagents Flammable y Toxic), Special waste solids Urban. By the previous Was

it is necessary to evaluate the Environmental Management Plan to comply with Mexican regulations and the needs of the LESP.

3.2 Materials used.

The material that was used was a digital scale for the quantification of waste, formats, stationery, labels, red transport trolleys of capacity 0.24 $m^{3,}$ shelves to classify waste by its characteristics, registration logs, checklists, rubrics, for the follow-up in initiation, training and final evaluation of the staff.

3.3 Diagnosis.

As a diagnosis although there was a compliance in the waste management was not visualized in a way integral the entire cycle from the time a waste is generated to its Final disposition, interviews were conducted with the personnel who Has the waste for know y understand the compliance in the handling of the same, likewise Made Lists of collation for establish the degree of compliance in accordance with the applicable regulations with this information herself Chose by carry out together with the loud direction to establish programs, train staff, carry out one plan What Cover the standards in matter environmental and to involve staff substantially in allActivities

3.4 Methodology.

It was a quasi-experimental study with complementary DICO design, which was divided into two stages, the first to evaluate criteria related to the management and quantification of hazardous waste and the second to evaluate the performance indicators and their levels of entry, appropriation and empowerment for the log a culture of recycling, for social, environmental, technological and economic efficiency in the LESP. 170 workers from the staff incorporated in three technical departments participated: Department of Epidemiological Diagnosis, Department of Radiological Control and Department of Health Analysis and a waste warehouse.

3.4.1 Criteria for the management and quantification of Waste.

The first activity was to apply the pretest to all participants, then to know the formats of checklists, evaluation rubrics, registration log and calendar of activities.

To comply with the "learn-by-doing" strategy was implemented for the workers who carry out the activities on a daily basis, pausing to review the checklist and core points; for example, for the handling, identification, separation and packaging of waste; exercises were carried out simulated (situated, meaningful and collaborative learning) the personnel involved and the users were trained in the hazardous waste generating areas.

Thus, in each department the weight per waste RPBI and CRIT was recorded monthly, delegating the information to a person in charge per technical department.

3.4.2 Performance indicators.

Performance indicators were evaluated in three moments at the start (input) with a pretest applied to everyone the participants, during the training (appropriation) with checklists and rubrics, and at the end (empowerment) with the Post. Each indicator was selected accordingly with the regulations and needs of the LESP, so that workers will optimize the quantification and management of waste with strategies such as exchangingroles between the companions, do teams of work by department Rains of Hits Focusing in reduce one5 % consumption of water, paper and RPBI, CRIT and specials. Diagrams offlow for every One of they Like this how establish one monitoring in every department with logs ofmonitoring and correct evaluation of your management of the onset and end of the cycle. In the same way, a person in charge was appointed. by department.

3.4.3 Storage of hazardous waste.

For the fulfillment of this activity, it was proposed to train the staff in the identification, classification, collection, transport and storage by work tables and type of generators associated with the type of waste that is generated in each department.

It was established that the activities were carried out by the operational staff, of each generating department and in accordance with current legislation [6], [7], [8]. It was established that the laboratory assistant or assigned personnel always use the personal protective equipment required to carry out the collection of the RPBI that was validated with a checklist with the following points: Overalls or cotton gown sleeve long, hair cover,latex gloves, closed shoe, safety glasses, mask, as well as the storage and disposal of RPBI [8] and CRIT solutions based on the applicable Regulations [7]. For this, a format was generated according to the waste, which included biological-infectious residues and CRETI
– CRIT collected in the generation area, were deposited in the temporary storage of hazardous waste, as shown in Figure 1 respecting the rule of incompatibility of these, and not carry out the operations of selecting, transferring, compact, drag and load. It is important to note that prior to storage we identify its generation by item.

Fig. 1 Temporary Hazardous Waste Storage Facilities

3.4.3.1 Generation and Storage of Hazardous Waste.

The waste generated during the development of the activities of the LESP is classified according to the General Law for the Prevention and Integral Management of Waste and we can classify it as follows:

3.4.3.2 Biological-Infectious Hazardous Waste (RPBI).

They are generated during the processing of biological samples, classified into five groups: blood, cultures and strains of infectious agents, sharp, pathological and non-anatomical residues all these are temporarily stored in the areas. generators and every week collections are made in the different areas to later store them temporarily in the temporary warehouse exprofeso for it where they are deposited in red containers of 0.24 m^3 except the pathological ones which are stored at no more than 4°C.

3.4.3.3 Hazardous Waste CRIT.

In the technical departments of the LESP and in the General Warehouse; approximately 598 chemical substances and gases are handled; that when used they will become part of a hazardous waste. The inventory of these materials is in electronic file, under the protection of the general warehouse, with its safety sheets and its table of incompatibility of chemical substances as it is embodied in NOM-054- SEMARNAT-1993 [7], and by source in NOM-052- SEMARNAT-2005 [6], containers and packaging of these, hazardous waste is delivered to a company to be transported to a site authorized by SEMARNAT considering as a primary option final disposition *"in-situ"* and / or final confinement.

3.4.3.4 Municipal Solid Waste.

3.4.3.4.1 Organic waste derived from leftovers from the dining room, sanitary waste, garden waste and its storage and disposal is identified as municipal garbage.

3.4.3.4.2 Food subjected to analytical processes is handled as RPBI, for the safety of personnel and the environment.

3.4.3.4.3 Inorganic waste: plastics, glass, paper and cardboard are separated and stored in bags and boxes without staples, rings, etc.

- Special handling of electronic waste (cards, computers, mice, keyboards etc.)
- Paper: all trades, documents that are generated in the LESP of different areas.
- Pet: they are generated by the STAFF of the LESP.
- Cans: They are generated by LESP staff.
- Toner's: They are generated in all administrative areas of the LESP (they are forwarded to the provider or recharged).
- Batteries.
- Nickel - Cadmium and Alkaline Batteries: these are already spent batteries from equipment and other instruments are sent to the SEMARNAT collection.
- Fluorescent lamps are generated throughout the laboratory and are disposed to the temporary warehouse and later to the company authorized by SEMARNAT for transport and final disposal.
- Lubricating oils waste that are generated in the different areas of the institution are taken to the temporary warehouse of hazardous waste are stored in 20 L bottles with their corresponding labels.

3.4.3.5 Radioactive waste.

The Radiological Control Department is licensed to possess the following radioactive material. Open sources and sealed sources as an example of open sources we have the Am-241, Cs-137, Sr-90, Eu-152, Pu-236, Ra-226, Ra-228, Th-228, multinuclides (Cd-109,Co-57,Te- 123m,Cr-51,Sn-113,Co-60,Y-88,Cs-137) among others and sealed as the disk type sources of Cs-137, Co-60. Radiological waste must comply with the requirements established by the National Commission for Nuclear Safety and Safeguards (CNSNS) for its final disposal.

3.4.4. Culture of the 3 R's.

The staff was trained in the culture of the 3 R's such as reducing consumption in inputs such as paper, electrical energy reducing the impact on the environment, reusing the containers emphasizing to the staff that the containers of the chemical reagents could be used to store the chemical waste and recycle the glass, paper, cans and plastics generated in the LESP. For this point it was requested to carry out activities of the 3 R's so that each department carried out a micro project. Which was evaluated with a rubric.

IV. RESULTS AND ANALYSIS

4.1 MAGED Y CUANTIFICACIÓN OF THE RESIDUOS PELIGROSOS.

As a result in this area, it was possible to satisfactorily comply with the management and quantification of waste since with the established methodologies learning by doing and simulated-exercises the staff learned to manage the waste and managed to be clear what to do when carrying out the activities as they were: identify, separate, package and quantify the waste, and having a technical manager was decisive. In Table I, the hazardous waste generated and arranged by the LESP are identified, the result was effective, it was possible to have quantified each waste as well as the amounts of generation with its code of CRETIB dangerousness, excluding those of a radioactive nature. As can be seen, there is an estimated 9335.1 kg of waste generation annually. When performing the analysis of the management and quantification it was identified that the non-anatomical item is the one with the highest generation due to the amounts of determinations that are made in the LESP, however the waste of lower generation is that of pathological and from there the blood continues and that its management is appropriate in accordance with the established regulations.

TABLE I . GENERATION OF HAZARDOUS WASTE IN THE LESP IN 2020.

No.	Number of the physical waste	Characteristics			Code of dangerousness from waste						Quantity Annual(kg)
		Sólido	Liquido	Another	C	R	E	T	I	B	
1	Strains and crops of agents	X								X	2896.4
2	Pathogens Waste Sharp Waste patológicos	X								X	536.8
3		X								X	14.1
4	Residue No	X							x		3795.6
5	Blood	X	X							X	31.1
6	Solvents Used organics	X	X					x		X	2061.1
7	Waste radiological	X	X		Radiological waste, its handling and disposal is regulated by the regulatory body CNSNS through authorized procedures.						

4.2 □DEVELOPMENT OF PERFORMANCE INDICATORS IN THE WORKING COUNTRIES OF THE LABORATORIO-LESP.

For the development of performance and competence indicators on the subject of hazardous waste; "learning-doing", "exercises-simulated", "round tables and discussion", "rain of successes", were a set of strategies used for the development of learning competencies from management to the disposition of hazardous solid waste, exchanging roles between colleagues, making work teams and combining experiences among workers, allowed a collaborative work that they demonstrated satisfactory results with values for entry levels = 50%, appropriation in range of (70-80%), and empowerment = 100%, (Figure 2)

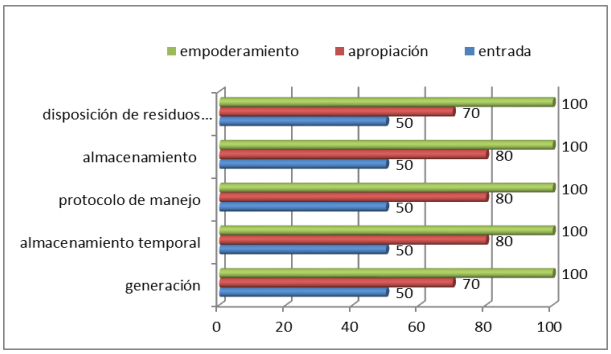

Fig. 2. Learning Levels and Performance *Indicators, in the Management, and Disposal* of *Hazardous Waste of the LESP.*

For Figure 2, three learning moments were presented in the training for performance indicators, which are presented on the left side of the figure and are represented by: waste disposal, storage, handling protocol, temporary storage and generation. The application of the pretest to the workers obtained results of 50/100, which indicated important deficiencies, the strategies used during the process allowed to increase their scores to 70/100 and 80/100 and were evaluated with the checklists and rubrics; At last Was applied the Post What Indicated empowerment or in other words the domain of knowledge for waste and obtained the qualification maximum 100/100, the above allows to incorporate score to the Management Plan that was applied for the fulfillment of the goal of the LESP which was to minimize waste and its valorization.

The management of criT and RPBI waste required greater supervision, dedication and monitored management to comply with each action in the learning exercise, the strategies always included the accompaniment of checklists in the individual and team activities for the achievement satisfactory and with 0% error.

Performance indicators (Figure 3) for labelling, identification, packaging, packaging, contingency plan, emergency equipment, leaks and spills, requirements for collection, RPBI transport and CRIT presented the following results: entry levels 50%, appropriation levels 80% and empowerment levels 100%.

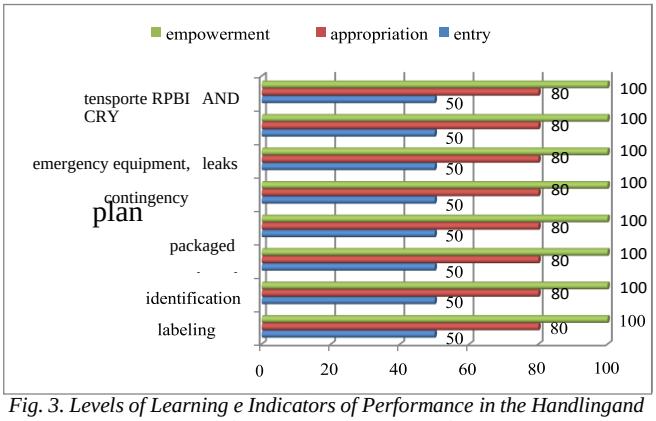

Fig. 3. Levels of Learning e Indicators of Performance in the Handlingand Disposition of the Waste CRY y RPBI of the LESP.

The confidence generated during the programmed activities and the final evaluation in this first module for the waste demonstrated the empowerment at 100% of each step and concretized a significant learning for personal and Laboratory benefit.

For the development of the indicators of performance and competence in the subject of Urban Solid Waste and Special Management of awareness campaigns, infographics and awards or distinctions in the departments were the strategies that allowed a healthy competition in the workers, since the percentages achieved for the goals determined the correct action after their training and application of the Environmental Management Plan.

Below are the topological triangles that describe in their backdrop the indicators and categories for the topic of hazardous waste, CRIT and RPBI waste; and for municipal and special treatment solid waste. In turn, the triangle on its sides maintains a direct relationship with situated, collaborative and meaningful learning; competencies and performance indicators and with the results of environmental, technological, social and economic effectiveness. (Figures 4,5 and 6)

Fig. 4. Topological Triangle of THE *CRIT and RPBI Residues of the LESP.*

Fig. 5. Topological Triangle *of Urban Solid Waste of the LESP.*

Fig. 6. Topological Triangle of Urban Solid Waste of Special *Management.*

4.3 Storage of Hazardous Waste.

The result of having established the strategy of training by department and type of waste that was generated in them gave excellent results since a list of formats to be used was made, by type of waste such as CRIT – RPBI and special management as well, a flow diagram was made to track the waste from the moment it is generated until it is disposed of through the Temporary storage, as shown in Figure 7, thus familiarizes staff with the protocol for handling, storing and disposal hazardous waste.

Figure 7 shows that CRIT and RPBI waste is taken to temporary storage for final disposal.

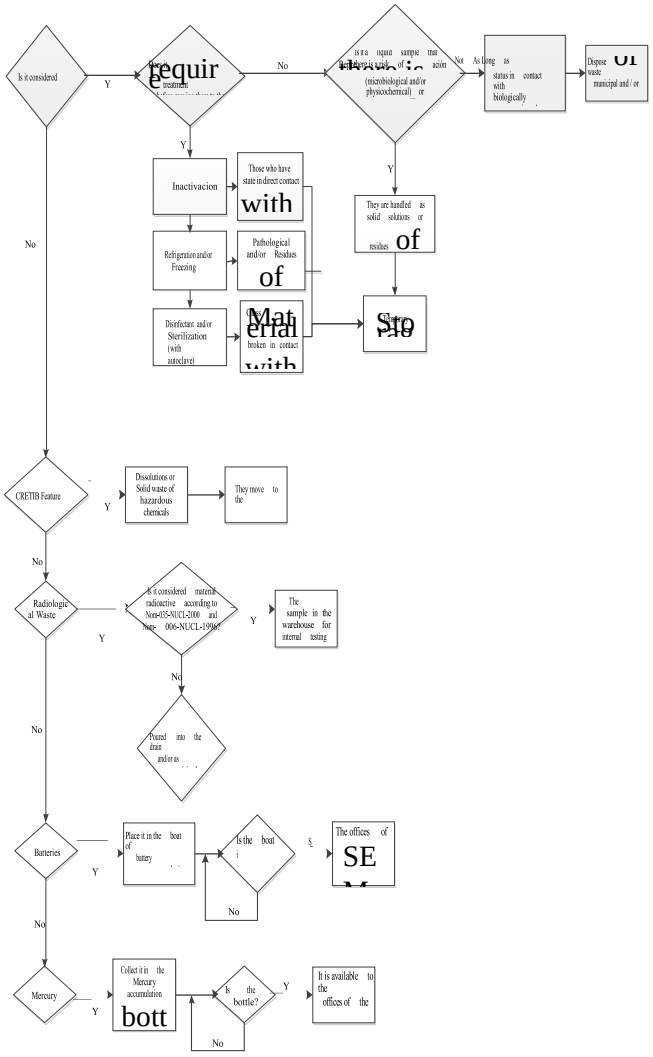

Fig. 7 Handling, Storage and Disposal of Hazardous Waste from lesp.

Through companies authorized by SEMARNAT (Ministry of Environment and Natural Resources) the workers reviewed compliance and the requirements that by law are applied as that the waste was properly labeled and identified, packaged and packed, a contingency plan was included as well as the equipment to attend emergencies due to leaks or spills, that the personnel who made the collection had the federal driving license and the permit to transport waste granted by SEMARNAT, it was verified that when TRANSPORTING CRIT waste, RPBI waste is not being transported in the same unit. The staff assessment applied 100% of the points for the responsible storage of waste.

4.4 CULTURA DE LAS 3´R

This item is as important as the others since the fundamental activity was to reduce waste from the initial source, in the case of paper a substantial improvement was observed since when training the staff so that before printing the requested documents, a thorough review to avoid errors and with it printing Correct y Necessary. Yes the documents Were Internal then herself Used the intranet, for Take a corporal of Digitally and in PDF format, Figure 8 shows the flowchart for this exercise. As a result of the application to the Management Plan, has been migrated since only you can use paper unless strictly necessary and those used must be recycled to reduce up to one 80% this waste. The soda cans by arrangement of the Secretariat of Health no longer are an option of use in the facilities, he removed vending machines and reference is made to a monthly consumption of 300 cans with respect to this day which is zero cans. The Pet Go on staying at the level of use and each worker brings his or her own thermos or recycled bottle. The toners of printers are concentrate for delivery to the recycling company, which I grant the distinction of being permanent collaborators of the recycling. The Batteries y Batteries herself put together in Containers special and are annually arranged in the centers of the SEMARNAT. The waste of handling special the electronic components are taken to collection centers for the process of recycling the Which one Has allowed the incorporation into the production chain. As a result in the culture of the 3 R´s it was possible to implement the exercise for develop culture at all levels of the organization that in the end has managed to unify the criterion in all the staff and achieve a directly proportional relationship since the reduce the inputs that generated waste is also decreased impact environmental.

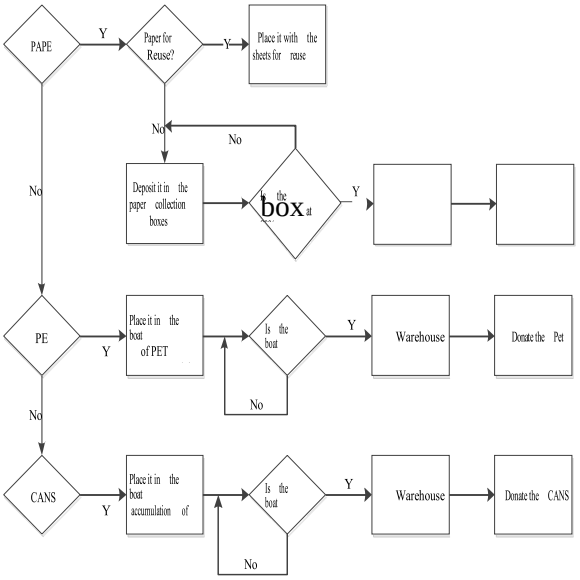

Fig. 8 Handling y Disposal of the Waste Solids Urban y of Handlingspecial of the LESP.

V. FUTURE WORK

Although the State Laboratory has grown by applying the Environmental Management Plan, it is important to evaluate its functionality annually, due to the continuous growth in the number of tests that are carried out, in this period an increase associated with the COVID-19 pandemic was observed since the increase in waste is visible.

It is also necessary to apply composting techniques for food waste, migrate to smart bulbs, change to pastures that are irrigated less frequently, to mention a few, which gives direction to a future work since in environmental matters there is a long way to go.

V. CONCLUSIONS

The four particular objectives were correctly implemented. The LESP staff complies with the management and quantification of hazardous waste in accordance with the regulations indicated in the Environmental Management Plan, since waste increased by 1%, which meant no impact on the environment and without generating more than 10 tons, which gave regulatory compliance to the LESP.

The methodology applied in the training for competencies and performance indicators for know-how, know-how and know-how in activities with situated, collaborative and meaningful learning that related environmental, technological, social and economic demonstrated 100% empowerment.

All the departments involved in the Environmental Management Plan demonstrated knowledge of the valorization, shared responsibility, health in the population and the environment, environmental awareness, dependence and belonging to their environment in relation to the integral management of the hazardous reagents, CRIT-RPBI.

The urban waste was valorizable and was disposed of with companies that are dedicated to its recycling and provided an economic contribution, which was invested in inputs from the management program and / or was donated to altruistic boards to support the community.

Finally, it is concluded that the Environmental Management Plan of the LESP was validated and evaluated satisfactorily in compliance with the objectives set, for the indicators of environmental responsibility, but above all it was to strengthen an environmental culture in the personnel who are part of a gear within the LESP system, since by carrying out each activity in a consent and responsible manner, the fulfillment and the proposed goals were achieved.

THANKS

We thank the staff that makes up the LESP of Veracruz for the effort they have provided to implement this management plan.

REFERENCES

[1] Barahona Paz y Miño, María Fernanda, Salas Vernis,Gabriela Rocío (2013). Environmental management plan of the livestock area and food processing of the Agricultural Sciences-IASA I career, Hacienda el Prado. Master's Degree in Environmental Management Systems. ESPE. Sangolquí Headquarters. http://repositorio.espe.edu.ec/handle/21000/6346

[2] DOF (Official Journal of the Federation) (2002) decree of creation.

[3] DOF (Official Journal of the Federation) (2015). "General Law for the Prevention and Integral Management of Waste". Official Journal of the Federation, May 22, 2015.

[4] ISO/IEC 17025 general requirements for the competence of testing and calibration laboratories.

[5] Martínez Rizo, Felipe. (2010). Indicators as tools for assessing the quality of education systems. Synectic, (35), 1-17. Retrieved april 18, 2021. http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1665-109X2010000200004&lng=en&tlng=en

[6] NOM-052-SEMARNAT-2005, Which establishes the characteristics, the procedure for identification, classification and lists of hazardous waste.

[7] NOM-054-SEMARNAT-1993, Which establishes the procedure for determining the incompatibility between two or more wastes considered hazardous by NOM-052-ECOL-1993.

[8] NOM-087-SEMARNAT-2002, infectious biological hazardous wastehandling specifications.

[9] Sarango Rodríguez, J. A., Sánchez Gálvez, S., & Landívar, J. (2016). Environmental education. Why History?. Revista Universidad y Sociedad [online series], 8 (3). pp. 184-187. Retrieved from http://rus.ucf.edu.cu/

[11] SEMARNAT. Report on the situation of the Environment in Mexico. Compendium of Environmental Statistics. Key Indicators, Environmental Performance and Green Growth. 2015 Edition. SEMARNAT. Mexico 2016.

[12] Serrano, M. J. (2006) "Clean Environmental and Environmental Protection Part 1". Special Supplement of the University for All Course Towards sustainable consumption. ISBN: 978-959-270-097-0.

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