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# ECORFAN Journal Republic of Nicaragua

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Support the international scientific community in its written production Science, Technology and Innovation in the Field of Biotechnology and Agricultural Sciences, in Subdisciplines of agriculture-forest, pathology-sustainable, forest, management, horticulture, engineering and integrated water use.

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Encourage the interlocution of the International Scientific Community with other Study Centers in Mexico abroad and promote a wide incorporation of academics, specialists and researchers to the publication in Science Structures of Autonomous Universities - State Public Universities - Federal IES - Polytechnic Universities - Technological Universities - Federal Technological Institutes - Normal Schools - Decentralized Technological Institutes - Intercultural Universities - S & T Councils - CONACYT Research Centers.

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ECORFAN Journal Republic of Nicaragua is a Journal edited by ECORFAN-Mexico S.C in its Holding with repository in Republic of Nicaragua, is a scientific publication arbitrated and indexed with semester periods. It supports a wide range of contents that are evaluated by academic peers by the Double-Blind method, around subjects related to the theory and practice of agriculture-forest, pathology-sustainable, forest, management, horticulture, engineering and integrated water use with diverse approaches and perspectives , That contribute to the diffusion of the development of Science Technology and Innovation that allow the arguments related to the decision making and influence in the formulation of international policies in the Field of Biotechnology and Agricultural Sciences. The editorial horizon of ECORFAN-Mexico® extends beyond the academy and integrates other segments of research and analysis outside the scope, as long as they meet the requirements of rigorous argumentative and scientific, as well as addressing issues of general and current interest of the International Scientific Society.

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**Instructions for Scientific, Technological and Innovation Publication**

**Knowledge Area**

The works must be unpublished and refer to topics of agriculture-forest, pathology-sustainable, forest, management, horticulture, engineering and integrated water useand other topics related to Biotechnology and Agricultural Sciences.

## Presentation of Content

In volume seven, issue twelve, as the first article we present, *Use of the governor (Larrea tridentata), as a surfactant in the treatment of soils contaminated with hydrocarbons*, by RESENDIZ-VEGA, Marisol & GARCÍA-MELO, José Alberto, with adscripction in the Universidad Tecnológica Tula – Tepejí, as a second article we present, *Physiographic and hydrological characterization in the Zula River basin, Jalisco, a challenge to the sustainability of water in the region*, by CARO-BECERRA, Juan Luis, MAYORAL-RUIZ, Pedro Alonso, VIZCAÍNO-RODRÍGUEZ, Luz Adriana and LUJÁN-GODÍNEZ, Ramiro, with adscripction in the Universidad Politécnica de la Zona Metropolitana de Guadalajara and Centro Universitario Tlajomulco de la Universidad de Guadalajara, as third article we present, *Multiresidual analysis of pesticides in a soil with cacao culture, in Úrsulo Galván, Veracruz,* by GARAY-PERALTA, Ignacio & LUNA-DÍAZ PEÓN, Antonio, with adscripction in the Tecnológico Nacional de México Campus Úrsulo Galván and Universidad Veracruzana, as fourth article we present, *Agrologistic chain redesign applied to the sheep meat sector in Hidalgo, Mexico*, by QUINTERO-RAMIREZ, Juan Manuel & OMAÑA-SILVESTRE, José Miguel, with adscripction in the Cátedra CONACyT and Colegio de Postgraduados.

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# Use of the governor (*Larrea tridentata*), as a surfactant in the treatment of soils contaminated with hydrocarbons

# Utilización de la gobernadora (*Larrea tridentata*), como tensioactivo en el tratamiento de suelos contaminados con hidrocarburos

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**Abstract**

In Mexico, the oil industry has been one of the mainstays of the economy, but it has had a negative impact on the environment since pipeline breakage and the dispersion of chronic spills have been detected. Likewise to clandestine taps, which have affected large areas. Phytoremediation has emerged as a cost-effective technology for contaminant removal. Some plant species have shown remarkable resistance to polluted environments. This ability is believed to be due to the evolution of chemical functional groups that inhibit toxicological effects. Therefore, plants growing in contaminated areas can be a good source of natural biological compounds that have potential for contaminant remediation. Such is the case of Larrea tridentata. In the present project, its surfactant effect is compared to decontaminate the soil of oil and its derivatives; with the following findings: The extract of Larrea tridentata obtained from the leaf turned out to have a better surfactant effect than that obtained from the stem. The leaf extract at a temperature of 50°C, turned out to have a better surfactant effect than the extract obtained at 21°C. Comparing the removal percentage, the Larrea tridentata extract is less effective with a removal percentage of 62%, compared to: humic acids 74%, fulvic acids 77%, lechuguilla extract obtained at 50°C, 79%, lechuguilla extract obtained at room temperature 90%.

**Phytoremediation, Surfactant, *Larrea tridentata***

**Resumen**

En México, la industria petrolera ha sido uno de los sustentos de la economía, pero ha tenido un impacto negativo para el ambiente ya que se han detectado rotura de oleoductos, la dispersión de los derrames crónicos. Así mismo a tomas clandestinas, que han afectado grandes extensiones. La fitorremediación ha aparecido como una tecnología rentable para la remoción de contaminantes. Algunas especies de plantas han mostrado una notable resistencia a ambientes contaminados. Se cree que esta capacidad se debe a la evolución de grupos funcionales químicos que inhiben los efectos toxicológicos. Por lo tanto, las plantas que crecen en áreas contaminadas pueden ser una buena fuente de compuestos biológicos naturales que tienen potencial para la remediación de contaminantes. Tal es el caso de *Larrea tridentata*. En el presente proyecto se compara su efecto surfactante para descontaminar el suelo de petróleo y sus derivados; con los siguientes hallazgos: El extracto de *Larrea tridentata* obtenido de la hoja resultó tener mejor efecto surfactante que el obtenido del tallo. El extracto de la hoja a temperatura de 50°C, resultó tener mejor efecto surfactante que el extracto obtenido a 21°C. Comparando el porcentaje de remoción el extracto de *Larrea tridentata* es menos efectivo con un porcentaje de remoción del 62%, comparado con: ácidos húmicos 74%, fúlvicos 77%, extracto de lechuguilla obtenido a 50°C ,79%, extracto de lechuguilla obtenido a temperatura ambiente 90%.

**Fitorremdiación, Surfactante, *Larrea tridentata***

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## Introduction

Undoubtedly, one of the great challenges for humanity is to convert production processes into clean and energy efficient processes. Environmental pollution caused by oil and petrochemical products (complex mixtures of hydrocarbons) is recognized as one of the most serious problems today, especially when associated with large-scale accidental spills (Plohl K, and Leskovsek H., 2002).

In Mexico, the oil industry has considerably increased its infrastructure in the last three decades (García et al., 2006), it has had a negative impact on the environment, due to its extensive exploitation, since it has been for several years one of the mainstays of the economy, the activities are oriented to the exploration, exploitation, storage and transportation of hydrocarbons. The sources of contamination of the soils by oil are due to the rupture of oil pipelines, the dispersion of chronic spills, the spills of sewage coming from the refining processes, spills of drilling mud and maintenance work of the wells ( Riveroll-Larios et al., 2015). Also to clandestine intakes, which have affected large areas of land, mainly for agricultural use (Pérez *et al*., 2006).

Oil is a mixture of paraffinic, cycloparaffinic, aromatic hydrocarbons and low amounts of sulfur, nitrogen and oxygen compounds (Ortiz-Salinas et al. 2021), as well as metals such as V, Ni, Pb and Fe. (Figueruelo and Dávila 2001, Owamah 2013), its effects on the soil depend on the components of the ecosystem, the physical and chemical properties of the oil hydrocarbons and the type of environmental emergency (García-López *et al*., 2006, Pinkus-Rendón and Contreras-Sánchez 2012).

Given the problem of contamination by oil and its derivatives in the soils of Mexico, alternatives have been sought to solve this situation. There are remediation technologies, physical and chemical, that may be more practical and effective, from the point of view of times, which are shorter, to remediate contaminated sites. In recent years, bioremediation and phytoremediation technologies are being applied in soils affected by oil and its derivatives (Fiorenza *et al*., 2000).

Remediation is the set of corrective operations aimed at avoiding the harmful effects that a contaminated soil causes or may cause. The choice of remediation technology should be based on the results of previous environmental studies conducted on site sampling. Remediation can be *on-site;* elimination of pollutants on the ground itself, without removal from it, and *ex situ*; the soil is transferred to other facilities for its treatment or confinement (Jiménez, 2017).

Bioremediation has emerged as an inexpensive solution (Atlas, 1995). More recently, phytoremediation has emerged as a cost-effective technology for the removal of metals from contaminated areas. Some plant species have shown remarkable resistance to contaminated environments (Delgadillo-López et al. 2011). This ability to grow in highly contaminated areas is believed to be due to the evolution of chemical functional groups that inhibit toxicological effects (Lue-Kim and Rauser, 1986). Therefore, plants growing in contaminated areas can be a good source of natural biological compounds that have potential for remediation of contaminants.

Another relevant factor intervenes in the biodegradation of oil: the availability of hydrocarbons for the microorganism, since some compounds have low solubility in water, which makes their transport difficult within the microorganism. This aspect is very relevant since oil and its derivatives are insoluble in water.

Considering that bioremediation has been favored with the presence of surfactants and / or biosurfactants, where bioavailability has been considered as one of the most beneficial factors for bioremediation and possible inhibition and / or toxicity as the adverse factors to consider, This project focuses on the analysis of the effectiveness of extracts of *Larrea tridentata* (governor) as a surfactant agent for the effective extraction of hydrocarbons from soils contaminated with hydrocarbons.

## Hypothesis

The use of the flat *Larrea tridentata* as a surfactant agent could help the extraction of hydrocarbons present in contaminated soils.

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**Objectives**

**General**

To evaluate the effect of the extract of the *Larrea tridentata plant* as a surfactant agent for the extraction of hydrocarbons present in soils contaminated with hydrocarbons.

**Specific**

1. Obtain soil from the surroundings of the Miguel Hidalgo Refinery and determine its fat and oil content.

2. Obtain governor extract by hot and cold method (room temperature 20 ° C) and hot (50 ° C).

3. Wash the soil contaminated with hydrocarbons.

4. Monitor the effectiveness of the removal by comparing the fat and oil content, before and after washing.

5. Monitor the effectiveness of the removal by measuring the Chemical Oxygen Demand (COD) of the solutions of the biosurfactant used in the washing of each of the soil samples.

6. Analyze advantages and disadvantages of the governor, as a surfactant agent.

**Theoretical framework**

In accordance with NOM-138-SEMARNAT / SSA1-2012, below, we review the following definitions:

Unconsolidated

**Soil**: material composed of inorganic particles, organic matter, water, air and organisms, which comprises from the upper layer of the earth's surface to different levels of depth.

**Soil contaminated with hydrocarbons**: The one in which the hydrocarbons included in table 1 are present, in a concentration greater than the maximum permissible limits established in tables 2 and 3.

**Hydrocarbons**: Organic chemical compounds, consisting mainly of carbon atoms and hydrogen.

**Light fraction hydrocarbons**: A mixture of hydrocarbons whose molecules contain between five and ten carbon atoms (C5 to C10).

**Middle fraction hydrocarbons**: A mixture of hydrocarbons whose molecules contain between ten and twenty-eight carbon atoms (C10 to C28).

**Heavy fraction hydrocarbons**: A mixture of hydrocarbons whose molecules contain between twenty-eight and forty carbon atoms (C28 to C40).

| POLLUTANT PRODUCT | HYDROCARBON | | | | |
|---|---|---|---|---|---|
| | FRACTION HEAVY | FRACTION MEDIA | HAP | FRACTION LIGHT | BTEX |
| Mixture of unknown products derived from oil | X | X | X | X | X |
| Crude oil | X | X | X | X | X |
| Fuel Oil | X | | X | | |
| Paraffins | X | | X | | |
| Petrolates | X | | X | | |
| Petroleum derived oils | X | | X | | |
| Diesel oil | | X | X | | |
| Diesel | | X | X | | |
| Jet fuel | | X | X | | |
| Kerosene | | X | X | | |
| Creosote | | X | X | | |
| Gasaplane | | | | X | X |
| Gas solvent | | | | X | X |
| Gasoline | | | | X | X |
| Naphtha gas | | | | X | X |

**Table 1** Hydrocarbons that must be analyzed according to the polluting product
*Source: NOM-138-SEMARNAT / SSA1-2012*

| FRACTION HYDROCARBON | PREDOMINANT SOIL USE (mg / kg DRY BASE) | | | ANALYTICAL METHOD |
|---|---|---|---|---|
| | Agricultural, forestry, livestock and conservation | Residential and recreational | Industrial and commercial | |
| **Light** | 200 | 200 | 500 | NMX-AA-105-SCFI-2008 |
| **Medium** | 1 200 | 1 200 | 5 000 | NMX-AA-145-SCFI-2008 |
| **Heavy** | 3 000 | 3 000 | 6 000 | NMX-AA-134-SCFI-2006 |

**Table 2** Limits Maximum allowable for fractions of hydrocarbons in soil. NOM-138-SEMARNAT / SSA1-2012PREDOMINANT

| HYDROCARBONS SPECIFIC | SOIL USE (mg / kg DRY BASE) | | | ANALYTICAL METHOD |
|---|---|---|---|---|
| | Agricultural, forestry, livestock and conservation | Residential and recreational | Industrial and commercial | |
| Benzene | 6 | 6 | 15 | NMX-AA-141-SCFI-2007 |
| Toluene | 40 | 40 | 100 | NMX-AA-141-SCFI-2007 |
| Ethylbenzene | 10 | 10 | 25 | NMX-AA-141-SCFI-2007 |
| Xylenes (sum of isomers) | 40 | 40 | 100 | NMX- AA-141-SCFI-2007 |
| Benzo [a] pyrene | 2 | 2 | 10 | NMX-AA-146-SCFI-2008 |
| Dibenzo [a, h] anthracene | 2 | 2 | 10 | NMX-AA-146-SCFI-2008 |
| Benzo [a] anthracene | 2 | 2 | 10 | NMX-AA-146-SCFI-2008 |
| Benzo [b] fluoranthene | 2 | 2 | 10 | NMX-AA-146-SCFI-2008 |
| Benzo [k] fluoranthene | 8 | 8 | 80 | NMX-AA-146-SCFI-2008 |
| Indene (1, 2, 3-cd) pyrene | 2 | 2 | 10 | NMX-AA-146-SCFI-2008 |

**Table 3** Maximum permissible limits for specific hydrocarbons in soil
*Source: NOM-138-SEMARNAT / SSA1-2012*

## HPA

Polycyclic aromatic hydrocarbons Polycyclic aromatic hydrocarbons can be classified as light (3-4 rings) or heavy (5 or more rings). Some of these compounds have proven carcinogenic properties, such as benzo-**α**-pyrene (WHO, 1993).

They come from the incomplete combustion of certain organic compounds, they are compounds of low solubility in water and also in the soil. Once in the sediment, PAHs can undergo UV photo-decomposition, being also totally or partially degraded by some microorganisms (Marín, 2003).

Surfactant agents are also known as surface active substances.

## Surfactant agents Surfactants

Are amphipathic molecules that accumulate at the interfaces, gas / liquid (air-water), liquid / liquid (oil-water) or liquid / solid (water / surface of solids), causing a decrease in surface tension. and interfacial of the medium. From certain concentrations these molecules tend to form aggregates such as micelles, bilayers and vesicles (Van Hamme et al., 2006). Surfactants have two clearly differentiated regions in their chemical structure, which gives them the dual character characteristic of all amphipathic substances (see figure 1).

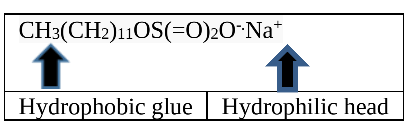


**Figure 1** Sodium dodecyl ester sulfate molecule
*Source: Own source*

One region is the hydrophilic fraction (polar head), which has a strong affinity for polar solvents, especially water, while the other hydrophobic fraction (apolar tail), has a higher affinity for organic or non-polar solvents (Burgos-Díaz et al., 2011). The hydrophobic part can be constituted by hydrocarbon chains, saturated hydrocarbon rings and aromatic rings, and the hydrophilic part by polar groups of different nature. Surfactants are available in many forms, and are generally classified depending on the charge on the polar head as anionic, non-ionic, cationic, and amphoteric (Pramauro and Pelizzetti, 1996; Rieger, 1997; Rosen, 2004).

## Classification *tensoac*Tive

Surfactants can be classified accordingtheir applications: soaps, detergents, dispersants, emulsifiers, foaming agents, bactericides, corrosion inhibitors, antistatic agents, etc .; or by the structures they form: membranes, microemulsions, liquid crystals, liposomes or gel. Many surfactants can be used in different applications, therefore, it is preferred to classify them according to the form of dissociation of their molecule in water (Salager, 2002). According to the type of dissociation of the hydrophilic group in the aqueous phase, these are classified as:

Anionic surfactants are those compounds that have a negative charge in their polar group. They are molecules with organic and inorganic cations ($Na^+$, $K^+$, $Ca^{2+}$, $Ba^{2+}$, $Mg^{2+}$, $NH_4^+$, etc.) and in their hydrophilic part they contain the anionic groups ($-COO^-$, $-SO_3$, -O-PO $^{2-}$, etc), attached to the organic fraction. They are important for use in the formulation of detergents for domestic and industrial use. Most anionic surfactants are alkyl carboxylates (better known as soaps), sulfonates (powdered detergents) and sulfates (foaming agents) (Salager and Fernández, 2004).

Cationic surfactants are those that have a positive charge on the polar group. Most are made up of quaternary ammonium salts or alkylamine salts, where the hydrophobic group is the long chain (8 to 25 carbon atoms) and the hydrophilic group is made up of the quaternary nitrogen.

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Due to the positively charged nitrogen, quaternary ammoniums have antistatic, softening and disinfectant properties, caused by the electrostatic adsorption of the surfactant on surfaces (fabrics, skin, hair ... usually with a negative surface charge) (García *et al*., 2001; Esumi, 2001; García *et al*., 2000; Esumi *et al*., 1998).

**Amphoteric surfactants** are those that have anionic and cationic groups within the same molecule, such is the case of amino acids, betaines and phospholipids. Of the latter, the main representatives are lecithins, which constitute the majority of the structural elements of biological membranes. These surfactants are characterized by their behavior dependent on the pH of the medium (Uphues, 1998). At acidic pH they behave as cationic surfactants, at alkaline pH they behave as anionic and at the isoelectric point (more or less close to neutral pH) they behave as non-ionic. They are stable products in acid and alkaline systems, very important in cosmetics because they have good tolerance on the skin and in the formulation of alkaline cleaning products or as corrosion inhibitors.

**Non-ionic surfactants**

Nonionic surfactants do not ionize in aqueous solution, since they possess hydrophilic groups of the alcohol, phenol, ether or amide type. A high proportion of these surfactants are relatively hydrophilic thanks to the presence of a polyethylene oxide chain. Among these are Tween and Span (ethoxylated and non-ethoxylated sorbitan esters respectively), used in food and cosmetic applications due to their low toxicity (Roberts, 2000; Holmberg et al., 2002; Rosen, 2004).

**Properties and characteristics of surfactants**

The most interesting properties of synthetic surfactants and bio-surfactants are mainly associated with their amphipathic character, which gives them the ability to reduce the surface and interfacial tension of two phases, and form micro-emulsions of two immiscible compounds, where hydrophobic compounds can be solubilized in water or where water can be solubilized in hydrophobic compounds. As mentioned above, these characteristics give them properties such as excellent detergents, emulsifiers, foaming agents and dispersants that make surfactants one of the most used products in chemical processes (Desai and Banat, 1997).

In addition to these properties, four more parameters characterize surfactants: critical micellar concentration (CMC), emulsifying capacity, hydrophilic-hydrophobic balance (HLB) and liquid crystal formation.

a) Surface and interfacial activity

The intermolecular forces of any liquid cause a tension membrane to be generated on the surface that is difficult to break. This is due to the fact that within a liquid each molecule is subjected to attractive forces in all directions that on average are canceled. However, the molecules that are on the surface are only attracted inwards, forming a kind of film on the surface that allows light objects to float on it Mathematically, the work necessary to bring the molecules to the surface per unit area, N / m or J / $m^2$, is what is called the surface tension of a liquid and is represented by a Greek letter gamma or sigma (Desai and Banat, 1997; Rosen, 2004), and is expressed with the following formula :

$$\gamma rs = \_dW \quad (Nm-1)$$

dA

b) Critical micellar concentration (CMC)

As the surfactant concentration increases, the number of surfactant monomers on the surface increases, decreasing the surface tension until reaching a critical value, called micelle concentration critical (CMC). At this concentration, the interface is sutured with surfactant and the molecules begin to aggregate to form structures such as micelles, bilayers, and vesicles. CMC is a characteristic parameter for each surfactant and is used to measure the efficiency of a surfactant (Jiménez Islas *et al*., 2009).

c) Formation of aggregates

The aggregates formed by surfactants can be constituted by a single surfactant, a single aggregate, or by several surfactants, mixed aggregates. The morphology of surfactant aggregates depends, among other factors, on the chemical structure of the compound and the nature of the medium in which it is dissolved.

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The formation of the aggregates occurs through non-covalent intermolecular interactions, such as hydrophobic interactions, hydrogen bonding, etc., producing in each case, the set of interactions that give rise to the most stable structure. In addition to the molecular structure of the surfactant and the polarity of the medium, there are other factors such as ionic strength, pH and the procedure used for the formation of the aggregate that decisively influence the type of aggregate formed (Morigaki *et al*., 2003). The most characteristic simple aggregate types formed by surfactants are spherical micelles, vesicles, bilayers and inverse micelles (see figure 2).

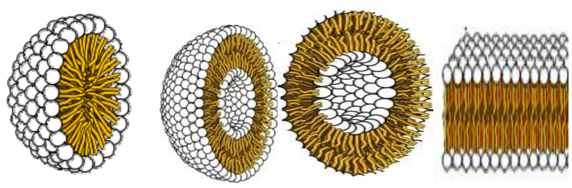


**Figure 2** Different types of simple aggregates formed by surfactants

The tendency of surfactants to adsorb at the interface of a system and to form molecular aggregates within the liquid from a certain concentration, It is also responsible for the series of classical properties of surfactants such as surface tension reduction, emulsification, foaming, detergency, wettability, etc.

d) Formation of lyotropic liquid crystals by surfactants

Lyotropic liquid crystals appear in a certain temperature and concentration range when certain amphiphilic substances, such as surfactants, are dispersed in water. As the surfactant concentration increases, the micelles clump together in an ordered structure and form a lyotropic liquid crystal. (Pasquali, 2006).

**Biotensoactivesactive**

In addition to the chemical compounds that possess surface-properties, there are compounds of biological origin that can also have this capacity, and which are called Biotensoactive (BT).

BTs are molecules that can be produced and secreted by different types of microorganisms and their interest has increased considerably in recent years due to their applications in industry and the environment (Nitschke *et al*., 2005 and Mukherjee *et al*., 2006). In addition, by presenting low toxicity, being biodegradable and having a better compatibility with the environment, they make them candidates to replace chemically synthesized surfactants.

Bio-surfactants (BT) are amphipathic molecules produced by a wide variety of microorganisms (bacteria, fungi and yeasts). These are classified into two groups, those of high molecular weight and low molecular weight. Low molecular weight BTs are generally glycolipids or lipopeptides and are more effective in lowering the surface and interfacial tension of the medium. High molecular weight BTs, polysaccharides, proteins, lipopolysaccharides and lipoproteins, are more effective in stabilizing oil-in-water emulsions (Pacwa-Plociniczak *et al*., 2011).

**Governor**

According to Jerzy Rzedowski (1987), the governor (Larrea tridentata) is the Mexican plant best adapted to arid conditions, since it can live in the most extreme conditions that occur in Mexico, without being a succulent plant, nor presenting spines, nor tomentum and also being evergreen.

*Larrea tridentata*, is ecologically dominant and widely distributed in the semi-arid regions of North America that extend from the southern United States to northern Mexico (Downum et al., 1988). In Mexico it is known as "governor", but also as a creosote bush, sonora, beef jerky, jarilla and smelly odor due to the peculiar smell it has, especially after a rain. It is an evergreen xerophytic evergreen shrub (Brinker, 1993). The major compounds in extracts of L. *tridentata* are numerous, in table 4 a summary of the most important is presented. Phenolic lignans stand out, followed by saponins, flavonoids, amino acids and minerals. The most important compound found in leaf and stem cells is nordihydroguaiaretic acid (NDGA), one of the best-known antioxidants (Seigler *et al*., 1974).

| Dry weight percent | Type | Compound |
|---|---|---|
| 16-21 | Lignans Phenolic | acid Dihidroguaiarético Hemi-norisoguaiacin nordihydroguaiaretic acid Nordihidroguaiacin |
| 5 - 7.5 | Flavonoids | Apigenin Kaempferol |
| 10 to 15 | Saponins and Terpene | Larreagenin A Larréico Acid |
| 0.1 - 0.2 | Monoterpenes Volatile Hydrocarbons 35 | Alpha penene Delta-3-carene Limonene |
| | Aromatics | Benzaldheido Benzyl acetate Benzylbutane Methyl naphthalene |
| | Steroids | Beta-sitosterol Cholesterol Campesterol |
| | Tannins Carbohydrates | Glucose Sucrose |
| 70.1 (from stems) | Lipids | Alkyl esters (C46-C56) |
| 16.6 | Amino acids | Phenylalanine, Isoleucine, Glutamic acid,Aspartic acid Glycineand GlycineGlycine |
| 15.6 19.8 mg /19.8 / 100 mgmg / 100 mg /g | Vitamins | Carotenes Vitamin C |
| 13.7 | Minerals | Sodium, Potassium, Calcium, Magnesium, Iron, Sulfur and Phosphorus |

**Table 4** Main phytochemical constituents of *Larrea tridentata*
*Source: (Brinker, 1993)*

The nordihydroguaiaretic acid, also known as β, γ-Dimethyl-α, δ-bis (3,4-dihydroxyphenyl) butane; (see figure 3). There is a difference in the mean concentration of the NDGA, depending on the geographic area where the governor grew up; in the Chihuahuan desert they report 2.62%, while those of the Sonoran Desert contain 3.84% (Gisvold, 1948).

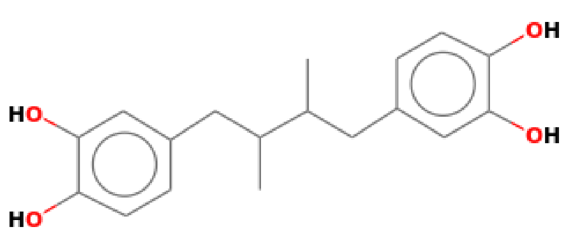


**Figure 3** β, γ-Dimethyl-α, δ-bis (3,4-dihydroxyphenyl) butane (Nordihydroguaiaretic acid) NDGA
*Source: Retrieved from https://webbook.nist.gov/cgi/cbook.cgi?ID=500-38-9*

Governor extracts have antioxidant, anti-inflammatory, cytotoxic, antimicrobial and enzyme inhibitor properties (Mabry *et al*., 1977; Fernández, 1979; Brinker, 1993).

The combined effect of these constituents is synergistic, which means that better results are obtained from an extract containing leaves and branches than from the use of purified NDGA.

Experiments have shown that the biomass of the governor can adsorb ions Cu (II), Ni (II), Cd (II), Pb (II), Zn (II), Cr (III) and Cr (VI), from solutions watery. When the heavy metal tolerant plant was compared with plants grown in uncontaminated areas, the uncontaminated plant showed a higher copper binding capacity. The difference in absorption is due to the occupation of the chemical binding sites by previously absorbed ions (Gardea, 1998).

Different applications derived from its chemical content have been described; some of its uses are described in Table 5.

| Species | Uses |
|---|---|
| **Gobernadora *Larrea tridentata*** | Forajero: the branches and leaves of the governor contain large amounts of proteins and other nutrients, which indicates that the plant could serve as livestock feed once the resins it contains are extracted. |
| | Food: its main component is norhydroguaiaretic acid (NDGA), which acts as a powerful antioxidant, which is why it is used in the food industry. |
| | Industry: to reduce saline incrustations in boilers and containers; for the preparation of phenolic type polymers and organic fungicides and insecticides. The resins are used to manufacture footwear greases. Glue (from sheets) for plywood and compressed cardboard. |
| | Cosmetics: Manufacture of soaps |
| | Medicine: used for urinary tract conditions such as kidney stones; kidney pain and bladder inflammation. In gynecological problems such as female sterility; for postpartum and to regularize menstruation; as an infusion in baths for hemorrhoids, fever, malaria, pimples, bumps; promote healing and cure rheumatism; as a remedy for rheumatism, gallstones and kidney stones, dermatitis, hepatitis, measles, erysipelas and as an antiseptic. Properties and actions against gastric discomfort, venereal diseases and tuberculosis are attributed to it. It is used to treat mycosis. It has anti-amoebic |
| | insecticidal and fungicidal activity: the resins of the governor plant show antifungal activity against *Rhizoctonia solana*, *Fusarium oxysporum*, *Pythium spp*. and other phytopathogenic fungi. The insecticidal activity is used against the brown bean weevil (*Acanthoscelides obtectus*, Coleóptera: *Bruchidae*); major grain borer (*Prostephanus truncatus*, Coleoptera: *Bostrichidae*) |

**Table 5** Uses of *Larrea tridentata*
*Source: Own elaboration based on a review of the literature*

**Materials and Methods**

The focus of the study is quantitative descriptive experimental since it seeks to analyze the effectiveness of the flat *Larrea tridentata* as a surfactant agent

**Origin and taking the soil**

The samples were taken from soils contaminated with hydrocarbons in the surroundings of the Miguel Refinery Hidalgo, which were conserved in sterile amber jars and processed within 24 h of their collection / kept in refrigeration.

**Obtaining the governor (*Larrea tridentata*)**

Theplant *Larrea Tridentata* was obtained from the Progreso de Obregón municipality, Hidalgo.

**Theoretical Methods**

The methods used were those described in the Official Mexican Standards: Determination of pH in water (NMX-AA-008-SCFI-2011), and for COD the EPA 5220 D method; APHA, 1989. NMX-AA-005-SCFI-2013-Analysis of water - measurement of fats and oils

**Obtaining hot and cold extract of the governor (*Larrea Tridentata*), extraction of humic and fulvic acids and washing of soil contaminated with hydrocarbons**

In this stage the following materials were used: 250ml Pyrex brand graduated cylinder, perilla, 500ml beakers (Kimax), Potentiometer, Conductimeter, heaters with stirring, magnets, Refrigerants and the following procedures were followed:

Cold extraction and hot stem and leaf separately.

**Cold extract**

It is obtained separately and 220 grams of leaves and stems are placed in mortars. It is ground in a blender adding 240 ml of de-ionized water, it was passed through a sieve to eliminate solid residues (see figure 4A and B).

**Hot extraction**

In the flat-bottomed ball flask add 250gr of the governor (stems and leaves separately), and 240 ml of de-ionized water. It is placed in a closed reflux system for 2 hours. The extract is passed through a sieve to remove residues (see Figure 4C).

**Soil washing**:

4 washes were carried out in triplicate:

**Washing with extract *Larrea tridentata*, obtained by method at room temperature (cold method) and hot**

Sift the contaminated soil with a sieve number 18 and 10, We weigh 10 grams of the sample for each beaker, using the extracts obtained in a 5: 1 ratio (extract / soil), it is subjected to agitation for a period of 2 hours. The hydrocarbon-free washed soil and the contaminated residual solution are filtered and recovered separately (see figure 1), they are labeled for determination of fats and oils and Chemical Oxygen Demand (COD). These determinations are made on the soil samples before and after washing. Likewise, a triplicate series was used in each case of a wash blank with uncontaminated soil and a reagent blank with deionized water. (See figure 4D).

**Determination of fats and oils in the soil; before and after washing**

Bring the balloon flask to constant weight. Weigh the sample and place it in the cartridge, Install the Soxhlet, add 185ml of hexane, perform the extraction for 4 hours, once completed, recover the hexane by distillation, let it cool in a desiccator and obtain the amount of fats and oils by difference. weight (see figure 5A).

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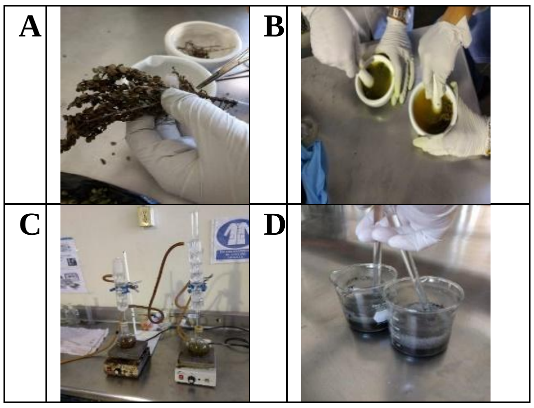



**Figure 4** Obtaining extracts of *Larrea tridentata* and washing the soil contaminated with hydrocarbons A. Separation of stems and leaves of *Larrea tridentata* (governor), B. Obtaining the cold extract. C. Obtaining the extract in hot. D. Washing of soils contaminated with hydrocarbons

## COD determination

Glass tubes with a Teflon stopper were used, to which 2.5ml of sample, 1.5ml of digester solution (10.216g of $K_2Cr_2O_7$ + 33.3 $HgSO_4$ and 167ml of$H_2SO_4$) and 3.5ml of sulfuric acid solution ( 10.142g of $Ag_2SO_4$ of $H_2SO_4$), once the samples are prepared, they are digested within a heating block at 150 ° C for 2 hours. Subsequently, allow the samples to cool to room temperature and read the absorbance at 600nm. (EPA 5220 D; APHA, 1989) (see figure 5B).

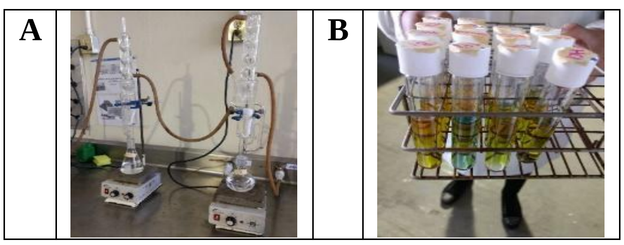
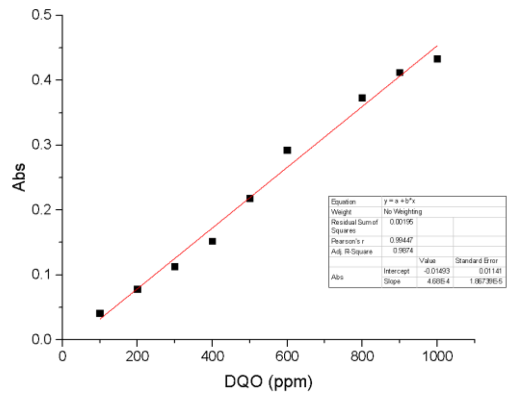



**Figure 5** Determination of fats (A) and oils and COD (B)

## Results

### CODofextracts *Larrea tridentata* before and after washing soil contaminated with hydrocarbons

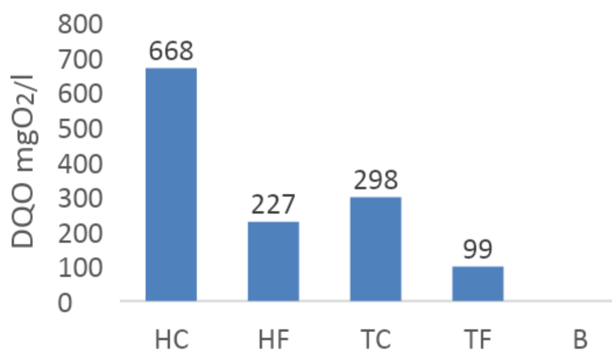
The COD values are obtained from a calibration curve made with potassium biphthalate (0-681mg / l, equivalent to 0-800 mgO2 / l). (See Graph 1).




**Graphic 1** Calibration Curve for COD
*Source: Own elaboration*

From the graph, the formula to determine the COD of the studied samples was defined.

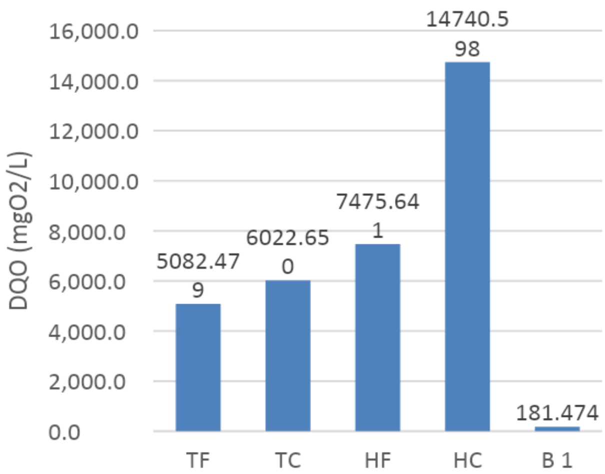
The COD values of the leaf and stem extracts, obtained separately through processes at 21 ° C and 50 ° C, are shown in graph 2, in which we can see that the extract of the Governor Leaf, obtained in hot has a higher content of organic matter, this is explained, since, according to literature, the leaf has numerous lignans, saponins, terpene and flavonoids present in its resinous exudates, among others, one of the most abundant acid nordihydroguaiaretic. The cold extract presents a lower quantity in both cases: stem and leaf extract.




**Graphic 2** COD of the governor extracts before washing

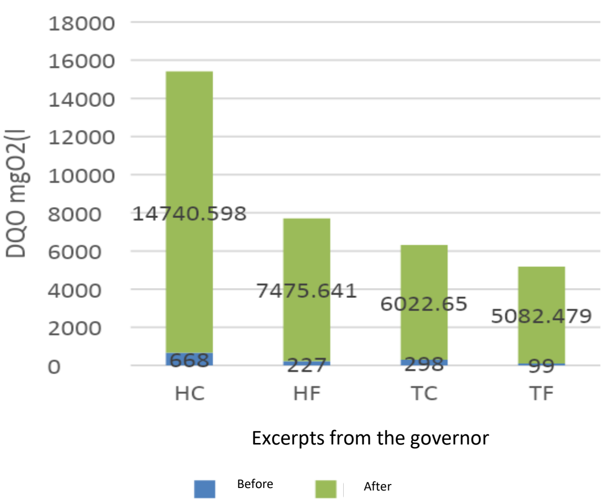
Once the soil was washed with the different extracts: TF has a COD of 5082,478 mgO2 / l, TC of 6022,650 mgO2 / l. HF of 7475,641 mgO2 / l, and HC of 14740,598 mgO2 / l (see graph 3), although the 4 extracts tested removed organic matter from the soil, there is a greater removal in the case of soil washed with the HC extract, every time that a greater amount of organic matter passed into the aqueous extract.

In this case, a sample of soil from the gardens of the Tula-Tepeji University was used for the blank, which was washed with distilled water, said sample contained 181,474mg$O_2$/ l, this may be due to herbicides that are used in garden areas or contaminated irrigation water, (see graphic 3).




**Graphic 3** COD after soil washing with extracts from different parts of the plant, cold stem (TF), hot stem (TC), cold leaf (HC) and White (B1)

We can see that with the HC extract, 14,072,598 mgOwere removed2/ l of oxidizable matterfrom the contaminated soil (see graph 4).




**Graphic 4** COD before and after soil washing with extracts from different parts of the plant, cold stem (TF), hot stem (TC), cold leaf (HC) and White (B1)

## Fat and oil content in the contaminated soil, before and after washing with the extracts

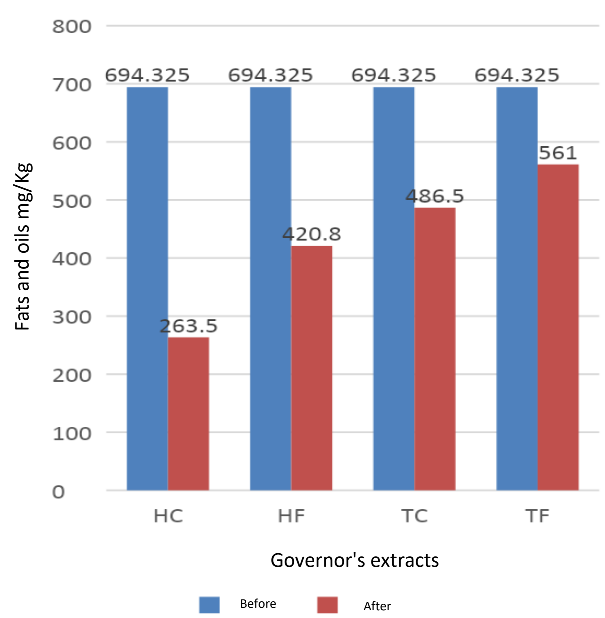
Once the soil was washed, fats and oils were determined, finding a lower amount in the soil washed with HC extract (see graph 5).

The soil initially had a fat and oil content of 694,325 mg / Kg, when it was washed, this amount decreased. With CH at 263.5 mg / Kg, HF at 420.8 mg / Kg, TC at 486.5 mg / Kg, and with TF at 561.0 mg / Kg. There was a greater removal of fats and oils in the case of the governor leaf extract obtained in hot 50 ° C. (see graphic 5).

Returning to the data from Reséndiz-Vega and García-Melo (2019), where 3 surfactant agents were tested: humic and fulvic acids and hot and cold extracts of lechuguilla (*Agave lechuguilla* Torrey), the following results were obtained:

Reséndiz-Vega and García-Melo, 2009… "in the case of soil washed with a humic acid solution from 694.7 g / Kg to 178g / Kg, in the case of soil washed with a solution of fulvic acids it dropped from 694.7 g / Kg to 155.5 g / Kg, in the case of the hot lettuce extract the decrease was from 694.7 g / Kg to 139.2g / Kg and in the case of washing with the lettuce extract obtained at room temperature (cold lettuce) the decrease was 694.7g / Kg to 65.6g / Kg"

The 4 biosurfactants are effective since a percentage of removal of: humic acids 74%, fulvic acids 77%, extract of lettuce obtained at 50 ° C 79%, extract of lettuce obtained at room temperature 90 % and the governor leaf extract obtained at 50 ° C 62%.




**Graphic 5** Fat remaining in the soil washed with the different extracts obtained from the governor Cold leaf (HF), hot leaf (HC), cold stem (TF) and hot stem (TC)

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**Conclusions**

The extract of *Larrea tridentata* obtained from the leaf turned out to have a better surfactant effect than that obtained from the stem.

Theextract *Larrea tridentata* obtained from the leaf at a temperature of 50 ° C, turned out to have a better surfactant effect than the extract obtained at 21 °C.

Comparing the removal percentage, the extract of *Larrea tridentata* is less effective with a removal percentage of 62%, compared to: humic acids 74%, fulvic acids 77%, lechuguilla extract obtained at 50°C 79%, lechuguilla extract obtained at room temperature 90%.

The extract of *Agave lechuguilla* Torrey is the most effective and economical since it is obtained at room temperature.

The effectiveness of *Larrea tridentata*, as a surfactant agent varies, depending on the place from where it is collected, since, if it is a contaminated place, its effectiveness in bioremediation has been observed to decrease.

The effectiveness of *Agave lechuguilla* Torrey may be due to the fact that it contains saponins in higher concentration; if we compare it with the content of *Larrae tridentata*. *Agave lechuguilla* Torrey contains 9 saponins (smilagenin, yucagenin, gitogenin, hecogenin, tigogenin, diosgenin, gentrogenin, chlorogenin and ruizgenin), which have a surfactant effect. Hernández *et al*., (2005), extract was a better option for washing soils contaminated with hydrocarbons *Agave lechuguilla* Torrey, compared to the other biosurfactant agents tested.

Finally, it is necessary to treat the extracts contaminated with hydrocarbons, for which a system that encourages their biodegradation will be adapted.

**References**

Atlas RM y Unterman, R. (1999). Bioremediation. In: Demain AL & Davies JE (Eds) Manual of Industrial Microbiology and Biotechnology 2nd ed (pp 666-681), ASM Press, Washington DC

A. y Marqués, AM (2011). Isolation and partial characterization of a biosurfactant mixture produced by *Sphingobacterium* sp. isolated from soil. *J Colloid Interface Sci* 361, 195-204

Bautista, FZ (1999). *Introducción al estudio de la contaminación del suelo por metales pesados. México: UADY, (Capítulo 1).*

Botello, AV, Von, JR, Gold-Bouchot, G., & Agraz, CH (2005). *Golfo de México: contaminación e impacto ambiental: diagnóstico y tendencias.* (2da ed.). México: Universidad Autónoma de Tabasco. (Capítulo 17).

Botkin, CW and Duisberg, PC 1949. The nordihidroguayeretic acid content of the creosotebush. Bul, 349, New Mexico State College. 15 p.

Brinker, F. 1993. *Larrea tridentata* (DC) Coville (Chaparral or Creosote Bush). British Journal of Phytotherapy 3:10- 30.

Burgos-Díaz, C., Pons, R., Espuny, MJ, Aranda, FJ, Teruel, JA, Manresa, A., Ortiz, Desai, JD y Banat, IM (1997). Microbial production of surfactants and their commercial potential. *Microbiol Mol Bio R* 61, 47-64

CCA (2014), La quema de residuos agrícolas: fuente de dioxinas, Comisión para la Cooperación Ambiental, Montreal, Canadá, 6 pp.

Coronado-Ortega y col., 2011. Hacia la sustentabilidad: Los residuos sólidos como fuente de energía y materia prima: 270-274.

Dávila G, Vázquez-Duhalt R. Enzimas lignolíticas fúngicas para fines ambientales. Mensaje Bioquímico. 2006; XXX: 29-55.

Delgadillo-López, Angélica Evelin, González-Ramírez, César Abelardo, Prieto-García, Francisco, Villagómez-Ibarra, José Roberto, & Acevedo-Sandoval, Otilio. (2011). Fitorremediación: una alternativa para eliminar la contaminación. *Tropical and subtropical agroecosystems,14*(2), 597-612. Recuperado en 30 de julio de 2021, de http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1870-04622011000200002&lng=es&tlng=es.

ISSN-On line: 2414-8830

Delgadillo Ruíz, Lucía, Bañuelos Valenzuela, Rómulo, Delgadillo Ruíz, Olivia, Silva Vega, Mónica, & Gallegos Flores, Perla. (2017). Composición química y efecto antibacteriano in vitro de extractos de *Larrea tridentata*, origanum vulgare, artemisa ludoviciana y ruta graveolens. *Nova scientia*,*9*(19), 273-290.https://doi.org/10.21640/ns.v9i19.1019

Esumi, K. (2001). Adsorption and adsolubilization of surfactants on titanium dioxides with functional groups. *Colloids Surf Physicochem Eng Aspects* 176, 25-34.

Esumi, K., Toyoda, A., Goino, M., Suhara, T., Fukui, H. y Koide, Y. (1998). Adsorption Characteristics of Cationic Surfactants on Titanium Dioxide with Quaternary Ammonium Groups and Their Adsolubilization. *J Colloid Interface Sci* 202, 377-384.

Figueruelo EJ y Dávila MM (2001). Química física del me- dio ambiente. Ed. Reverté, México DF, México, 619 pp

Fiorenza, S., Oubre, CL, & Ward, CH (2000). *Phytoremediation of Hydrocarbon-Contaminated Soil.*United States: Lewis Publishers, (Chapter 2).

García-López, E., Zavala-Cruz, J. y Palma-López, DJ (2006). Caracterización de las comunidades vegetales en un área afectada por derrames de hidrocarburos.*Terra Latinoamericana*,*24*(1), 17-26

García, MT, Ribosa, I., Guindulain, T., Sánchez-Leal, J. y Vives-Rego, J. (2001). Fate and effect of monoalkyl quaternary ammonium surfactants in the aquatic environment. *Environ Pollut* 111, 169-175.

García, MT, Campos, E., Sanchez-Leal, J. y Ribosa, I. (2000). Anaerobic degradation and toxicity of commercial cationic surfactants in anaerobic screening tests. *Chemosphere* 41, 705-710

Gardea-Torresdey, JL; Hernandez, A.; Tiemann, KJ; Bibb, J.; and Rodriguez, O. (1998) "Adsorption of Toxic Metal Ions From Solution by Inactivated Cells of *Larrea tridentata* Creosote Bush,"Journal of Hazardous Substance Research: Vol. 1.https://doi.org/10.4148/1090-7025.1002

González García, Yolanda, González Reynoso, Orfil, Nungaray Arellano, Jesús. Potencial del bagazo de Agave tequilero para la producción de biopolímeros y carbohidrasas por bacterias celulolíticas y para la obtención de compuestos fenólicose-Gnosis [en linea] 2005,[Fecha de consulta: 10 de julio de 2021] Disponible en:<http://www.redalyc.org/articulo.oa?id=73000314> ISSN

Guerrero, (2002). *Curso de suelos. Centro de Gestión y Tecnología Ambiental*. UNALM-Perú.

Hernández S., Rosa, & Lugo C., Eugenia C., & Díaz J., Lourdes, & Villanueva, Socorro (2005). Extracción y cuantificación indirecta de las saponinasde agave lechuguilla Torrey. e-Gnosis, (3),0.[fecha de Consulta 30 de Julio de 2021]. ISSN:Disponible en: https://www.redalyc.org/articulo.oa?id=73000311

Holmberg, K., Jonsson, B., kronberg, BI y Lindman, B. (2002). Surfactants and polymeric in aquos solution. 2ª Ed wiley and Sons, New York.

Jiménez Islas, D., Medina Moreno, SA y Gracida Rodríguez, JN (2010). Propiedades, aplicaciones y producción de biotensoactivos. *Rev Int Contam Ambient* 26 (1), 65-84

Jiménez, RB (2017). *Introducción a la contaminación de suelos.* España: Mundi-Prensa, (Capítulo 26).

Lue-Kim H., Rause WE r, Partial Characterization of Cadmium-Binding Protein from Roots of Tomato ,Plant Physiology, Volume 81, Issue 3, July 1986, Pages 896–900,https://doi.org/10.1104/pp.81.3.896

Lira, RH (2003). Estado Actual del Conocimiento Sobre las Propiedades Biocidas de la Gobernadora [*Larrea tridentata* (DC) Coville]. *Revista Mexicana de Fitopatología, 21 (2), 214-222.*

Morigaki K., Walde P., Misran M. y Robinson BH (2003). Thermodynamic and kinetic stability. Properties of micelles and vesicles formed by the decanoic acid/decanoate system. *Colloids Surf A* 213, 37-44

Mukherjee, S., Das, P. y Sen, R. (2006). Towards commercial production of microbial surfactants. *Trends Biotechnol* 24, 509-515

National Institute of Standards and Technology (NIST). Libro del Web de Química del NIST. DOI:https://doi.org/10.18434/T4D303 https://webbook.nist.gov/

Nitschke, M., Costa, SG y Contiero, J. (2005). Rhamnolipid surfactants: an update on the general aspects of these remarkable biomolecules. *Biotechnol Prog* 21, 1593-1600.

Ortiz-Salinas R., Cram S. y Sommer I. (2012). Hidrocar- buros aromáticos policíclicos (HAPs) en suelos de la llanura aluvial baja del estado de Tabasco, México. Revista Universidad y Ciencia 28 (2), 131-144.

Owamah HI (2013). Heavy metals determination and assessment in a petroleum impacted driver in the niger delta región of Nigeria. J. Pet. Environ. Biotechnol. 4, 135-138. DOI: 10.4172/2157-7463.1000135

Pasquali, RC, Bregni, C. y Serrao, R. (2006). Características e identificación de los cristales líquidos liotrópicos. Revisión bibliográfica. Revista Mexicana de Ciencias Farmacéuticas 37 (2), 38-53

Peñuelas-Rubio, Ofelda, Arellano-Gil, Maritza, Verdugo-Fuentes, Abel Alberto, Chaparro-Encinas, Luis Abraham, Hernández-Rodríguez, Sharon Elena, Martínez-Carrillo, José Luis, & Vargas-Arispuro, Irasema del Carmen. (2017).

Peñuelas-Rubio, O., Arellano-Gil, M., Verdugo-Fuentes, A., Chaparro-Encinas, L., Hernández-Rodríguez, S., Martínez-Carrillo, J., & Vargas-Arispuro, I. (2017). Extractos de *Larrea tridentata* como una estrategia ecológica contra Fusarium oxysporum radicis-lycopersici en plantas de tomate bajo condiciones de invernadero.Revista Mexicana De FitopatologíA, Mexican Journal Of Phytopathology, 35(3). doi:http://dx.doi.org/10.18781/R.MEX.FIT.1703-3

Pérez, GC, Iturbe, RA, & Flores, RM (2006). Cambio en las propiedades físicas de un suelo contaminado con hidrocarburos debido a la aplicación de una tecnología de remediación. *Revista AIDIS de ingeniería y ciencias ambientales: investigación, desarrollo y práctica,* 1-10.

Pinkus-Rendón MJ y Contreras-Sáncez A. (2012). Impacto socioambiental de la industria petrolera en Tabasco: el caso de la Chontalapa. Revista LiminaR Estudios Sociales y Humanisticos 10 (2), 122-144.

Plohl, K. and Leskovsek, H. (2002) Biological Degradation of Motor Oil in Water. Acta Chimica Slovenica, 49, 279- 289

Pramauro, E. y Pelizzetti, E. (1996). Surfactants in Analytical Chemistry. Applications of Organized Amphiphilic Media, *Wilson and wilson's Comprehensive Analytical Chemestry* 31. SG Weber (Ed) Elsevier, Netherlands

RESENDIZ-VEGA, Marisol & GARCÍA-MELO, José Alberto. Effectiveness of Humic Acids, Fulvic Acids and lechuguilla extract (Agave lechuguilla), as biosurfactants in the Remediation of soils contaminated with Hydrocarbons. Journal of Environmental Sciences and Natural Resources. 2019, 5-16: 17-25

Rieger, MM, Rhein, EL y Dekker, M. (1997). Surfactants in Cosmetics. 2nd ed, Marcel Dekker, Nueva York.

Salager, JL (2002). Surfactantes tipos y usos, Cuaderno FIRP 300, Laboratorio FIRP, Universidad de los Andes. Mérida, Venezuela.

Riveroll-Larios J., Escalante-Espinosa E., Fócil-Monterru- bio RL y Díaz-Ramírez IJ (2015). Biological activ- ity asessment in mexican tropical soil with different hydrocarbon contamination histories. Water, Air, Soil Poll. 226 (10), 353-362.

Roberts, D. (2000). Aquatic toxicity—Are surfactant properties relevant. *J Surfactants Deterg* 3, 309-315

Rosen, MJ (2004). *Surfactants and Interfacial Phenomena*, 3rd ed. Edited by John Wiley and Sons, Inc., New York. pp. 1-10.

ISSN-On line: 2414-8830

Rzewdowski, Jerzy y Graciela Calderón de Rzedowski. 1988. Dos nuevas localidades de *Larrea tridentata*

Saldívar, Ricardo HL (2003). Estado actual del conocimiento sobre las propiedades biocidas de la gobernadora [*Larrea tridentata*(DC) Coville]. Revista Mexicana de Fitopatología, 21(2), 214-222.

Salager JL y Fernández A. (2004). Surfactantes-Parte 3. Aniónicos. Cuaderno FIRP S302PP, Laboratorio FIRP, Universidad de los Andes. Mérida, Venezuela.

Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), 2012, Norma Oficial Mexicana que establece los límites máximos permisibles de hidrocarburos en suelos y las especificaciones para su caracterización y remediación (NOM-138-SEMARNAT/SS-2012). México, DF Diario Oficial de la Federación, 10 de septiembre de 2013, 21 Recuperado de http://www.dof.gob.mx/nota_detalle.php?codigo=5313544&fecha=10/09/2013

Subsecretaría de recursos naturales (junio, 2020), Especies Forestales Maderables y No Maderables Sujetas a Aprovechamiento,Sistema Integral de Información ambiental del Estado de Coahuila, http://www.sema.gob.mx/SRN-SIIAEC-SFE-USOS-ESPECIES-GOBERNADORA.php

Tejada, A. (2014). Hidrocarburos aromáticos policíclicos. *Revista de ciencias de la Universidad Pablo de Olavide*, 104, 86-88.

Uphues, G. (1998). Chemistry of amphoteric surfactants. *Lipid/Fett* 100, 490-497

Van Hamme, JD, Singh, A. y Ward, OP (2006). Physiological aspects. Part 1 in a series of papers devoted to surfactants in microbiology and biotechnology. *Biotechnol Adv* 24, 604-620

Velasco, JA, & Volke, TS (2002). *Tecnologías de remediación para suelos contaminados.* México: INE...

ISSN-On line: 2414-8830

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# Physiographic and hydrological characterization in the Zula River basin, Jalisco, a challenge to the sustainability of water in the región

# Caracterización fisiográfica e hidrológica en la cuenca del Río Zula, Jalisco, un desafío a la sustentabilidad del agua en la región

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**Abstract**

Water abundance along the Zula River has provided an important economic impulse to the agricultural and industrial sectors of tows and localities located within the river basin; therefore, such an impulse has caused greater water demands and to change from rural to urban the type of the watershed. The objective of this paper is to determine the physiographic and morphological characterization of the Zula River basin, to obtain peak flows based on 2 to 50 years return periods (Tr). This was achieved using a rainfall-runoff method in conjunction with probability and statistical models, all of which are indispensable tools for the proposal of flood protection embankments occurring along the tower part of the basin. The results obtained include the analysis and design of a synthetic hydrograph for the Zula river basin. As a final conclusion, the hydrological modelling responds accordingly to the equivalent speed of response and time of concentration aimed to minimize risks and disasters on the lower part of the basin, thus promoting the protection of human lives and material assets along the downstream.

**Basin, Floods, Risks. Disasters**

**Resumen**

La abundante agua del río Zula ha facilitado a pueblos y localidades de la cuenca el impulso económico en el sector agrícola e industrial principalmente el sector mueblero, como consecuencia ha ocasionado mayores demandas de agua, además de la transformación de la cuenca hidrográfica del tipo rural a una urbana. El objetivo de este trabajo es determinar la caracterización fisiográfica y morfológica de la cuenca del río Zula, así como la obtención de gastos picos para periodos de retorno Tr desde 2 hasta 50 años. Esto se logró utilizando la metodología del modelo lluvia-escurrimiento, así como modelos de probabilidad y estadística, herramientas indispensables para la propuesta de bordos de protección contra inundaciones que se presentan en la parte baja de la cuenca. Los resultados obtenidos fueron el cálculo y diseño del hidrograma sintético de la cuenca del río Zula, así como las subcuencas que la conforman Como conclusión la modelación hidrológica responde a la velocidad de respuesta y tiempo de concentración equivalentes para minimizar los riesgos y desastres en la parte baja de la cuenca, previniendo con ello la seguridad de vidas humanas y bienes materiales aguas abajo.

**Cuenca, Inundaciones, Riesgos. Desastres**

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## Introduction

The Zula River and its tributaries suffer a severe pollution along theirs channels due to factors that have been accumulating over the last thirty years, among those agents we can mention the following: agricultural returns, creation of new housing developments, overexploitation of local aquifers, as well as direct wastewater discharges into the river (Lujan, 2016), these and other factors have substantially contributed to the ecocide of the Zula River.

Another problem found along the Zula River is the stagnation of its waters due to the small or null slope topographic configuration of the basin, thus, generating undesirable effects like the presence of large amounts of insects and unpleasant smells, especially during the dry season, some studies authored by scientists from the University of Guadalajara mention that the industrial pollution in the Zula River basin is originated by dairy wastes dumped directly into the municipal drainage, which flows into the river or study the area (Juárez, 2012).

It is well known that in most cases, liquid waste products with large quantities of milk whey, contain high concentrations of lactose (Lehninger, 2003) a disaccharide compound whose chemical name is β-D-galactosidase, also known as lactase which is widely used in the dairy industry for the hydrolysis of the lactose molecule into its corresponding derivatives: monosaccharides, glucose and galactose (Araujo, 2007); it is well documented that all these milk derivatives are discharged directly into the Zula River, as shown in the figure 1.

**Figure 1** Hydrological deterioration of the Zula River
*Source: www.decisiones.com.mx*

Another serious problem are the annual floods registered periodically din the region. As a result of the heavy rains in the neighbouring municipality of Tototlan, severe overflows were registered along the Zula River, which affected homes located on the lower part of the basin.

Despite the local actions taken to abate extreme hydrometeorological phenomena, in support of the Global Climate Change (GCC) agenda, and according projections of floodable areas for 50-year based return periods, it has caused alterations to the hydrological cycle, there have been various climatic phenomena that have worsened during recent times: prolonged droughts, extreme rainfall intensities during shorter time intervals, and consequently, frequent and grater flooding events in the urban area of Ocotlan (Sánchez, 2011).

Therefore, the objectives of this project are to determine some hydrological parameters, such as the geomorphology of the basin and the sub-basins into which it is divided, and to identify flood plains and/or overflows occurring in the basin as a consequence rainfall runoff downstream, using *rainfall-runoff* model.

## Project location

According to Mexico´s National Water Commission, the Zula River basin (CONAGUA, 2014) is located within the Administrative Hydrological Region VII Lerma-Santiago-Pacific, and the Hydrological Region 12 Lerma-Chapala which include portions of the hydrological basin of the Lerma River 7 and the hydrological basin of the Santiago River 1 *(ibid).*

The Zula River originates in the upper part in the municipality of Arandas and flows down into the Santiago River, which is formed by the numerous streams coming from all directions, its waters are not perennial runoff, and along its course there exist several waterbodies such as: Santa Isabel, El Rodeo, Agua, El Tule and Bombela reservoirs (State Water Commission, 2015).

The central geographic coordinates of the Zula River basin are 20° 20’ 48” north latitude and 102° 46’ 28” west longitude at an average altitude of 1750 meters above sea level, as shown in figure 2. The Ocotlan area, specifically the valley zone of the municipality is strongly influence by the Zula River, which flows through the region.

**Figure 2** Location on the Zula River basin
*Source: www.earthgoogle.com*

## Background

Rivers are one of the most visible phenomenal of the hydrological water cycle, for example: moisture that evaporates from the sea rises and is transported to the upper parts of the atmosphere where it condenses forming clouds, then, falls down later to earth in the form of liquid water (rain) or solid ice or snow (Aparicio, 2012).

Water bodies formed as part of the hydrological cycle make possible to provide to neighbouring populations with sufficient drinking water for their personal use and consumption. The availability of surface water in the Ocotlan area is almost exclusively intended for agricultural activities, with very a little portion of the remaining volume of liquid being provided for urban public urban use. Dams in the area, such La Guaracha, Xoconostle and San Vicente operate with a capacity equal to or less than 5 million m³ (CEA, 2015).

Within the entire municipality of Ocotlan, surface water availability has been declared unavailable or having a water ban status. The only notable water source is the Chapala Lake. Wastewater sanitation is approximately 165 l/sec, precipitation averages 889 mm and evaporation averages 600 mm annually *(ibid).*

**Figure 3** Overflows of the Zula River that caused flooding in the towns of the municipality of Ocotlan
*Source: www.noticierostelevisa.com*

It is a prevailing knowledge to think that a forecast has to predict exactly how much rain will fall on a particular site in order to be able to make a proper decision. It is not possible to scientifically forecast weather variations due to the chaotic behaviour of rain, the challenge is precisely to use climatological information in an accurate way to properly communicate it to the population, so that data can be used as an element of risk management in the face of the GCC requirements and recommendations (Landa *et al,* 2009).

## Historical background

The abundance of water in the Zula River basin facilitated the establishment of the Central Mexican Railroad segment between the Santiago River and Chapala Lake, a fact which impacted not only city of Ocotlan but also the surrounding towns across the region, promoting many economic activities such as agriculture, fishing, cattle raising and agriculture industries, among others (Montes de Oca, 1947).

These new forms of water management in the post-revolutionary period directly affected the waters users of the Zula River, especially farmers. The processes of reconstruction and nationalization of surface water required changes and new plans through which the civil engineers of the time were able to translate and adapt worldwide techniques of great complexity, based on a scientific and technological developments to be applied onto hydraulic infrastructure (Aboites-Aguilar, 2000).

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Industrial activities in the municipality of Ocotlan, Jalisco began in 1935 with the establishment of the Swiss company Nestle to settled to produce condensed milk, and in 1947 the North American company Celanese Mexicana, dedicated to the production of synthetic fibers, moved to the outskirts of Poncitlan (González, 1989). It was time when there was no an industrial development strategy for Jalisco and the activity expanded *"anarchically"* (McCulligh, 2020).

Later, during the Governor Juan Gil Preciado´s administration, the Guadalajara-La Barca highway was built, thus connecting the communities of Atequiza, Atotonilquillo, Poncitlan, Ocotlan, Jamay and La Barca with the purpose of promoting the industrial region of western Mexico.

During the government period of President Luis Echeverria (1970-1976) new economic incentives were introduced for the establishment of industries in less developed regions of the country (Cypher, 2013). Part of this decentralization process was the promotion of the then called Industrial Park of Jalisco (Lezama, 2004).

At first, it consisted of a 90 km long river stretch extending from the municipality of El Salto until the city of La Barca, Jalisco, an area which included the territory comprise between the Santiago River and the Guadalajara-La Barca highway, a region where electricity, railroad infrastructure and surface water services were available (Durán *et al,* 1999).

Water contamination along the Zula river is a severe problem, as shown with the following picture 4, from its source the river crosses the southern section of the downtown area of the municipal capital Arandas, where the ambient smell is imperceptible during rainy season, therefore, it is considered there a clean river; however, on the route between Arandas and the municipal capital of Atotonilco El Alto, the river passes by several tequila factories, receiving along its course wastewater and changing the water density and colour tone until it becomes a dense foamy gravy.

**Figure 4** Pedestrian bridge over the Zula River, where you can perceive the foul smell of industrial wastewater discharged from the riverbanks from hundreds of meters away
*Source: www.cronicajalisco.com*

Along its course between Atotonilco el Alto and Tototlan, the river moves away to the south of both municipalities; there, the waters of the stream carry along added wastewater and rainwater from Tototlan and towards Ocotlan, "crossing this municipality, the river presents a foul smell in the afternoons between the towns of Zula, Labor Vieja and the municipal seat" (Zúrita and Hernández, 2002).

## Methodology

The knowledge of the effects of a flood along a river allows us to obtain a reference line to take the most convenient preventive measures to implement safety protocols, in case of the presence of any extraordinary hydrological event that may cause flooding problems due to potential overflows coming from its channel and streams, we will have the necessary elements to determine the most appropriate solutions regarding a flood traffic, as well as the hydraulic behaviour of the Zula River.

The hydrological study is one the core activities of any kind, since it is the step that defines the amount of water that flows through the basin and the different sub-basins which are part of it, as well as the magnitude of the volumes that flow through the channels of the main streams is determined. For this purpose, the chosen methodology has been divided into three sections.

- Determination of the physiographic characteristics of the basin.

- Precipitation data analysis.

– Temporal distribution of rainwater for the basin.

## Physiographic characterization of the basin

In regards of the physiographic characterization of a basin, a CivilCAD software was used in addition to the topographic information from Ocotlan, where the information layers and the vector data sets provided in shape format were of great help to detail all the characteristics of the study area.

To calculate the speed of runoff generated in the watershed at the lowest site of the basin or the time it takes for the lower basin runoff to arrive, it is necessary to use the average slope of the main channel using roughness coefficients of existing streams, the hydrological complexity of the watershed, as well as the physiographic and geomorphological characteristics of the selected basin (Quillatupa, 2016).

*Basin area*

It is defined as the horizontal projection of a surface delimited by the watershed divide. Surface of an area is considered the most important physiographic parameter of a basin. It is obtained by means of planimeters or by delimitation of topographic maps, and calculated with Computer-Aided Design (CAD) systems (Caro *et al*, 2017), the resulting value for the Zula River basin was 108.90 km².

The study basin boundary was extracted from the Ocotlan F13D77 INEGI´S topographic chart, using a scale 1:20000 for a better result, as well as to counterbalance the results obtained from Landsat image. Figure 5 shows the result based on the altitudinal surface, the magenta line indicates the area between contour lines and the orange colour shows the longitudinal perimeter of the watershed.

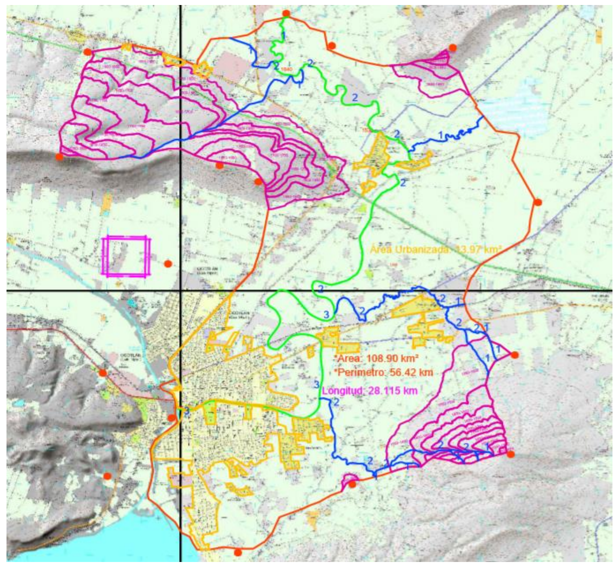



**Figure 5** Topographic charts worked in AutoCAD highlighting urbanized area and hypsometry of the watershed
*Source: National Institute of Statistics and Geography, INEGI*

*Main channel slope*

The slope of the main channel is one of the most important indicators of the degree of response for a storm. (Aparicio, 2007). To obtain the average slope of the main channel, the Taylor-Schwarz method is used to calculate the average slope of the river similar to that of a uniform channel of equal length and travel time (Campos, 1998). This is defined by the following equation:

$$S = \left( \frac{\sum_1^n li}{\sum_1^n \frac{li}{\sqrt{Si}}} \right)^2 \quad (1)$$

$$S = \left( \frac{28115}{1069733.68} \right)^2 = 0.0006907$$

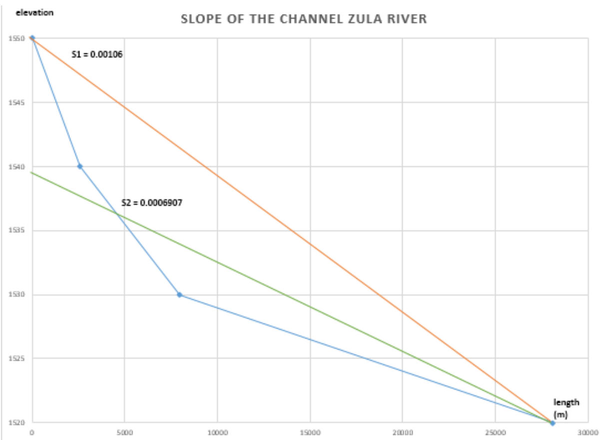
The following table and graph 1 show the lengths and slopes for each straight stretch, where runoffs were captured by the Zula River.

## Rainfall-runoff model

Where there is no hydrometric instrumentation within or very close to the basin under study, the peak discharge can be determined by applying indirect methods, based on mathematical rainfall-runoff models (Lafragua, 2003), since they originate from numerous analyses in which the relationship between the amount of water runoff in a given sub-basin and the volumes actually stored in the basin was sought.

| Elevation (masl) | Line between level curves | length (m) | slope | $\sqrt{Si}$ | $\frac{li}{\sqrt{Si}}$ |
|---|---|---|---|---|---|
| 1520-1530 | 10 | 20111 | 0.0049 | 0.02222 | 901883.6 |
| 1530-1540 | 10 | 5432 | 0.0018 | 0.0429 | 126601.7 |
| 1540-1550 | 10 | 2572 | 0.0038 | 0.06235 | 41248.33 |
| | | 28115 | | | 1069733 |

**Table 1** Slope data by segment of the Zula River, Ocotlan, Jalisco. To obtain the constant equivalent slope by the Taylor-Schwarz method
*Source: Own elaboration*




**Graphic 1** Slope of the Zula River Channel
*Source: Own elaboration*

As a first step for the creation of the hydrographs, it is necessary to consult data from the closest meteorological station closest to the study basin; in this case, El Fuerte climatological station is the only one near the basin that is still active, since Ocotlan station is out of operation. Within its monthly values, we find the summary of the last 60 years of precipitation (SMN, 2019). The method consists of determining a base precipitation height, which is associated with a duration of 1 hour and a return period of 10 years. From this, the specific precipitation height of the study basin is determined, for which the base precipitation is affected by three factors related to the duration of the storm, then the area of the basin and the return period are chosen to extrapolate the data.

Such factors were estimated after several analyses as shown in table 3, whose purpose was to establish a congruent relationship between the amount of precipitated water and the volumes of water runoff, its application is part of the effectiveness of the method so its values have been arranged in a table for practical purposes, as shown in table 2.

| For duration Storm duration (hour) | storm Recommended factor | For area Area (km²) | basin Recommended factor | For period Return period (years) | return Recommended factor |
|---|---|---|---|---|---|
| 0.50 | 0.79 | 1.00 | 1.00 | 2 | 0.67 |
| 1.00 | 1.00 | 10.00 | 0.98 | 5 | 0.88 |
| 2.00 | 1.20 | 20.00 | 0.96 | 10 | 1.00 |
| 8.00 | 1.48 | 50.00 | 0.92 | 25 | 1.15 |
| 24.00 | 1.50 | 100 | 0.88 | 50 | 1.25 |
| | | 200 | 0.82 | 100 | 1.38 |
| | | 500 | 0.70 | | |

**Table 2** Factors for adjusting the design rainfall
*Source: Regional Water Management of the Valley of Mexico*

The application of the method is very simple, but it is necessary to calculate some hydrological parameters of the basin, namely; length and slope of the main channel. On the other hand, it is also necessary to previously calculate some flood parameters, such as time of concentration (tc), excess duration time (de), lag time (tr), peak time (tp), base time (tb), unit peak flow (qp) and runoff coefficient (Ce).

As a first step to determine the peak flows, the concentration time is calculated using the Kirpich´s formula, which yields water travel time of the water from the upper area of (upstream) the basin down till the outlet point (downstream). Using a slope value of S = 0.0006907 which is exactly that of the land.

$$tc = 0.0003245 \left(\frac{lc}{S}\right)^{0.77} \quad (2)$$

$$tc = 0.0003245 \left(\frac{28115}{0.0006907}\right)^{0.77} = 14.24\ hr$$

The next step has involved the calculation of the design rainfall, associated with return periods of 2, 5, 10, 25, 50 and 100 years. Once the return periods have been assigned to the design rainfall, it is necessary to extrapolate numbers from the recorded maximum annual rainfall, since the return period designated for the analysis is rarely less than of the data. Once the design rainfall has been calculated for the proposed periods, the next activity consists of turn out the rainfall to runoff (Ce) and the unit peak flow (qp) based on the following models.

$$qp = \frac{0.555\ Ac}{tb} \quad (3)$$

$$qp = \frac{0.555 * 108.90}{32.94} = 1.836\ m^3/seg/m$$

$$Ce = \frac{Cnu*Anu}{Ac} + \frac{0.45*Iu*Au}{Ac} \quad (4)$$

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$$Ce = \frac{0.15 * 94.93}{108.90} + \frac{0.45 * 0.80 * 13.97}{108.90} = 0.1769$$

The *Cnu* and *Iu* coefficients were determined based on previous studies conducted in the Zula River basin, determining conservative values of 0.15 and 0.80 respectively for the study area. The values of the *Anu* and *Au* areas were obtained by means of INEGI´S topographic charts of the region (F13D77, Ocotlan) at a scale 1:50000 and with the support of observations made during field trips.

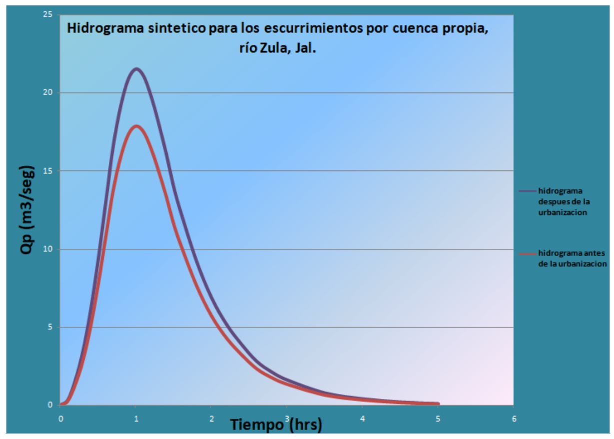
## Results

Calculations with the average monthly mean precipitation along with its standard deviation will allow the creation of a storm design and flood table, the methodology of the *rainfall-runoff* model provides calculations of storm times and flows, as well as those coefficients related to the basin area. The results are the calculation and design of a hydrograph for the basin of the municipalities of Ocotlan and Tototlan, based on different return periods, as well as the sub-basins it is comprised of and where evidence of flooding has been present.

Based on the maximum rainfall recorded in 24 hours at the climatological station El Fuerte, the one-hour maximum rainfall and a return period of ten years, this was carried out by means of the quotient adjustment factor for storm duration of one hour (1.00) and the adjustment factor associated with the storm duration of twenty-four hours (1.50), as shown in table 3 and graph 2, which is the graphic representation of the synthetic hydrograph.

<table>
<tr><th colspan="6">Zula River basin, Ocotlan, Jalisco</th></tr>
<tr><td colspan="6">Maximun rainfall in 24 hrs for a return period Tr 10 years<br>Climatological station: El Fuerte</td></tr>
<tr><td colspan="6">Pmax (Dt, Tr) = Pmax (24 hours, 10 Years) = 74.71 mm</td></tr>
<tr><td colspan="6">Adjustment factor for duration of 1 hr = 1.00<br>Adjustment factor for 24 hr duration = 1.50<br>Pmax (Dt, Tr) = Pmax (1 hour, 10 years) = (1.00/1.50) * 74.71 = 49.81 mm</td></tr>
<tr><td colspan="6">Maximum precipitation for the storm duration and 10 years return period. Storm duration is considered to be equal to the time of concentration (tc)</td></tr>
<tr><td colspan="6">Storm duration = 14.5 hr<br>Adjustment factor for storm duration = 1.49<br>Pmax (Dt, Tr) = Pmax (2 hr, 10 years) = 1.49 * 49.81 = 74. 22 mm</td></tr>
<tr><td colspan="6">Maximum precipitation for the duration of the storm and 10 years return period associated with basin area</td></tr>
<tr><td colspan="6">Basin area adjustment factor = 0.875<br>Pmax (Dt, Tr, Ac) = Pmax (2 hr, 10 yr, 29.46 km²) = 0.875 * 74.22 = 64.92 mm</td></tr>
<tr><td rowspan="2">Return Period (years)</td><td rowspan="2">Adjustment factor for Tr</td><td rowspan="2">Design rainfall (mm)</td><td rowspan="2">Excess rainfall (mm)</td><td>Peak design</td><td>Flood discharge</td></tr>
<tr><td>Calculated m³/sec</td><td>rounder m³/sec</td></tr>
<tr><td>2</td><td>0.67</td><td>43.51</td><td>7.83</td><td>14.41</td><td>14.50</td></tr>
<tr><td>5</td><td>0.88</td><td>57.15</td><td>10.29</td><td>18.93</td><td>19.00</td></tr>
<tr><td>10</td><td>1.00</td><td>64.92</td><td>11.69</td><td>21.51</td><td>22.00</td></tr>
<tr><td>25</td><td>1.10</td><td>71.43</td><td>12.86</td><td>23.66</td><td>24.00</td></tr>
<tr><td>50</td><td>1.25</td><td>81.18</td><td>14.61</td><td>26.88</td><td>27.00</td></tr>
<tr><td>100</td><td>1.38</td><td>89.62</td><td>16.13</td><td>29.68</td><td>30.00</td></tr>
</table>

**Table 2** Determination of maximum floods for different return periods Tr
*Source: Own elaboration*




**Graphic 2** Synthetic Hydrograph on the basin Zula River
*Source: Own elaboration*

## Conclusions

It is necessary to have an inventory of the natural resources in the Zula river basin, and to elaborate territorial maps corresponding to land use vegetation cover, hydrography, population density, etc. This information will be integrated by three subsystems: physical conditions, natural resources and urban settlement.

Knowledge of the soil humidity balance is important for activities such as agriculture, soil conservation and drainage, while the mapping characterization of the functional zones of the river basins yields useful technical information.

In the Zula river basin, the catchment-transport area covers 50% of its total area, which is where the watercourses, sediment materials and nutrient are found.

In regards of the natural aspects, a null slope is a predominant feature so that the response velocities are gentle and waterlogging occurs in the study area.

The peak flows for urbanization effects (before and after construction for the Zula River) were obtained based on the *rainfall-runoff* model, this methodology allowed to determine a base specific precipitation height which is associated with a storm duration of 1 hour and return period Tr based on 10 years, from this base specific design precipitation was determined, which is affected by three adjustment factors such as: duration of the storm, basin area and return period that were chosen to extrapolate the obtained data.

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**Recommendations**

It is urgent to implement a bigger and better hydraulic infrastructure plan since only the urban area of the municipality has adequate sewer construction works, the afore mentioned will allow a more pleasant environment to detonate a totally sustainable and ecological tourism, in that order of ideas it is essential to work from an environmental engineering point of viuw in order to improve water quality.

The flora and fauna of the Zula River has been diminished and survives with difficulty, due to the ecocide in the region, fishing is not practiced because of the high degree of contamination, unfortunately one of the groups most affected have been the fishermen.

In terms of the national agenda, the priority construction of the Wastewater Treatment Plant (WTP) located in the town of San Juan Chico, as well as the work of dredging, removal of sludge and aquatic weeds as part of the Integral Plan for the Sanitation and Rescue of the Santiago River basin, in order not discharge wastewater to the Zula River.

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**References**

Aboites Aguilar, L. (2000). *Optimismo Nacional: Geografía, Ingeniería Hidráulica y Política en México (1926-1976). In:* Von Mentz Brígida (coord.) Luis Aboites, María Berteley, Yolanda Montiel, 2000. Identidades, Estado Nacional y Globalidad, México, siglos XIX y XX. CIESAS. Colección Historias. México, D. F.

Aparicio Mijares F. J. (2017). *Fundamentos de Hidrología de Superficie.* Ed. LIMUSA, México. D. F.

Araujo K., et al. (2007). *Efecto de la concentración de lactosa sobre la cinética de crecimiento de Kluveromyces marxianus var. marxianus y la producción de β-D-galactosidasa.* Revista Técnica de la facultad de Ingeniería de Zulia, Vol. 30, Num. 1, Maracaibo, Ven. Available in: http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0254-07702007000100008

Caro Becerra, J. L. (2014). *Ordenamiento Urbano y Territorial visto desde el manejo de cuencas a través de un Sistema de Información Geográfica (SIG) en la cuenca El Ahogado, Jalisco.* Revista CIENCIA *ergo-sum* de la Universidad Autónoma del Estado de México, Vol. 21, Núm. 1, Pp. 55-65. Toluca, Estado de México.

Comisión Estatal del Agua (2015). *Ficha Técnica Hidrológica del Municipio de Arandas*, Guadalajara, Jalisco, México.

Comisión Nacional del Agua (2014). *Ficha Técnica Hidrológica del Municipio de Ocotlán*, Guadalajara, Jalisco, México.

Comisión Nacional del Agua, *Programa contra contingencias hidráulicas por organismos de cuenca para las principales ciudades del país (etapa 2) – Ocotlán, Jal* (2016). Gobierno de México; Available in: https://www.gob.mx/cms/uploads/attachment/file/281361/ZONA_URBANA_OCOTLAN__JAL..pdf

Cypher, James (2013). *Neodevelopmentalism vs Neoliberalism: differential evolutionary institutional structures and policy response in Brazil and Mexico*. Journal of Economic Issues, Vol. 47, Num. 2, pp. 391-399. DOI: http://doi.org/10.2753/JEI00213624470212

Duran-Juárez J.M., Hernández-García A. (2010). *Cambios en los ríos y cuencas de México en el siglo XXI: La cuenca Sabinos-Zula en Jalisco*. Revista Agricultura, Sociedad y Desarrollo. Vol. 7, Num. 1, pp. 1-16. Available in: http://www.scielo.org.mx/pdf/asd/v7n1/v7n1a1.pdf

González Corona, E. (1989). *El Salto, Industria y Urbanización de Guadalajara,* Colección: Cuadernos de Difusión Científica, Num. 15, Universidad de Guadalajara, Guadalajara, Jalisco, México.

Landa R., Magaña V., Neri C. (2008). *Agua y clima: elementos para la adaptación al cambio climático.* Secretaria de Medio Ambiente y Recursos Naturales, Centro de Ciencias de la Atmósfera, Universidad Nacional Autónoma de México UNAM, México, D. F.

Lehningher Albert L., Nelson David L., Cox Michael M. (2003). *Principios de Bioquímica.* Sexta edición Ediciones Omega, Madrid, España.

Lezama, Cecilia (2004). Percepción del Riesgo y Comportamiento Ambiental en la Industria, El Colegio de Jalisco: Guadalajara, Jalisco, México.

Luján Godínez R. (2016). *Rescate de la Laguna de Cajititlán: Acciones, avances y perspectivas*. Revista mexicana de agroecosistemas. Pp. 254-260. XV Congreso Internacional, XXI Congreso Nacional de la Academia de Ciencias Ambientales, Oaxaca, Oaxaca, México.

McCulligh C. (2020). *Alcantarilla del Progreso: Corporaciones, corrupción institucionalizada y la lucha por el río.* 1ª ed. Ediciones CICCUS, Instituto Universitario de Investigación en Estudios Latinoamericanos (IELAT) de la Universidad de Alcalá, Campina Grande: Editora da Universidade Estadual da Paraiba, Newcastle upon Tyne: Red WATERLAT-GOBACIT.

Montes de Oca, José G. (1947). *Ocotlán en el primer centenario de la aparición del señor de la Misericordia,* Ocotlán, Jalisco.

Peniche Campos S., Guzmán Arroyo M. (2009). *Estudios de la Cuenca del Río Santiago. Un enfoque multidisciplinario.* Editorial Páramo, Medios UDG de la Universidad de Guadalajara, Guadalajara, Jal. México.

Quillatupa Espejo, Y. T. (2016), *Relación precipitación, Infiltración y Escorrentía para la época de lluvia en la microcuenca Yanango-Chachamayo*. Tesis de Licenciatura por la Facultad de Ciencias Forestales y del Ambiente, Universidad Nacional del Centro del Perú, Huancayo, Perú.

Sánchez Núñez, J. M. et al (2011). *Eventos hidrometeorológicos extremos y desastres en comunidades rurales y urbanas en Motozintla, Chiapas*. Revista Mexicana de Ciencias Agrícolas, Vol. 2, Núm. Especial 2, Texcoco, Estado de México.

Servicio Meteorológico Nacional, Estación Meteorológica El Fuerte, Ocotlán, Jalisco. Available in: https://smn.conagua.gob.mx/es/informacion-climatologica-por-estado?estado=jal

Zurita Martínez F. y Adriana Hernández García (2002). *La Región Ciénega de Chápala y el Desarrollo Regional Exento de Sustentabilidad en el Manejo del Agua. Dos Casos de Estudio: Ocotlán, Una Ciudad Media; Mezcala, Una Población Rural. In:* Revista Estudios de la Ciénega, Núm. 4 junio-agosto 2002. pp. 25-45.

Article

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# Multiresidual analysis of pesticides in a soil with cacao culture, in Úrsulo Galván, Veracruz

# Análisis multiresidual de pesticidas en un suelo con cultivo de cacao, en Úrsulo Galván, Veracruz

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**Abstract**

In the world and in Mexico, very risky agricultural practices are carried out due to the irrational use of chemical products, many of these practices have as a consequence the contamination of active ingredients of agrochemicals to human beings, after ingesting the foods they consume in their life daily. Unfortunately, only developed countries restrict entry to agricultural products that do not have a certain regulation in their production cycle, an example of this is that they even ask for certifications of good agricultural practices, as well as manufacturing, they even require studies of the products that They are exported to ensure or guarantee that they comply with the norms and harvest intervals of the application of chemical products, an example of all the above is the multi-residual pesticide analyzes, which ensure that the fruit or product, as well as the soils, is found free of the main agrochemicals used for crop production. A very simple practice in the cultivation of Cacao (*Theobroma cacao* L), in the Úrsulo Galván region, would be to carry out multi-residual analyzes on the soils, as we remember that many of the active ingredients of agrochemicals are where they remain the longest, before undergo any change in its process or stop being harmful.

**Irrational use, Agrochemicals, Active ingredients, Soils**

**Resumen**

En el mundo y en México se realizan prácticas agrícolas muy riesgosas debido al uso irracional de los productos químicos, muchas de estás praxis tienen como consecuencia la contaminación de ingredientes activos de agroquímicos a los seres humanos, después de ingerir los alimentos que consumen en su vida diaria. Lamentablemente sólo los países desarrollados restringen el ingreso a los productos agrícolas que no cuentan con una determinada normativa en su ciclo de producción, ejemplo de ello es que incluso piden certificaciones de buenas prácticas agrícolas, así como de manufactura, incluso requieren estudios de los productos que se exportan para asegurar o garantizar que cumplen con las normas e intervalos de cosecha de la aplicación de productos químicos, ejemplo de todo lo anterior son los análisis multiresiduales de pesticidas, los cuales aseguran que el fruto o producto, así como los suelos, se encuentra libre de los principales agroquímicos que se utilizan para la producción de cultivos. Una práctica muy sencilla en el cultivo de Cacao (*Theobroma cacao* L), en la región de Úrsulo Galván, sería la realización de análisis multiresiduales a los suelos, pues recordemos que muchos de los ingredientes activos de agroquímicos son donde permanecen más tiempo, antes de sufrir algún cambio en su proceso o dejar de ser perjudiciales.

**Uso irracional, Agroquímicos, Ingredientes activos, Suelos**

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## Introduction

At present, irrational uses of agrochemicals can not only damage or contaminate soils, but also the environment, as well as human beings through the ingestion of food that has not respected the harvest intervals for the application. of inputs or the use of very toxic products. It is because of the above, the importance of the MEXICAN STANDARD NMX-AA-91-1987, because by increasing agricultural production, the times that should be allowed for the application of inputs are not respected. According to Ryan et al. (2008), Human health as well as the well-being of people are strongly affected by factors or lifestyle, among which is smoking, hygiene, food and physical activity, that is, everything that implies behaviors that are potentially controllable by the same human being.

Under this approach, it is necessary not only to have knowledge and experience, but also to use the most friendly products with nature, without neglecting the yield of agricultural crops and preserving the principles of sustainability (Alejo-Santiago et al. 2015).

Although the benefits of pesticides are clear and important in agricultural production, a good use and better management must be made of them, to control the dangers that can originate in the different stages or productive cycles of the crop, such as production, transport, storage or application, the latter being one of the most important due to the risks of contaminating the environment, air, water, soils, as well as food, by being left with active ingredients of the product used, causing severe effects on human health and preventing its commercialization for export (Guerrero, 2003).

An erroneous justification for all this is that due to the low yields obtained in the production cycles, an excessive and irrational use of products must be made, however that is not the case, because despite the fact that technology or resources may be needed to technify In the productive system, there are agricultural practices such as the incorporation of compost into the soil or vermicompost, which also contribute to an increase in enzymatic activity and improve its physical properties (Uribe, 2008).

Something very simple can be very difficult to understand when you do not have enough information or skills in some topics, an example of this is the use of hormones, because it has advantages such as higher quality of commercial product, lower risk of insect bites pollinators and greater vigor of the crop, but it can interact with other foliar chemicals and cause stress to the crop (Tapia-Vargas et al. 2016).

Even pesticides not only produce acute or chronic effects in the environment, but also human health, since many of them can cause alterations or modifications in the genetic material (Benitez-Leite et al. 2012). They also affect the nervous system, damaging the lungs, reproductive organs, dysfunction of the endocrine system, the immune system, birth defects, as well as cancer, additionally some cases of acute poisoning are also attached, which generate a cause of morbidity and mortality throughout the world. world, developing countries are sadly particularly susceptible due to poor regulation or enforcement of the law, a lack of values and inadequate access to information systems (Thundiyil et al. 2008).

Hence the importance of carrying out the present investigation and verifying or knowing that according to the Multiresidual analysis of pesticides, our soil is free from the presence of active ingredients and that therefore the management that has been provided is the optimal one to take care of the health of the consumer, but also to respect the flora and fauna found in this agroecosystem, called cocoa plot or cultivation.

## Objectives

Determine if the soil of the experimental cocoa plot (Theobroma cacao L), has the presence of active ingredients of agrochemicals.

## Methodology

The experimental research was carried out in the municipality of Úrsulo Galván, Ver, Mexico.

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**Location of the experimental area**

The experiment was carried out at the facilities of the National Technology of Mexico Campus Úrsulo Galván. In the parallels 19º 24´ 48.91 ”of north longitude and 96 ° 21´ 09.10” of west latitude, with an elevation of 20 meters above sea level (masl).

**Climatic characteristics**

The climatic conditions present an annual precipitation of 1,350 mm per year, with a greater amount in the months of June to September and the dry period from January to May, has an average temperature of 24 to 25 ° C with a maximum of 35 ° C and a minimum of 16 ° C, the relative humidity is 80% on average.

**Vegetative characteristics**

In this area there is a predominant vegetation consisting of induced grasslands, low deciduous forest, rain-fed and irrigated agriculture, as well as lesser presence of vegetation, from thickets dominated by legumes to boiling acahuales.

**I usually**

A soil with a clay crumb texture predominates with an acid pH of 5.5 to 5.9.

**Description of the experimental area**

The experimental area is made up of 500 $m^2$ in which the following species are distributed: cocoa, banana, Persian lemon and avocado.

The experimental plot was established since October 2016 and basically the management that is applied is as follows: one application per year of compost (cachaça waste from the La Gloria sugar mill), which consists of making four holes of 50 cm each in the soil, at a distance of 1m from each cocoa tree and add 5 kg of compost for each hole, then cover it; The second fertilization is carried out with vermicompost, repeating the previous procedure, although the amount changes, since only 3 kg tree-1 are applied, while to the foliar application 1kg of Gro-Green® or Byfolan® is supplied, accompanied by 1 lt of Polyquel® Muti and 1 lt of Poliquel® Ca, Mg, B and Mo.

Added with 1 kg of copper oxychloride® and 250 ml of Biozyme® per 200 l drum, these applications are also made twice a year, in case of detecting the presence of red spider, Abamectin® is applied and damage by some insects in the Cypermethrin® or Imidacoprit® is used on the leaf, but it is important to mention that the latter two only if they occur or manifest themselves in the culture.

For weed control, only contact or burning products (Paraquat®) are used, as it tends to be less residual than Glyphosate®, but this alternates, because although in the rainy season it is applied up to twice a year to control the weeds, the rest of the year it is maintained by plowing, leaving the grass that is cut there.

**Determination of the sampling design**

The sampling that was carried out was a five of golds due to the topological conditions of the area, where subsamples of soil or each point were taken, at a depth of 40 cm by means of the quartering technique, to make a composite sample, it was sent to be analyzed by the Agrolab® laboratory in order to determine the multiresidual analysis of pesticides.

**Results**

The results presented by the laboratory show that for at least 490 active ingredients no significant pesticide residues were detected in the analyzed sample.

This means that at least for the comparison with the minimum amounts allowed of each one of these compounds, amounts that were equal to or greater than the controls were detected.

Within the agrochemical classifications we can find the following:

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| Active ingredient | LCL Analyte (ppm) | Amount obtained in mg / kg (ppm) |
|---|---|---|
| Aldrin | 0.010 | < LCL |
| Diedrin | 0.010 | < LCL |
| BHC lindane alpha | 0.010 | < LCL |
| BHC lindane beta | 0.010 | < LCL |
| BHC lindane delta | 0.010 | < LCL |
| BHC lindane gamma | 0.010 | < LCL |
| Dimethoate | 0.010 | < LCL |
| Disulfoton | 0.010 | < LCL |
| 4.4DDD | 0.010 | < LCL |
| 4.4 DDE | 0.010 | < LCL |
| 4.4 DDT | 0.010 | < LCL |
| Endosulfan I | 0.010 | < LCL |
| Endosulfan II | 0.010 | < LCL |
| Endosulfan Sulfate | 0.010 | < LCL |
| Endrin | 0.010 | < LCL |
| Endrin aldehyde | 0.010 | < LCL |
| BHC lindane alpha | 0.010 | < LCL |
| BHC lindane beta | 0.010 | < LCL |
| BHC lindane delta | 0.010 | < LCL |
| BHC lindane gamma | 0.010 | < LCL |
| Heptachlor | 0.020 | < LCL |
| Sulfotep | 0.010 | < LCL |
| Lookx | 0.010 | < LCL |
| LCL = Lowest Calibration Level.<br>ppm = Parts per million = mg / kg | | |

**Table 1** The products that were analyzed for the classification of organochlorines are shown
*Source: Own elaboration*

| | LCL Analyte (ppm) | Amount obtained in mg / kg (ppm) |
|---|---|---|
| Parathion | 0.010 | < LCL |
| Fenitrothion | 0.010 | < LCL |
| Dimethoate | 0.010 | < LCL |
| Methidathion | 0.005 | < LCL |
| Trichlorfon | 0.010 | < LCL |
| LCL = Lowest Calibration Level.<br>ppm = Parts per million = mg / kg | | |

**Table 2** The products that were analyzed for the classification of organophosphates are shown
*Source: Own elaboration*

| Active ingredient | LCL Analyte (ppm) | Amount obtained in mg / kg (ppm) |
|---|---|---|
| Tetradiphon | 0.010 | < LCL |
| LCL = Lowest Calibration Level<br>ppm = Parts per million = mg / kg | | |

**Table 3** The products that were analyzed for the classification of organosulfurized substances are shown
*Source: Own elaboration*

| Active ingredient | LCL Analyte (ppm) | Amount obtained in mg / kg (ppm) |
|---|---|---|
| Tell me | 0.010 | < LCL |
| LCL = Lowest Calibration Level.<br>ppm = Parts per million = mg / kg | | |

**Table 4** The products that were analyzed for the**n**classification of carbamates are shown
*Source: Own elaboration*

| Active ingredient | LCL Analyte (ppm) | Amount obtained in mg / kg (ppm) |
|---|---|---|
| Amitraz * | 0.005 | < LCL |
| LCL = Lowest Calibration Level<br>ppm = Parts per million = mg / kg | | |

**Table 5** The products that were analyzed for the classification of other groups are shown
*Source: Own elaboration*

## Conclusions

It is concluded that when analyzing the results obtained, it can be said at first that this research is a small island in an oasis, because although there is not much information in the area regarding the issues of pesticide multiresiduality, what was found in allows to be the spearhead to detonate such an interesting subject.

Additionally, obtaining or verifying that the management that is being provided to the cocoa crop, at least for the particular case of the soil, is not found with a record of active ingredients for all the compounds analyzed, the above allows corroborating that we can carry out agriculture cleaner and friendlier with the environment, as well as with the organisms that inhabit it.

Although in this multiresidual analysis of pesticides the presence of any ingredient is not manifested, it will be interesting to do at least two more things; the first, to analyze the fruits of the cocoa cultivation and the second to carry out analysis of the sugarcane soils to know in what state it is or, failing that, if the presence of an active ingredient is detected and what that compound would be, to know in what conditions it is They obtain the products that supply our families' food on a daily basis and the characteristics that they possess.

Finally, it is recommended to continue carrying out research to compare the results and to be able to affirm with more argument what is presented in this work.

**References**

Alejo-Santiago, Gelacio, Luna-Esquivel, Gregorio, Sánchez-Hernández, Rufo, Salcedo-Pérez, Eduardo, García-Paredes, Juan Diego, & Jiménez-Meza, Víctor Manuel. (2015). Determination of the nitrogen requirement for habanero pepper (Capsicum chínense Jacq.). *Revista Chapingo. Serie horticultura*, *21*(3), 215-227. https://doi.org/10.5154/r.rchsh.2014.04.015

Benítez-Leite, S., Macchi, M. L., Fernández, V., Franco, D., Ferro, E. A., Mojoli, A., ... & Sales, L. (2012). Daño celular en una población infantil potencialmente expuesta a pesticidas. *Revista de la Sociedad Boliviana de Pediatría*, *51*(1), 59-69.

Guerrero, J. A. (2003). Estudio de residuos de plaguicidas en frutas y hortalizas en áreas específicas de Colombia. *Agronomía Colombiana*, *21*(3), 198-209.

Ryan, RM, Patrick, H., Deci, EL y Williams, GC (2008). Facilitar el cambio de comportamiento en salud y su mantenimiento: Intervenciones basadas en la teoría de la autodeterminación. *El psicólogo de la salud europeo*, *10* (1), 2-5.

Tapia-Vargas, Mario, Larios-Guzmán, Antonio, Díaz-Sánchez, Deisy D., Ramírez-Ojeda, Gabriela, Hernández-Pérez, Anselmo, Vidales-Fernández, Ignacio, & Guillén-Andrade, Héctor. (2016). Produccion hidropónica de chile habanero negro (Capsicum chinense Jacq.). *Revista fitotecnia mexicana*, *39*(3), 241-245. Retrieved April 23, 2021, from http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-73802016000300241&lng=es&tlng=es.

Thundiyil, JG, Stober, J., Besbelli, N. y Pronczuk, J. (2008). Intoxicación aguda por plaguicidas: una herramienta de clasificación propuesta. *Boletín de la Organización Mundial de la Salud* , *86* , 205-209.

Uribe F. (2008) Chile habanero como opción de cultivo. *Hortalizas*. http://www.hortalizas.com/uncategorized/chile-habanero- como-opcion-de-cultivo/ (November 2015).

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# Agrologistic chain redesign applied to the sheep meat sector in Hidalgo, Mexico

# Rediseño de la cadena agrologística aplicado al sector carne de ovino en Hidalgo, México

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**Abstract**

For many years the livestock sector has been a fundamental part in the development of the food industry in Mexico, being an increasingly globalized market and with ever-changing consumption trends, forces the livestock industry in this case the sheep farming subsector of the state of Hidalgo, to develop new systems for its optimal improvement and continuous competitive growth. The objective of this document is to redesign the agrologistic chain of the sheep meat sector in the state of Hidalgo, through the location and configuration of multiple facilities, in order to determine the centroids by producing and consuming zones using the center of gravity model to identify the proposed installation of a classification center or feedlot and the TIF processing center, for the optimization of the transportation of this product, both in the supply of lamb and in the demand for the carcass in the regional market of the same state.

**Sheep meat, Center of gravity, Hidalgo**

**Resumen**

Durante muchos años el sector ganadero a formado parte fundamental en el desarrollo de la industria alimentaria en México, siendo un mercado cada vez más globalizado y con tendencias cada vez más cambiantes de consumo, obliga a la industria ganadera en este caso el subsector de la ovinocultura del estado de Hidalgo, a desarrollar nuevos sistemas para su mejora óptima y su continuo crecimiento competitivo. El presente documento tiene como objetivo rediseñar la cadena agrologística del sector ovino cárnico del estado de Hidalgo, a través de la ubicación y configuración de múltiples instalaciones, con lo que se quiere determinar los centroides por zonas productoras y consumidoras mediante el modelo de centro de gravedad para identificar la propuesta de instalación de un centro de clasificación o feedlot y el centro de procesamiento TIF, para la optimización del transporte de este producto, tanto en la oferta del cordero, como en la demanda del canal en mercado regional del mismo estado.

**Carne de ovino, Centro de gravedad, Hidalgo**

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**Introduction**

For many years the livestock sector has been a fundamental part in the development of the food industry in the world; And in Mexico, it is no exception, in an increasingly globalized market with increasingly changing consumption trends, it forces the livestock industry to develop new systems for optimal improvement and continuous competitive growth.

The sheep meat industry in Mexico and in particular in the state of Hidalgo, which occupies the second national place in production (SIAP, 2019), is deeply rooted in the customs of the population, since a large percentage of its consumption is only in traditional dishes, being mostly barbecue, which represents 95%, with a per capita consumption of 510 grams (Castelán, 2015).

This sector cannot depend to a great extent on the barbecue industry, this would be too risky, since barbecue production is based on the production of maguey stalks, an increasingly scarce input.

The agrologistics chain includes supply, storage, transformation and distribution activities, which are necessary to adapt the supply of livestock products to market demand, highlighting the link between these activities, through transportation.

Faced with the change in the environment, institutions are forced to take on the challenge of competing with the application of business networks, which causes continuous collaboration between them.

The distribution of the chain in the production of lamb is very complex and includes many intermediaries as well as at the national level, in the same way the flow can be as long or very short, as the case may be.

This reduces competitiveness, since as there are no adequate conditions for a lamb to be processed directly by a producer or marketer, this does not guarantee a safe product and much less with good quality characteristics.

That is why the need to propose the redesign of the agrologistics chain of the sector, because the existing TIF (Tipo Inspección Federal, Type Federal Inspection) center is only used in part, possibly due to its poor location and poor integration of the agrologistics chain that facilitates cargo supply operations alive, until the distribution of finished products.

The products offered by a company or industry serve as an input for another network before reaching the final consumer market; Therefore, for this to be accomplished, it is important that the supply chain is well integrated.

In accordance with the above, the present research aims to redesign the agrologistics chain of the meat sheep sector in the state of Hidalgo, Mexico, through the optimal location and configuration of multiple facilities, through the evaluation of supply and distribution geospatially.

It is intended to determine the centroids by producing and consuming area, to locate the supply and distribution centers with the highest concentration of supply and demand.

In the same way, it intends to establish the macro location of the collection center (feedlot), which will be fed by the supply network, this through the center of gravity model (considering the slaughterhouse and refrigerator with TIF certification).

*Integrated logistics systems*

It is irrevocable that collaboration and integration are essential factors for the success of modern supply chains and for their improvement methodologies, processes, standards and of course technological solutions have been created. Within a supply chain, collaboration has two dimensions within the company and between different organizations, but if there is no internal collaboration, external collaboration will never be possible. The integration of a logistics chain is unimaginable if none of the organizations that collaborate with it cannot align their processes internally.

The concept of collaboration is very important for the integration of modern logistics systems or supply chains, which adds value to products and processes, and of course competitiveness to the organization.

*Model for locating multiple facilities in the supply chain*

Nowadays, thanks to various technologies, especially refrigeration systems, they allow the integration of processes within the same plant, such as: slaughter, processing and storage, the last two susceptible to having a controlled temperature environment; therefore, in the present model two links in the chain, collection and processing, will be fragmented, seeking to strategically locate each of them.

In such a way that it is very important to adequately integrate the supply chain and thus reduce costs, taking into account as a starting point the location of the main consumption and production areas.

The Center of Gravity model as a good starting point for evaluating locations in the target area. This model allows to locate multiple facilities in a supply chain to later evaluate the flow of operations through the transport model. When a company with an existing network of facilities plans a new facility, there are two conditions:

1. The facilities operate independently

2. The facilities interact jointly, in such a way that the location of units with independent operation can be managed each one as a separate facility (Krajewski, Ritzman, Malhotra, 2015).

In other words, the center of operations will be attracted to the strongest concentration of supply or demand, as a magnet is attracted to a metal.

## Methodology

This research will take as a regional market the state of Hidalgo and its different producing areas, taking as supply the production of lambs using the average weight in foot and its conversion to carcasses using the average weight of the carcass in the state, referring as demand, to the per capita consumption recorded.

For the design, as a first point an analysis of the closed internal market was carried out, in this case state, since it allows to have better control and accessibility in the production and consumption data, in this way a micro environment is created in which only it is competed, produced and bought in this geographical environment; therefore, exports and imports are omitted, imports of this meat are omitted, in order to measure this case of lamb meat, to measure the self-sufficiency or inefficiency of this product in the state of Hidalgo.

In this way, it will be possible to know the excess or deficit supply and demand, which will dictate the supply of this product or the surplus that can be used to create new products, without affecting traditional local consumption, which will allow the design of a model of network, supply and physical distribution in the supply chain.

Subsequently, a series of activities was followed, based on the Geographic Information Systems Methodology, to locate multiple facilities, as proposed by Krajewski et al., (2015). The application of this methodology recommends the geographic mapping of the study area, using satellite maps; allowing the investigation to show the localized points of the facilities.

According to Krajewski et. al (2015) “the x coordinate of the center of gravity, designated as x *, is found by multiplying each x coordinate of the points (length of the location or x coordinate in the mesh) by its load (li), adding these products (Σlixi), and then dividing by the sum of the charges (Σli). The y coordinate of the center of gravity (latitude or y coordinate on the mesh), denoted as y *, is found in the same way. The formulas are as follows ":

a) Length ($x$):

$$x^* = \frac{\sum_i l_i x_i}{\sum_i l_i}$$

b) Latitude ($y$):

$$y^* = \frac{\sum_i l_i y_i}{\sum_i l_i}$$

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The model designed was the physical supply and distribution model, based on the proposed methodologies, designed in such a way that it is capable of solving the existing gaps in the supply and distribution process, emphasizing transportation costs, including the configuration of facilities that allow to have a control of the entry of lambs and exit of finished products, which in turn create a transport plan, which allows estimating requirements, in addition to estimating the installed capacity of the necessary facilities in a certain period of time to be able to meet the demand.

Likewise, for the developed system to have an impact on the sector, it is recommended to take the model that is ideal for a more specific planning and to be able to execute these activities in the flow of operations in the supply chain of the livestock subsector of sheep farming to meat production.

In a practical way, the following points were a fundamental part for the development of the model:

1. As supply, the number of heads produced per region was taken, according to the average weight of the lambs, in the same way as demand, the number of carcasses obtained by annual per capita consumption for 2017 is taken using the average weight registered in it anus.

2. In this way, the number of trips or transport units to be used can be determined, respecting the parameters established by NOM-012-SCT-2-2014, on weights and dimensions in transport.

3. The existing TIF center has a macro location in the municipality of Cuautepec Hidalgo, with the coordinates: Longitude: -98.3267919 and Latitude: 20.0429636.

## Results

For the analysis of this research, relevant and complete information was executed that was processed to obtain the expected results within the state closed market, these being:

Market: Hidalgo State

Supply: The amount of live lamb production per municipality, interpreted in head of cattle with the average weight.

Demand: The national annual per capita consumption of lamb meat, translated into lamb carcasses, with the average weight.

It was identified that, of a total of 84 municipalities in the state of Hidalgo, 65 are capable of supplying their demand by themselves, that is, they have a production surplus, which allows knowing that the state has sufficient capacity for consumption and autonomous production, and is a strategic area in the production of lamb. For a better grouping in the state of all municipalities, zones mentioned in table 1 were created according to the Agricultural and Fisheries Information System (SIAP).

Once the surplus and deficit producing municipalities were established, the available supply and demand were generated, excluding imports and exports, as well as production destined for industry, since this product does not have an industrialized development or is very poor.

The analysis shows that in a closed market for consumption and production, the state of Hidalgo has a production surplus of 5,756 tons of lamb meat equivalent to 274,095 carcasses of 21 kilograms, which can be used for the development of new products or take advantage of that surplus as an exportable supply.

*Location of multiple facilities*

To continue with the supply chain design process, the macro location of location of the physical supply facilities was followed:

a) Collection centers

b) Feedlot.

With the grouping of municipalities by zones in the state, it is possible to generate an accumulated supply of live lambs and the demand for channels that will later allow locating each of the facilities by zone.

| Supplying Zone | Sheep meat Offer (carcass) | Demand (carcass) |
|---|---|---|
| Huasteca | 719 | 6,762 |
| Sierra | 7,558 | 5,147 |
| Valle Tulancingo | 44,504 | 10,226 |
| Región Cebadera | 137,971 | 21,951 |
| Valle del Mezquital | 137,160 | 19,530 |
| Bajío Hidalguense | 18,100 | 5,147 |
| Total | **346,012** | **68,763** |

**Table 1** Sheep meat supplying zone, offer and demand by area
*Source: Own elaboration with analyzed information*

The allocation of the macro location of the installation for each zone is based on the highest density of supply and demand as the case may be in each municipality (collection centers and distribution centers), allowing the generation of a surplus in supply.

Once the offers have been generated, the collection centers are located by zone, that is, they were located in the municipalities with the highest supply for each zone, being as follows:

| Zone | Municipality | Length | Latitude |
|---|---|---|---|
| Huasteca | Huejutla | -98.075164 | 20.460486 |
| Sierra | Meztitlan | -98.763261 | 20.595519 |
| Valle Tulancingo | Singuilucan | -98.5199 | 19.968077 |
| Región Cebadera | Apan | -98.45407 | 19.711382 |
| Valle del Mezquital | Ixmiquilpan | -99.217117 | 20.483141 |
| Bajío Hidalguense | Tecozautla | -99.632332 | 20.532635 |

**Table 2** Sheep collection centers
*Source: Own elaboration with analyzed information*

With the established demands, the distribution centers are located by zone, that is, they will be located in the municipalities with the highest demand for each region, being as follows:

| Zone | Municipality | Length | Latitude |
|---|---|---|---|
| Huasteca | Huejutla | -98.075164 | 20.460486 |
| Sierra | Tlanchinol | -98.657308 | 20.989473 |
| Valle Tulancingo | Tulancingo | -98.3691 | 20.989473 |
| Región Cebadera | Pachuca | -98.759131 | 20.101060 |
| Valle del Mezquital | Tula | -99.339563 | 20.101060 |
| Bajío Hidalguense | Huichapan | -99.650840 | 20.378667 |

**Table 3** Channel distribution centers
*Source: Own elaboration with analyzed information*

Graphically, the collection centers (blue drop) and distribution (green drop) would be represented on a map as follows:

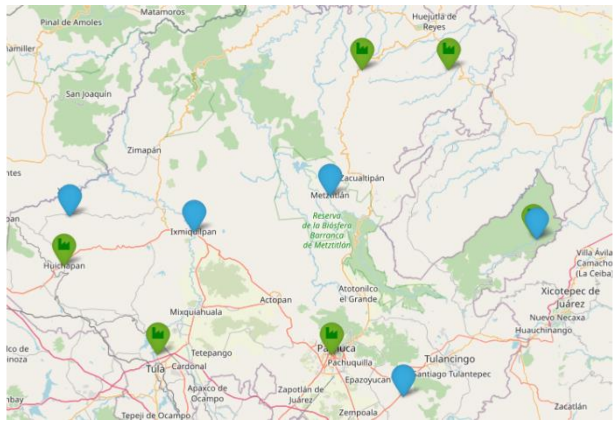


**Figure 1** Mapping of distribution and collection centers
*Source: Own elaboration with analyzed information*

To assign the macro location for the new TIF center, the demand concentrations were used and the supply concentrations were used for the feedlot. With the center of gravity model, the exact point of the macro location of the classification center was determined, identifying the area in the municipality of Santiago Tlapacoya, as shown in Table 4.

| Zone | Offer | Length | Latitude |
|---|---|---|---|
| Huasteca | 719 | -98.0751645 | 20.460486 |
| Sierra | 7,558 | -98.7632619 | 20.5955194 |
| Valle Tulancingo | 44,504 | -98.5199000 | 19.9680771 |
| Región Cebadera | 137,971 | -98.4540700 | 19.711382 |
| Valle del Mezquital | 137,160 | -99.2171174 | 20.4831412 |
| Bajío | 18,100 | -99.6323321 | 20.5326359 |
| **SantiagoTlapacoya** | | **-98.8326134** | **20.1141553** |

**Table 4** Macro location of the sorting center or feedlot
*Source: Own elaboration with analyzed information*

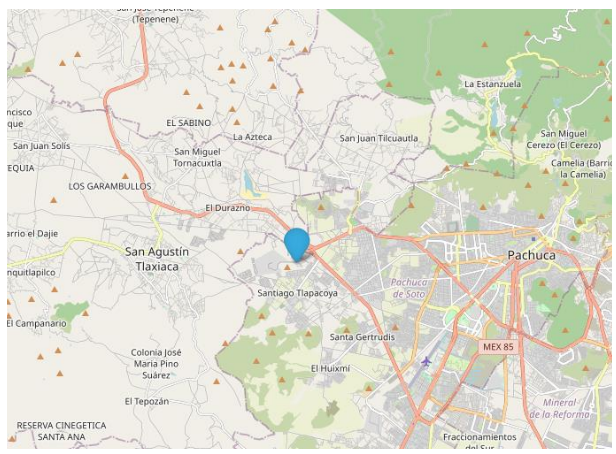


**Figure 2** Exact location of the sorting center or feedlot
*Source: Own elaboration with analyzed information*

With the location of the classification center, the new TIF center is located, in order to generate the configuration of facilities that allows evaluating the supply flow and physical distribution, the location using the center of gravity method, is as follows:

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| Zone | Demand | Length | Latitude |
|---|---|---|---|
| Huasteca | 6762 | -98.0751645 | 20.460486 |
| Sierra | 5147 | -98.6573084 | 20.9894734 |
| Valle Tulancingo | 10226 | -98.3691000 | 20.9894734 |
| Región Cebadera | 21951 | -98.7591311 | 20.1010608 |
| Valle del Mezquital | 19530 | -99.3395636 | 20.0535516 |
| Bajío | 5147 | -99.6508401 | 20.3786677 |
| **Actopan** | | **-98.8578475** | **20.342312** |

**Table 5** Macro location of the new TIF center
*Source: Own elaboration with analyzed information*

When establishing the geographical location to the corresponding TIF center, it is necessary to mention that the center of gravity generated a preliminary location, which allowed it to be located in a reference point, the exact location shows a point in a mountainous region between Metztitlán and Actopan (blue drop); Therefore, it was determined to locate the macro location in the municipality of Actopan (green drop), for three simple reasons:

a) It is the main area at the state level in production and consumption of barbecue.

b) The proximity to federal communication channels.

c) It is a point closer to the main consumption centers such as Pachuca, Tula and Tulancingo.

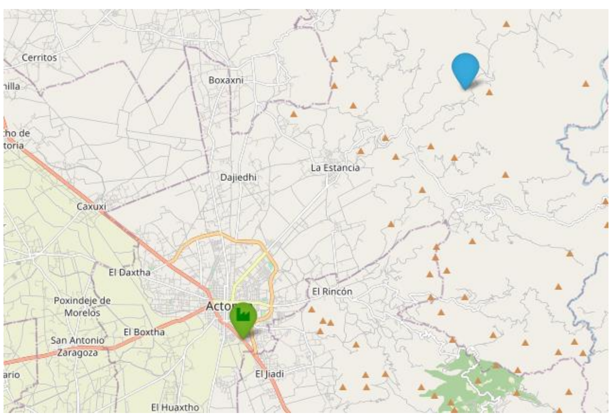


**Figure 3** Proposed location of the new TIF center
*Source: Own elaboration with analyzed information*

## Conclusions

The importance of the design of the supply chain has a high impact on improving the flow of supply and distribution, since the restructuring of the chain allows optimizing and systematizing the processes of a company and, therefore, makes it more productive.

Another important point to mention is that carrying out the design of the supply chain is a difficult task, since it is not only necessary to know in depth the market situation of the sector to which the supply chain will be designed, but also to have a high conceptual and abstraction capacity is required, so that the model includes all the fundamental elements to obtain the expected results.

The design is only the beginning in the process of improvement of the sector, it is still necessary to implement changes, once a system can be mathematically modeled that allows the entire chain to operate effectively and on the fly apply corrections since everything is perfectible, the system ideal does not exist.

From the analysis carried out, it was found that in the state it is mostly exceeded in its offer, which should look for options to carry out the distribution at the national level or, where appropriate, make the necessary openings to export, either in the channel or in specific cuts.

Main Findings:

– The configuration and location of the facilities is important for the efficiency in supply and distribution operations, which could guarantee a better service, an improvement in prices, thanks to the reduction of transport costs, through this having a better diversification of products.

– Checking the resulting data, it is important to say that this operations center is designed as a tool to reduce logistics costs and, of course, to facilitate the integration of state producers, thus partially encouraging social development.

– It is necessary to have a growth plan gradually, that is, this center must grow in installed capacity at the same time the production community is gradually integrated so as not to waste or saturate the fattening center (Feedlot), whose objective is to This is the homogenization and finishing of lambs.

– The purpose of strategically locating these facilities is to reduce distances and hours of transportation in the transport of lambs, which guarantees animal welfare that will result in a good quality of meat.

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– Thanks to the redesign of the supply chain, a production community could be generated, integrating horizontally and vertically this industry, and putting the Hidalgo sheep farming as a key activity in the development of the state.

## References

Anaya, J. (2007). Logística integral: La gestión operativa en la empresa. Madrid: ESIC.

Ballou. (2004). Logística (5.a ed.). Pearson Educación.

Castelán, J. D. (2015). Barbacoa del futuro/Entrevistado por E. Méndez.

Douglas L. (2008). Logística Internacional: Administración de la cadena de abastecimiento global. México: LIMUSA.

FND. (2015). Panorama de la carne y lana de ovino. México: Dirección general adjunta de planeación estratégica, análisis sectorial y tecnologías de la información. México

Jacobs, C. (2018). Administración de Operaciones (15.a ed.). McGraw-Hill.

Krajewsky. (2013). Administración de Operaciones (10.a ed.). Pearson Educación.

SAGARPA. (7 August 2014). SAGARPA. Retrieved from: http://www.sagarpa.gob.mx/agronegocios/Paginas/agrologistica.aspx

Servicio de Información Agroalimentaria y Pesquera (2019) Producción estatal agropecuaria-ovino. Accessed January 2019 on their website: https://www.gob.mx/siap

Trejo, B. (2011). Análisis de la cadena de valor del sector ovino en Salinas. Campus San Luis Potosí. Colegio de Postgraduados Pag. 254.

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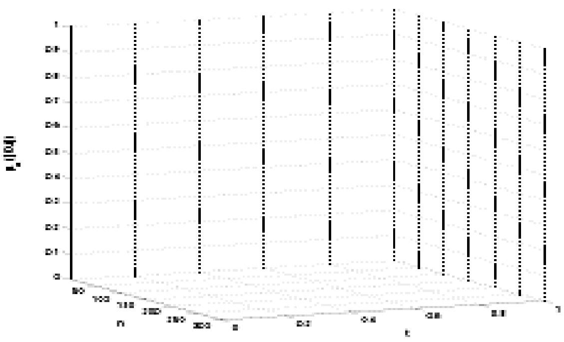

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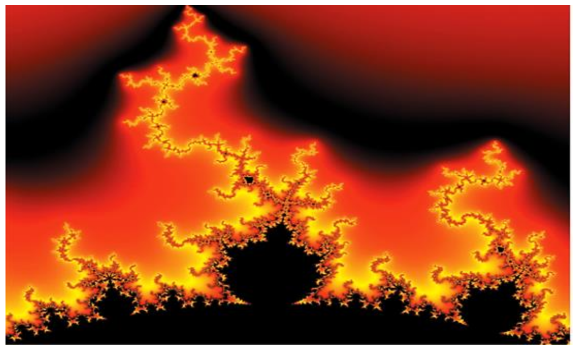

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