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REVIEW

Solid Waste Management in Villa El Salvador: Diagnosis and Strategic Proposal

Gestión de Residuos Sólidos en Villa El Salvador: Diagnóstico y Propuesta Estratégica

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ABSTRACT

The study addressed the generation and characterisation of municipal solid waste in the district of Villa El Salvador, applying methodologies proposed by the Ministry of the Environment. Both household and non-household waste was analysed in order to obtain quantitative and qualitative data on per capita generation, volumetric weight and the proportion of recoverable materials. This information allowed for a more realistic diagnosis to be made for the planning of the District Plan for the Environmental Management of Solid Waste (PDGARS), in compliance with the General Law on Solid Waste No. 27314. Throughout the research, it was observed that the characterisation of waste was an essential tool for decision-making in environmental management. In addition, background information and similar experiences in other districts of the country, such as Ica and Los Olivos, were reviewed, allowing comparisons to be made and the local approach to be enriched. The study also highlighted the historical, social and organisational role of the district, emphasising innovative initiatives such as the 'green voucher', which incentivised recycling through tax benefits for citizens. In conclusion, it was demonstrated that the analysis of solid waste had not only technical value, but also strategic value, as it enabled the optimisation of municipal resources and encouraged the active participation of the community in caring for the environment and the sustainable development of the district.

Keywords: Solid Waste; Villa El Salvador; Environmental Management; Characterisation; Recycling.

RESUMEN

El estudio realizado abordó la generación y caracterización de residuos sólidos municipales en el distrito de Villa El Salvador, aplicando metodologías propuestas por el Ministerio del Ambiente. Se analizó tanto la fracción domiciliaria como la no domiciliaria, con el objetivo de obtener datos cuantitativos y cualitativos sobre la generación per cápita, el peso volumétrico y la proporción de materiales recuperables. Esta información permitió elaborar un diagnóstico más realista para la planificación del Plan Distrital de Gestión Ambiental de Residuos Sólidos (PDGARS), en cumplimiento con la Ley General de Residuos Sólidos N.º 27314. A lo largo de la investigación, se observó que la caracterización de residuos constituía una herramienta fundamental para la toma de decisiones en materia de gestión ambiental. Además, se revisaron antecedentes y experiencias similares en otros distritos del país, como Ica y Los Olivos, permitiendo establecer comparaciones y enriquecer el enfoque local. El estudio también rescató el papel histórico, social y organizativo del distrito, destacando iniciativas innovadoras como el "bono verde", que incentivó el reciclaje mediante beneficios tributarios para los ciudadanos. En conclusión, se demostró que el análisis de residuos sólidos no solo tenía valor técnico, sino también estratégico, ya que posibilitó la optimización de recursos municipales y fomentó la participación activa de la comunidad en el cuidado del ambiente y el desarrollo sostenible del distrito.

Palabras clave: Residuos Sólidos; Villa El Salvador; Gestión Ambiental; Caracterización; Reciclaje.

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INTRODUCTION

The generation and characterization of municipal solid waste are very important parameters for decision-making regarding the planning and design of solid waste management and disposal systems. Therefore, special attention must be paid to this parameter from the planning of all market research work and the selection of the sample until its statistical analysis.[1]

This thesis analyzes municipal solid waste from households and non-households using the methodology proposed by the Ministry of the Environment in its Comprehensive Solid Waste Management Plan for all municipalities in Peru, which has been used in different districts of Metropolitan Lima to determine the quantity and characteristics of residential and non-residential solid waste to improve the quality of life of residents and the economic well-being of the municipality in terms of revenue.[2]

In this thesis, we will seek to generate qualitative and quantitative information, using statistical sampling methods and analysis, to determine per capita generation, volumetric weight, and the percentage of recoverable and non-recoverable products. This information will support the conclusions and necessary adjustments for the establishment of alternative solutions for waste management and disposal in the district of Villa el Salvador.[3]

A study of the generation and characterization of solid waste is essential for preparing the district's solid waste management plan. This allows for a more realistic diagnosis and proposals for its management, which will be included in the PDGARS (solid waste management and administration program), which is established as a requirement of General Law No. 27314 on solid waste.[4]

The characterization study determines the main qualities and characteristics of solid waste. It consists of determining the percentages of the main elements that constitute the waste, establishing the quantities and variations over time, and estimating some of its physical properties (moisture, density, etc.) .[5]

Characterization is important because it is a method that allows us to know the composition of household and commercial solid waste in the district. This knowledge will enable us to design better comprehensive management, thereby optimizing the resources available for such purposes.[6]

DEVELOPMENT

Previous research similar to the current study

Physical characteristics of household solid waste and its relationship with socioeconomic factors in Peru (2016). Author: Willington Ortiz Mestanza. National Agricultural Library.

This thesis studied the physical characteristics of 519 districts belonging to the 25 regions of Peru. The independent variables were: per capita family expenditure (GsPC), human development index (HDI), total poverty index (IPT), unmet basic needs (NBI), and inequality coefficient (GINI). The dependent variables were per capita generation (GPC), density, and physical composition of household solid waste.[7]

Characterization of urban solid waste (green areas and markets) for composting in the district of Los Olivos (2012). Author: Arenas Yovera Ricardo / Romero La Puente Edgar. National Agricultural Library.

This thesis investigated the characterization of organic solid waste production in the markets of the Los Olivos district. It also characterized the parks and gardens in that district and the extent to which various products are recycled there.[8]

Characterization of household solid waste in the districts of Ica, Los Aquijes, Parcona, and Subtanjalla (province of Ica) for reusing PET plastic and organic solid waste. Author: Alcas Reátegui Cesar. National Agricultural Library.

This thesis investigates the amount of usable solid waste, both organic and inorganic, and provides insights into the habits and customs of domestic users. It also obtains per capita information and detailed amounts of solid waste in the province of Ica.[9]

The district was created by Law No. 23605 dated June 1, 1983, during the second administration of President Fernando Belaúnde Terry. Miguel Azcueta Gorostiza was elected as the first mayor and, together with the community, carried out the second development plan for Villa El Salvador, which had several focal points: Urban, productive, and social development with the participation of the residents themselves and their organizations, especially CUAVES, FEPOMUVES, APEMIVES, and cultural groups with innovative ideas such as participatory budgeting, which originated in Villa El Salvador through the political relations of Izquierda Unida del Perú with the Workers' Party, reaching Brazil and spreading throughout Latin America.[10] Two years later, Villa El Salvador became known to the world with the arrival of Pope John Paul II. His presence in the district drew more than a million faithful who waited since the night before to welcome him in the dunes, where today the Industrial Park and a monument called the Piedra del Papa (Pope's Stone) stand, built by the residents themselves in his honor. In 1987, Villa El Salvador received the Prince of Asturias Award for Concord and its position defending peace with social justice.[11] That same year, the United Nations declared the district a "MESSENGER CITY OF PEACE." This defense of peace led the terrorist group Shining Path to begin its violence and terror in Villa El Salvador, especially between 1990 and 1993, murdering police officers and leaders such as Major Commissioner Rolando Galindo Percovich and Deputy Mayor María Elena Moyano, who was brutally assassinated on February 15, 1992. Her murder was widely condemned both nationally and internationally and is considered the beginning of the end of the Shining Path. On June 16, 1993, Shining Path attempted to assassinate former mayor Michel Azcueta. María Elena Moyano was later proclaimed a National Heroine by the Congress of the Republic of Peru.[12]

Today, it is a prosperous district that has developed rapidly and whose population has also grown exponentially, making it one of the most populous districts in metropolitan Lima.[13]

Background

On April 28, 1971, hundreds of people from different districts of Lima and Peru arrived and invaded land on the outskirts of San Juan de Miraflores, next to the Panamericana Sur highway and Benavides Avenue. Benavides, with the support of Father Ruggiere of the Niño Jesús de Ciudad de Dios parish and a representative of the municipality, who promised to provide basic services: water, sewage, and electricity.[14] When they saw this promise was not fulfilled, the residents organized themselves in March of that same year to create a new city.[15] After many clashes with the police and the military, in which Edilberto Ramos, the first martyr of what would become Villa El Salvador, was killed, the government at the time arrested Monsignor Luis Bambarén, Auxiliary Bishop of Lima, for defending the residents and decided to hand over the sandy areas adjacent to the Tablada de Lurín on May 11, 1971, so that over the years and with the efforts of its residents, it would become a district symbolizing entrepreneurship: "Villa El Salvador," a name suggested by Monsignor Bambarén.[16] Thus, the Cristo El Salvador Parish was established, with Father José Walljevski as its first parish priest. In 1973, the residents approved their organization, the Self-Managed Urban Community of Villa El Salvador (CUAVES), and directed their first comprehensive development plan themselves. CUAVES transformed the progress of Villa El Salvador, becoming an example for the popular and neighborhood sectors of Peru and Latin America. In 1980, with the return of democracy to Peru, President Fernando Belaúnde called new municipal elections, and the residents of Villa El Salvador had to vote in different districts, especially in Villa María del Triunfo. As a result, in 1981 and 1982, a separate municipality was proposed, given the characteristics and identity of the community of Villa El Salvador.

Solid waste management in Peru has been carried out based on immediate attention to the services demanded by the population, without considering long- and medium-term planning and inter-institutional synergies in most cities, despite national regulations for this purpose. A starting point for planning the management and operation of solid waste services at the municipal level is a study to characterize the solid waste under the jurisdiction of local governments, as this study is used to define the planning of projects to improve or expand municipal services and the sizing of solid waste infrastructure, with the consequent allocation of resources for their implementation (personnel, time, frequency, machinery, etc.).

Municipal solid waste characterization studies (ECRS) are generally considered a technical tool because they provide specific information on the generation, density, and composition of solid waste, among other parameters that can be determined (moisture, field capacity, etc.). However, they are a management tool that allows for the projection of the parameters mentioned above and, therefore, medium- and long-term planning for solid waste management. For this reason, this characterization study aims to provide a management tool that allows for decision-making based on knowledge of the parameters related to the generation and management of municipal solid waste.[17]

Villa el Salvador is no stranger to this problem, which is why the district municipality of that commune carries out technical studies on solid waste, such as the "Study on the Characterization of Municipal Solid Waste," a fundamental input for the design of collection and final disposal systems in the short, medium, and long term.[18]

In order to develop the District Solid Waste Management Plan, a study on the generation and characterization of solid waste is essential. This study allows for a more realistic diagnosis and proposals for its management to be included in the PDGARS, which is established as a requirement of General Solid Waste Law No. 27314.[19]

The characterization study determines the main qualities and characteristics of solid waste. It consists of determining the percentages of the main elements that constitute the waste, establishing their quantities and variations over time, and estimating some of their physical properties (moisture, density, etc.).[20]

Characterization is important because it is a method that allows us to know the composition of household and commercial solid waste in the district. This knowledge will allow us to design better comprehensive management, thereby optimizing the resources available for such purposes.[21,22]

THEORETICAL FRAMEWORK

Solid waste in the district of Villa El Salvador

It is important to note that the district of Villa El Salvador is one of the districts in Lima that invests the most of its budget in solid waste management. The implementation of the green bonus, a social benefit that offers residents discounts on their property taxes at the end of the year through recycling, is an interesting proposal promoted by the district's Municipal Services Management. Similarly, studies of this type have improved people's quality of life in many places due to many benefits such as reduced payments, training sessions on solid waste management, and, above all, awareness of recycling to reduce the emission of solid waste. In this regard, we will mention some crucial points to remember.

Solid waste is any substance, product, or by-product in a solid or semi-solid state discarded by its generator. A generator is defined as a person who produces solid waste as a result of their activities. It is usually considered to have no economic value and is colloquially called "trash." It is important to note that the law also includes in this category semi-solid materials (such as mud, sludge, and slurry, among others) and those generated by natural events such as precipitation and landslides, among others. Law No. 27314 - General Law on Solid Waste requires that solid waste be managed through a system that includes, as appropriate, the following operations or processes:

a. Waste minimization
b. Segregation at source
c. Reuse
d. Storage
e. Collection

f. Marketing
g. Transportation
h. Treatment
i. Transfer
J. Final disposal

Solid waste can be defined as "organic or inorganic materials of a compact nature that have been discarded after their useful life has ended." It is also explained that "the concept of solid waste is a dynamic concept that evolves in parallel with economic and productive development."

Classification of solid waste

- By origin
- Household waste

Law No. 27314—General Law on Solid Waste defines solid waste as waste generated by domestic activities carried out in homes. This includes food scraps, newspapers, magazines, bottles, packaging, cans, cardboard, disposable diapers, personal hygiene waste, and similar items.

Household solid waste is any item, object, or substance discarded or abandoned due to human consumption and activities." The table below provides examples of different types of household solid waste:

Table 1. Household solid waste

Type	Examples
Organic	Putrescible waste, such as vegetable waste, generally from the kitchen, such as fruit and vegetable peelings. Also excrement from small animals.
Paper	Notebook pages, magazines, newspapers, books.
Cardboard	Boxes, whether thick or thin.
Plastics	There is a wide variety of plastics, which are grouped into seven types: • PET (polyethylene terephthalate): transparent soda bottles, cosmetics, electronic packaging. • HDPE or PEAD (high-density polyethylene): shampoo bottles, yogurt bottles, paint buckets, electronic bags, beer crates, trays, and tubs. • PVC (polyvinyl chloride): tubes, oil bottles, electrical insulation, balls, shoe soles, boots, etc. • LDPE - PEBD (low-density polyethylene): bags, syrup bottles and cream jars, serum bags, milk bags, soda labels, trays, and tubs. • PP (polypropylene): food packaging (noodles and cookies), paint bucket lids, soda bottle caps, black CD cases. • PS (polystyrene): toys, syringes, transparent spoons, Styrofoam cups, razor blades, disposable plates (white and brittle), cassettes. • ABS (polyurethane, polycarbonate, polyamide): compact discs, Bakelite, mica, electronic casings (computers and cell phones), toys, furniture trim pieces.
Fill	Snack wrappers, candy wrappers.
Glass	Clear, amber, green, and blue bottles, window glass.
Metal	Tin cans, milk jugs, iron and steel appliances.
Textiles	Fabric scraps, clothing, etc.
Leather	Shoes, handbags, bags.
Tetra pack	Juice, milk, and other containers.
Inert materials	Dirt, rocks, construction debris.
Bathroom waste	Toilet paper, diapers, sanitary napkins.
Batteries	From appliances, toys, vehicles, etc.

Source: Municipal Oversight of Solid Waste (2016)

Commercial waste

This is waste generated during commercial activities. It mainly consists of paper, plastics, various types of packaging, personal hygiene products, cans, and similar items.

Law No. 27314—General Law on Solid Waste defines solid waste as waste generated in commercial establishments selling goods and services, such as food supply centers, restaurants, supermarkets, stores, bars, banks, offices, and other similar commercial and work activities.

Public space cleaning waste

As the name suggests, this is waste generated by street sweeping and cleaning services in roads, sidewalks, squares, parks, and other public areas, regardless of the cleaning process used. Street sweeping and cleaning of public spaces can be done manually or with the help of equipment.

Waste from healthcare facilities and medical support centers

This is waste generated by medical care and research activities in hospitals, clinics, health centers and posts, clinical laboratories, doctors' offices, and other facilities. According to Law No. 27314 - General Law on Solid Waste, such waste is characterized by being contaminated with infectious agents or containing high concentrations of potentially dangerous microorganisms (e.g., hypodermic needles, gauze, cotton, culture media, pathological organs, and laboratory material).

Industrial waste

This is hazardous or non-hazardous waste generated in the production processes of various industries, such as manufacturing, mining, chemical, energy, fishing, and other similar industries. According to Law No. 27314—General Law on Solid Waste, the aforementioned waste is presented as sludge, ash, metal slag, glass, plastic, paper, cardboard, wood, and fiber, which are generally mixed with alkaline or acidic substances and heavy oils, among others, generally including waste considered hazardous.

Waste from construction activities

This is waste generated in the activities and processes of building and infrastructure construction, rehabilitation, restoration, remodeling, and demolition.

Law No. 27314: General Law on Solid Waste defines it as waste that is essentially inert and generated in the construction and demolition of works such as buildings, bridges, roads, dams, canals, and other structures.

Agricultural waste

Law No. 27314: General Law on Solid Waste defines it as waste generated during agricultural and livestock activities.

This waste includes containers for fertilizers, pesticides, and various agrochemicals.

Waste from special facilities or activities

This is solid waste generated in infrastructure, usually large, complex, and risky in their operation, to provide certain public or private services, such as water treatment plants for human consumption or wastewater, ports, airports, land terminals, shipping and military facilities, among others; or from those public or private activities that mobilize human resources, equipment, or infrastructure on an occasional basis, such as musical concerts, health campaigns, or similar activities.

- Due to their hazardous nature
- Hazardous and non-hazardous waste

Hazardous solid waste is waste that poses a significant risk to human health or the environment due to its characteristics or how it is handled.

By Law No. 27314 – General Law on Solid Waste, waste is considered hazardous if it has at least one of the following characteristics: self-combustibility, explosiveness, corrosiveness, reactivity, toxicity, radioactivity, or pathogenicity. Thus, for example, sludge from water treatment systems for human consumption or wastewater is considered hazardous solid waste, unless the generator proves otherwise.

On the contrary, waste that does not pose a significant risk to human health or the environment due to its characteristics or handling is considered non-hazardous.

- Based on its management
- Municipal waste

This is waste generated in homes, businesses, and activities that create similar waste, the management of which has been entrusted to municipalities.

The municipality is responsible for managing this waste from the moment the generator delivers it to the operators of the entity responsible for providing solid waste services or when it is disposed of at the location established by that entity for collection.

The final waste disposal within the municipal management scope uses sanitary landfilling.

- Non-municipal waste

This is waste generated in processes or activities not covered by municipal management. Its final disposal is carried out in safety landfills, which can be of two types, by Article 83 of the Regulations of Law No. 27314 - General Law on Solid Waste:

1. Safety landfill for hazardous waste, where non-hazardous waste may also be handled.
2. Safety landfill for non-hazardous waste.

By nature

Organic

Waste of biological origin (plant or animal) decomposes naturally, generating gases (carbon dioxide and methane, among others) and leachates at treatment and final disposal sites. Proper treatment can reuse it as soil improvers and fertilizers (compost, humus, and manure, among others).

Inorganic

Waste of mineral origin or produced industrially that does not degrade easily. It can be reused through recycling processes.

Municipal solid waste management

The supply of goods has increased significantly in recent years due to changes in people's consumption habits. Goods that were once produced to last a long time now have shorter useful lives, generating a large amount of solid waste.

Solid waste management and handling have not changed in the same way. This has often led to an imbalance between the ecosystem and human activities.

Solid waste must be properly managed before final disposal to prevent a negative environmental impact. Municipal solid waste management can be carried out by the municipality itself or by a solid waste service provider (EPS-RS) contracted by the city as a private or mixed company. It must be carried out in a sanitary and environmentally appropriate manner, subject to the principles of preventing negative impacts and protecting health.

In accordance with Law No. 27314 - General Law on Solid Waste, solid waste management consists of the following stages:

Generation

This is the moment when waste is produced as a result of human activity. As explained above, solid waste can be generated by everyday activities, commercial activities, public cleaning services, health services, construction, or other related activities.

Segregation at source

This consists of grouping certain types of solid waste with similar physical characteristics so that they can be managed accordingly. The aim is to facilitate garbage reuse, treatment, or commercialization through sanitary and safe separation of its components.

Solid waste segregation is only permitted at the generation source and treatment facilities operated by an EPS-RS or a municipality, provided that it is an authorized operation or, in the case of an EC-RS, when basic waste conditioning before commercialization is planned.

Local governments should promote the implementation of treatment plants within landfills so that organized recyclers can segregate reusable waste for sale.

Storage

This is the temporary accumulation of waste under appropriate technical conditions, as part of the management system, until its final disposal.

Marketing of solid waste

The marketing of solid waste is the action through which solid waste marketing companies (EC-RS), authorized by DIGESA, buy and sell solid waste from Segregation.

Collection and transportation

The action of collecting solid waste and transporting it using an appropriate means of transportation is to continue its subsequent handling in a sanitary, safe, and environmentally appropriate manner.

It can be conventional, using properly equipped compactors; semi-conventional, using dump trucks or trucks; or unconventional, using wheelbarrows, tricycles, or motorized vans, among other methods.

Notes

a) Citizens must comply with the household solid waste collection schedules established by the municipality. This will prevent animals, vehicles, and informal waste sorters, among others, from handling garbage bags and spreading waste on public roads.

b) The use of inadequate equipment and vehicles causes waste to be lost during transport and scattering of materials and paper if they are transported in open vehicles.

Transfer

Solid waste is transferred to a facility or infrastructure, where it is unloaded and temporarily stored from collection units. Then, in larger capacity units, it is transported to an authorized site for final disposal.

LEGAL FRAMEWORK

Political Constitution of Peru

Article 2, paragraph 22, establishes the right of every person to enjoy an environment that is balanced and suitable for the development of their life. Article 67 states that the state shall determine national environmental policy and promote the sustainable use of natural resources. Article 194 also states that municipalities, as local governments, enjoy political, economic, and administrative autonomy in matters within their jurisdiction. Article 195, paragraphs 5 and 8, establish the powers of municipalities to organize, regulate, and administer local public services under their responsibility, as well as to develop and regulate activities and/or services related to the Environment and the sustainability of natural resources.

Framework Law on the National Environmental Management System – Law No. 28245

This system is based on state institutions, bodies, and offices of various ministries, decentralized public agencies, and public institutions at the national, regional, and local levels that exercise powers and functions related to the Environment and natural resources, as well as regional and local environmental management systems, with the participation of the private sector and civil society. It also establishes the obligation of the members of the system to comply with the National Environmental Policy, the National Environmental Action Plan and Agenda, and the cross-sectoral regulations issued to achieve their objectives.

General Environmental Law – Law No. 28611

This Law regulates the legal framework for environmental management in Peru. It establishes the basic principles and rules to ensure the effective exercise of the inalienable right of every person to live in a healthy, balanced environment suitable for the full development of life, as well as the fulfillment of the duty to contribute to effective environmental management and to protect the Environment and its components, to improve the quality of life of the population and achieve the sustainable development of the country. It also establishes the right to participate responsibly in decision-making processes and the definition and application of policies and measures relating to the Environment and its components, adopted at each level of government. The state agreed with civil society on environmental management decisions and actions.

General Law on Solid Waste, and DL No. 1065 amending the Law on Solid Waste

Recognizes provincial municipalities as responsible for managing solid waste from households, businesses, and activities that generate similar waste throughout their jurisdiction. They are also required to plan the comprehensive management of solid waste within their jurisdiction, harmonizing the solid waste management plans of their districts and smaller population centers with local and regional development policies, as well as establishing the rights, obligations, powers, and responsibilities of society as a whole to ensure the proper sanitary and environmental management and handling of solid waste, subject to the principles of minimization, prevention of environmental risks, and protection of human health and well-being. Its purpose is the comprehensive and sustainable management and handling of solid waste in the country through the coordination, integration, and harmonization of the policies, plans, programs, strategies, and actions of those involved in managing and handling solid waste.

Organic Law on Municipalities Law No. 27972

This Law states that local governments promote comprehensive development to enable economic growth, social justice, and environmental sustainability. At the same time, they have the following specific exclusive powers: Regulate and control the final disposal of solid waste, as described in the following articles:

Article 80 states that the municipality is responsible for sanitation and health to "regulate and control the process of final disposal of solid waste at the provincial level," thereby ensuring proper service management and preventing any environmental and public contamination. Article 73, paragraph 3, subsection 3.3, establishes that municipalities, concerning environmental protection and conservation, shall promote environmental education and research in their localities and encourage citizen participation at all levels.

National Plan for Comprehensive Solid Waste Management

This plan aims to reduce national solid waste production and control the associated health and environmental risks. This involves, among other actions, the implementation of permanent ecological education programs and the promotion of citizen participation in the control and minimization of per capita waste generation; increasing the quality and coverage of solid waste services, including the implementation of selective collection; reducing, recovering, reusing, and recycling waste; recover the organic matter in solid waste through effective treatment methods such as composting; and dispose of unused solid waste in a safe, sanitary, and environmentally acceptable manner.

By DL No. 1013, the Law on the Creation, Organization, and Functions of the Ministry of the Environment, the purpose of the Ministry is to design, establish, implement, supervise, and evaluate national environmental policy. This involves promoting a balance between socioeconomic development, the sustainable and responsible use of natural resources, and environmental protection, to contribute to the comprehensive development of the human person and guarantee present and future generations the right to enjoy an environment that is balanced and suitable for the development of life.

CONCEPTUAL FRAMEWORK

The research has identified some concepts that it considers most relevant to the development of the thesis.

Strategic competencies

Interpretive competence

This refers to a person's actions to understand a situation in a specific "context." This competency includes and evaluates the ability or capacity to identify and understand the fundamental ideas of a text or communication, a problem, diagram, graph, or map, to understand the relationships between these ideas, and the subject being evaluated is asked to decide which of the interpretations offered in the answer choices is the best.

Argumentative competency

This refers to a person's actions to justify or support a statement, decision, or event. It investigates the ability to recognize and

differentiate the different arguments that support an idea, proposal, thesis, or solution to a case or problem, and the person being evaluated is asked to establish the validity and relevance of the different arguments to choose the best one. This competency includes the ability to reason to explain how the various parts of a process are ordered and related to each other to achieve a particular effect or conclusion. When arguing, one explains why things are the way they are, justifies ideas, gives reasons, establishes one's criteria, and interacts with knowledge.

Proactive competence

This refers to a person's actions to propose alternatives for decision or action and establish new relationships or links between events or theoretical perspectives. It questions the ability to act critically and creatively in proposing options or alternatives to generate hypotheses, solve problems, establish generalizations, and propose alternative explanations for an event. This competence involves creatively combining elements to form new meaning; ideas are organized under a new pattern, or new configurations of ideas are created. This competence represents the apex of the pyramid of thought development, as it requires synthesis, change, or transformation of ideas.

Solid waste

Solid waste is defined as any object or material produced after manufacturing, transforming, or using consumer goods and discarded after use. This solid waste may or may not be suitable for reuse or transformation to give it another use or direct application. The origin of this waste is due to the different activities carried out daily. Still, most of it is generated in cities, specifically homes where so-called urban solid waste is produced. It comes from domestic activities in houses and public buildings such as schools, offices, and the demolition and repair of structures.

Environment

This is any space of interaction and its consequences between society (social and cultural elements) and nature (natural elements) in a specific place and at particular times.

Use

This is the process by which, through waste management, recovered materials are efficiently incorporated into the economic and productive cycle through reuse, recycling, incineration for energy generation, composting, or any other method that provides health, environmental, and/or economic benefits.

Garbage

Any material considered waste needs to be disposed of. Garbage is a product of human activities deemed zero value because it has been discarded. It is usually placed in designated collection sites to be sent to dumps, landfills, or other locations. Currently, this term is used to refer to that fraction of waste that is not usable and should therefore be treated and disposed of to avoid health or environmental problems.

Garbage dump

A place where Garbage and other waste from a population is thrown away. Landfill.

Pollution

The harmful alteration of the natural state of an environment as a result of the introduction of an agent foreign to that Environment (contaminant), causing instability, disorder, damage, or discomfort in an ecosystem, the physical Environment, or a living being. The contaminant may be a chemical substance, energy (sound, heat, or light), or even genes. Sometimes the contaminant is a foreign substance, a form of energy, or a natural substance. It is always a harmful alteration of the Environment's natural state and is usually generated by human activity. Pollution can be classified according to the source from which it originates: point sources (isolated and easy to identify) and non-point sources (dispersed and difficult to locate).

Waste

That which remains (residue, Garbage, etc.) after the most valuable parts have been selected or used is understood as waste from urban centers and households.

Development of solid waste management

Solid waste management can be defined as the discipline associated with controlling the generation, storage, collection, Transfer, transportation, processing, and disposal of solid waste in a manner that harmonizes with the best principles of health, economy, conservation, aesthetics, and other environmental considerations and meets public expectations. Within its scope, solid waste management includes all administrative, financial, legal, and planning functions involved in solving all solid waste problems.

Waste

Any solid or semi-solid residue of animal or vegetable origin subject to putrefaction resulting from the handling, preparation, and consumption of food.

Generator

A legal or natural person who produces waste through production or consumption processes.

Process

The set of physical or chemical activities related to the production, obtaining, conditioning, packaging, handling, and packing of intermediate or final products.

Production Process

The activities related to the extraction, beneficiation, transformation, processing, and/or use of materials to produce goods and services.

Recovery

Removal of waste from its final disposal. In this process, recovered waste loses its status as "material intended for disposal" and ceases to be waste. Through its revaluation, it acquires the status of "secondary raw material."

Landfill

Infrastructure work applies an engineering method for the final disposal of solid waste located in sites suitable for ecological management. Solid waste is deposited and compacted to the smallest practical volume and covered with natural or synthetic material to prevent and minimize the generation of pollutants into the Environment and reduce health risks.

Source separation

This is the waste classification at the site where it is generated for subsequent disposal and/or reuse.

Toxic

This is waste that, due to its physical and chemical characteristics, can harm or kill living beings or pollute the Environment.

Service provider

A company authorized to carry out one or more activities: collection, transport, storage, treatment, and final disposal of waste.

Composting

Composting is the aerobic biological process by which microorganisms act on rapidly biodegradable matter (crop residues, animal excrement, and urban waste) to produce compost, an excellent fertilizer for agriculture.

Recycling

This is a physical-chemical or mechanical process of subjecting a material or product already used to a total or partial treatment cycle to obtain a raw or new product. It could also be defined as obtaining raw materials from waste and reintroducing them into the life cycle. It is carried out given the depletion of natural resources and macroeconomic factors and to eliminate waste effectively.

CONCLUSIONS

The study on the generation and characterization of municipal solid waste in the district of Villa El Salvador highlights the importance of accurate and up-to-date technical information in designing sustainable and efficient public waste management policies. Through standardized methodologies and qualitative and quantitative analysis of the waste generated, fundamental parameters such as per capita generation, density, composition, and recovery potential of solid waste have been identified.

These results allow for more realistic diagnoses for the planning of the District Solid Waste Management Plan (PDGARS) and provide key tools for optimizing resource allocation and improving the quality of public cleaning services. Furthermore, the experience of Villa El Salvador demonstrates how a technical approach, accompanied by innovative initiatives such as the "green bonus," can contribute to raising public awareness, promoting waste recovery, and improving the population's quality of life.

In this context, solid waste characterization should not be seen solely as a technical exercise but as a strategic tool for environmental and social management. Its correct application makes it possible to establish sustainable solutions, encourage citizen participation, comply with the current regulatory framework, and promote a responsible environmental culture committed to the district's comprehensive development.

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