Handbook T-III

Productive System, Territory and Sustainability

NIÑO-GUTIÉRREZ, Naú Silverio
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ECORFAN Productive System, Territory and Sustainability

Volume III

The Handbook will offer volumes of selected contributions from researchers who contribute to the scientific dissemination activity of Universidad Autónoma de Guerrero in their areas of research in Social Sciences. In addition to having a total evaluation, in the hands of the directors of the Universidad Autónoma de Guerrero, the quality and timeliness of its chapters, each individual contribution was refereed to international standards (RESEARCH GATE, MENDELEY, GOOGLE SCHOLAR and REDIB), the Handbook thus proposes to the academic community, recent reports on new developments in the most interesting and promising areas of research in the Social Sciences.

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Productive System, Territory and Sustainability T-III
Handbooks

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Preface

In education, the role of teachers and researchers is fundamental in the formation of committed citizens, who know their environment and make decisions for the benefit of a sustainable community. Therefore, as teachers, we must reflect, within our classes, on the current social, economic, environmental, political and cultural challenges, to prepare our students to live in a world that demands new interaction forms between all the agents of society. The main objective of the handbook Productive Systems, Territory and Sustainability T-III 2021 was to enrich the scientific literature on the topics of productive systems, territory and sustainability worldwide with full adherence to the bibliography available in various digital databases such as Web of Science, Scopus, Redalyc, among others, and printed texts from which relevant information concerning basic and applied research on the topics of the handbook was taken. The method used was multimodal given that we resorted to desk research based on quantitative techniques and field work both in Mexico and Brazil where qualitative techniques such as participant observation and the application of questionnaires were applied.

The contributions, results and conclusions of each of the chapters of the handbook appear in hierarchical order: the first chapter "Nematodos gastrointestinales: respuesta inmune, desarrollo de la resistencia, nutrición y nutrigenómica en ovejas" de *Cruz Tamayo, Alvar Alonzo, Méndez Ortiz, Francisco Alejandro, Duarte Ubaldo, Ivonne Esmeralda y González Garduño, Roberto* where nutrition modulates the expression of genes involved in the immune response of GIN-infected sheep, and the application of immunogenomic analysis to infection may lead to new treatment approaches. These new phenotypic markers may identify animals resistant to gastrointestinal parasites that affect sheep production worldwide.

The second chapter "Social representation of violence in a sample of students and professors at UACAM", by *Magnolia de Rosario López Méndez*, who found and conceptually analyzed the meaning of violence and school conflicts within the teaching-learning process shared by students at the Autonomous University of Campeche (UACAM) at the undergraduate level. In order to structure an own meaning according to the idiosyncrasy of the inhabitants of Campeche, the normalization of the phenomenon and its use as a form of empowerment of teachers towards students within the teaching-learning process is demonstrated, the technique of semantic networks was used as a methodological tool to obtain the psychological meaning of six defining words.

The third chapter "Livestock system for milk production and trade: an analysis of economic and zootechnical indicators for food security and sustainability" by G*arcía Casillas, Arturo César, Prado Rebolledo, Omar Francisco and Hernández Rivera, Juan Augusto*, highlight that: Between 2008 and 2018, world bovine milk production grew at an annual rate of 1.4%. The production of dairy derivatives (e.g., cheese, butter and powdered milk, both skim and whole) continues to grow. In Mexico, cow's milk production grew at an annual rate of 2% to reach an all-time high of 12.279 million L during 2019. Although milk production continues to grow, it has not been sufficient to meet domestic market requirements, revealing productivity gaps in Mexican Dairy Production Units. These productivity gaps reflect the integral management of livestock enterprises, considering nutrition, reproduction, facilities, animal welfare and other zootechnical management practices. However, the heterogeneity of the different cow milk production systems in Mexico gives rise to particular problems of productivity, competitiveness and sustainability, all with their own associated characteristics, regions and management. Therefore, this work examines and integrates the international and national milk market, as well as the main zootechnical and economic indicators of its production, as a viable and practical proposal that allows cattlemen to participate successfully in national production in a globalized market where economies with unequal conditions are confronted. This information will serve as support to anyone involved or related to the sustainable production of dairy cows.

The fourth chapter entitled "Territory and sustainability of municipal waste management programs: The case of Piracicaba, Sao Paulo, Brazil" by *Ferraresi-De Araujo, Geraldo José and Niño-Castillo, Isaias Nau*, cites that in the municipality of Piracicaba there is a significant volume of biomass waste generated, which represents an opportunity. If not adequately treated, these residues are serious vectors of environmental degradation, both for the soil and for water catchment in the municipality and its surroundings. However, there are both legal frameworks and appropriate technologies for the reuse of such a volume of residual biomass, which can be converted into fertilizers, biogas and its use for electricity generation, fuel substitution and gas pipeline feeding from the purification of biogas into biomethane. Although this type of procedure is technically feasible, whether from digesters, motogenerators or cogenerators, the economic and financial viability of these projects varies according to the type of biomass, the economic scenario, the legal framework, public policies for the promotion of renewable energies and the efficiency of the biodigester and the motogenerator. Unfortunately, not only in the city of Piracicaba, but in Brazil as a whole, there are no policies that promote the energetic reuse of biomass residues, which means a triple loss: either because of the opportunity cost for agricultural producers, or because of the environmental impact of these residues on the surroundings and, finally, because of the non-creation of jobs, the latter being further enhanced by the economic, social, environmental and energy crisis that the country is going through, especially aggravated by the Sars-Cov-2 pandemic.

The fifth chapter "Evaluation in higher education" by *Víctor Manuel Hernández Esteban*, who explains that the evaluation process is not an independent entity from teaching, they are inseparable processes. It has been proven firsthand that the moment of greatest stress for students occurs during evaluation periods; exams generate innumerable reactions. At the same time, grades elicit comments that have common foci no matter what semester or career they are in, one hears that students are not satisfied with the grades they receive, because they feel that they are not a reflection of their actions, that they were not graded fairly, that the evaluation criteria are incomprehensible, or that professors grade arbitrarily. Therefore, the work presented is the result of a documentary research that seeks to understand the dissatisfaction of students, to provide theoretical and methodological elements to teachers to improve evaluation practices and thus, positively influence the performance of students. These chapters strengthen education in sustainability, integrating it to the functions of the universities, to strengthen a sustainable future in the young generations.

The sixth chapter "Education based on sustainability: A life in balance", by *Arely Yamile Plascencia Valerio*, mentions the concept of sustainability, its principles, foundations and main objectives; how to implement them in the daily life of society, achieving a better quality of life. Due to the high demands in manufacturing production, service provision and new technologies, the efficient implementation of sustainability has been reduced. Sustainable development has been developed but not as initially established, since one of its objectives is to maintain a balance between social, economic and environmental factors, without affecting natural resources for future generations, highlighting a factor of great importance for its realization: education, as it allows the introduction of knowledge, skills, values and principles of sustainability, from the basic level, to the graduate level.

The seventh chapter "Parasitism management in animal production system: sustainable approaches for their control" by *Vargas Magaña, Juan José and Duarte Ubaldo, Ivonne Esmeralda*, recognized that the control of parasites in a sustainable way is not an absolute concept given the different regions and productive systems of the world and, therefore, could have different levels of adoption and impact on farmers (Henrioud, 2011). Therefore, for control programs of parasites in productive systems to be sustainable, a type of management of parasite behavior is required, this management seeks to minimize the damage caused by parasites, not control them excessively (selection pressure), and carry out a preventive approach that pays close attention to changes at the ecosystem level caused by human activities and that are suited to the productive system in a particular way. The challenge is to use good animal husbandry practices and the principles of integrated parasite management (IPM) in a pragmatic way that allows sustainability in production; For this reason, the aspects proposed by Horwitz & Wilcox, (2005) must be considered, which among their recommendations include:

The eighth chapter "Geography of the COVID-19 pandemic and learnings for environmental sustainability" of *Antonio-Vieira, Elias and Niño-Castillo, Isaias Naú*, expose that, one of the measures to prevent the repetition of the spread of diseases is through the fulfillment of the Agenda 2030, of sustainable development, and global agreements, which, in short, proclaims the need to rebuild the relationship between society, and its mode of production and consumption, with nature. This process includes respect for natural ecosystems, decisions based on scientific guidelines, the adoption of sustainability measures and urban and rural resilience, which encompasses the reduction of inequalities and the solution to segregation among people, and other failures inserted in the proposal for the construction of a public policy to reduce the country's risk in the event of a repetition of pandemics. Likewise, these approaches may serve to formulate deeper reflections by other authors on the topic addressed, resulting in a path open for other research to follow in the study, promotion and development of new articles that disseminate the content of the 2030 Agenda on sustainable development and global agreements, whose implementation is attributable both to local, regional and global governance, as well as to the populations and their institutions as a whole.

The ninth article "State of art on the "El Veladero" National Park of Acapulco, Guerrero, Mexico" by *Zárate Añorve, Samuel and Niño-Castillo, Isaias Nau*, states that: "El Veladero" National Park (NP) was decreed as such on July 17, 1980. At the national level, it was one of the most recent NPs to be categorized under this federal category of protection contemplated in the Mexican Environmental Legislation. This NP has an area of 3,159 hectares. To be named as such, it had to meet a series of requirements stipulated by the Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT), which took into account its cultural and biological aspects, the capacity of researchers and academics to conduct scientific research, and the natural vocation of the land for ecotourism based on the characteristics of the natural landscape and its elements: water, soil, vegetation, climate, and hydrology, among others. El Veladero is located in the upper part of the bay of Acapulco, it is characterized by being irregular because it is mountainous, within the Natural Protected Area (NPA), there is an ecosystem of low deciduous forest that serves as a refuge for local biodiversity, which over time is increasingly decimated as a result of the anarchic activities of poaching and overpopulation in places where some five years ago there were no human settlements. This leads us to rethink its re-categorization in the immediate future.

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Content

Chapter 1 Gastrointestinal nematodes: Immune response, development of resistance, nutrition, and nutrigenomics in sheep

Capítulo 1 Nematodos gastrointestinales: Respuesta inmune, desarrollo de la resistencia, nutrición y nutrigenómica en ovinos

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Abstract

In tropical regions with warm and temperate climates, gastrointestinal nematode infections (GIN) are the main problems affecting the health and welfare of sheep. One of the strategies to control these infections is the selection of individuals genetically resistant to GIN. Such resistance implies the optimal development of the immune response, where animal nutrition plays an essential role. The objective is to describe the immune response, the development of resistance against GIN in sheep, and the use of nutrigenomics as a tool to evaluate the effect of dietary nutrients on the expression of genes involved in the immune response using a literature review. The conclusion is that for the proper functioning of the immune system, it is essential that animals have energy, protein, and micronutrients for cellular synthesis and other functions that demand a lot of energy during an infectious event.

Gastrointestinal nematodes, Immune response, Nutrigenomics, Sheep

Resumen

En regiones tropicales con climas cálidos y templados, las infecciones por nematodos gastrointestinales (NGI) son los principales problemas que afectan la salud y bienestar de los ovinos. Una de las estrategias de control de estas infecciones es la selección de individuos genéticamente resistentes a los NGI, dicha resistencia implica el óptimo desarrollo de la respuesta inmune, donde tiene un papel esencial la nutrición de los animales. El objetivo es describir la respuesta inmune, el desarrollo de la resistencia contra NGI en ovinos y el uso de la nutrigenómica como herramienta para evaluar el efecto de los nutrientes de la dieta en la expresión de genes implicados en la respuesta inmune, mediante una revisión bibliográfica. Se concluye que para el adecuado funcionamiento del sistema inmune es indispensable que los animales cuenten con nutrientes energéticos, proteicos y micronutrientes, para realizar la síntesis celular y otras funciones que demandan mucha energía durante un evento infeccioso.

Nematodos gastrointestinales, Respuesta inmune, Nutrigenómica, Ovinos

Introduction

Sheep production systems worldwide have something in common, their struggle against gastrointestinal parasites (especially nematodes), as they compromise animal health and productive performance due to stunting, weight loss, anemia, and even death of the most susceptible. Sheep can be simultaneously infected by different species of gastrointestinal nematodes (GIN). However, *Haemonchus contortus*, *Teladorsagia circumcincta*, and *Trichostrongylus colubriformis* are considered the most significant for their prevalence and pathogenicity (Ortolani et al., 2013). In the face of established anthelmintic resistance, identifying resistant animals by their immune response against GIN is one of the alternatives for infection control. The immune response is the result of a complex parasite-host interaction, where the host displaces all the defense mechanisms it possesses to eliminate the parasite. However, to survive, the parasite must not eliminate its host, which would be suicide, so the best option is to evade the immune response and establish a balance that allows it to subsist to develop chronic infections. In this balance, a factor that moves the faithful to one side or the other is the host's nutrition. Proper immune system function depends on energetic nutrients, proteins, and micronutrients, to perform cellular synthesis and other energy-intensive functions during an infectious event. The objective of this review is to describe the immune response, the development of resistance against GIN in sheep, and the use of nutrigenomics as a tool to evaluate the effect of dietary nutrients on the expression of genes involved in the immune response.

Gastrointestinal Nematodes

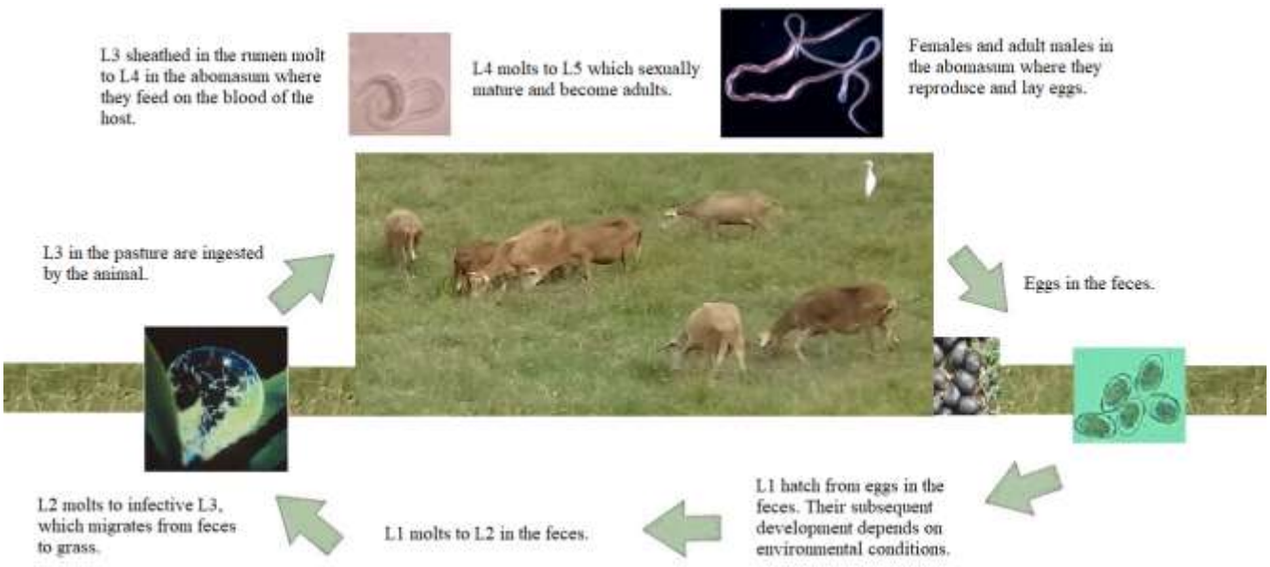
Life cycle

The life cycle of most GIN is monoxenous (it only requires one species to complete its life cycle) and comprises two phases. The first is a free-living phase (exogenous) directly influenced by the environment, and the second is a parasitic phase within the host (endogenous) influenced by the immune response generated by the infection (Urquhart et al., 1996).

The free phase begins with the elimination of eggs along with the feces. If environmental conditions are favorable (temperature between 10-35°C and more than 60% humidity), the embryonated eggs hatch, releasing the stage 1 larva (L_1), which molts to larva 2 (L_2) in 1-2 days. Both L_1 and L_2 remain in the feces feeding on organic matter and microorganisms present in the feces. The L_2 molts to L_3 (infective larva), retaining the cuticle (sheath) of the previous stage that protects it from the external environment. If the humidity conditions are suitable, the L_3 migrates towards the pasture waiting to be ingested by the host. The time elapsed between the hatching of L_1 to the appearance of L_3 is normally 5-6 days (there are variations due to the species). However, it can be delayed for several months if the temperature and humidity are not adequate (Urquhart et al., 1996).

The parasitic phase begins with the ingestion of grass with the L_3 by the host. The L_3 reaches the rumen, where they are released from the protective sheath and penetrate the mucosa of the abomasum to continue their development. After 4-5 days, the L_4 appear and after a new molt, they transform into preadults (L_5) that will sexually mature into adults that copulate and begin to produce eggs (in some species >5000 eggs per day) that are eliminated in the feces (Figure 1.1). The prepatent period is 2-3 weeks as long as the process of larval hypobiosis does not develop due to a host immune response or adverse environmental conditions (Urquhart et al., 1996; Besier et al., 2016).

Figure 1.1 Life cycle of the GIN Haemonchus contortus, showing the three main stages, host, feces, and pasture



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Immune response

The immune response that sheep develop against GIN is the result of a complex interaction between defense mechanisms that have developed because of the evolution of the parasite-host interaction. These mechanisms (innate immune system and acquired immune system) are composed of organs, tissues, cells, and molecules that elaborate a coordinated response, which has allowed the host to identify the parasite, differentiate it from its components and eliminate it. Innate immunity is based on non-specific mechanisms of immediate action, lacking memory and which are responsible for fighting the infection at its onset with great efficacy. If these mechanisms fail to eliminate the parasite, they at least keep it under control while the mechanisms of acquired immunity develop, which require more time (Karrow et al., 2013).

Innate immunity

Innate immunity is characterized by non-specific mechanisms of immediate action, does not generate immunological memory, but is associated with the acquired or memory response. The cells involved in the innate response are responsible for stopping the infection during its onset.

These mechanisms fail to regulate the infection, but various specific signals are emitted by the innate response (e.g., polymorphonuclear cells, PMN) to attract specialized T and B lymphocytes to generate effective mechanisms to regulate the parasitic infection (Karrow et al., 2014).

Likewise, innate or non-specific immunity constitutes the first line of defense against pathogens, including parasites. Hosts have various cellular and molecular mechanisms that can recognize antigens to control infection and repair damaged tissue (Alba-Hurtado and Muñoz-Guzmán, 2013). The components of the innate response can be classified as external (physical and chemical barriers) or internal (soluble molecules and PMN cells, macrophages, among others). Physical barriers such as skin and mucous membranes prevent parasite entry through the integrity of their structures and reactions such as coughing, sneezing, intestinal peristalsis, and mucous secretion. Chemical barriers comprise pH, temperature, and enzymes that act by inhibiting the development or altering the structures of the parasite. Soluble factors or molecules include the complement system, immunoglobulins, and cytokines, which promote inflammation, cellular attraction, and/or activation corresponding to acquired immunity.

The cells involved in innate immunity are macrophages, neutrophils, and NK (Natural Killer) lymphocytes, which have the function of phagocytosis, antigen presentation, effector action, and cytokine release (Collado et al., 2008). The immune response has two distinct phases: the pathogen recognition phase and the effector or response phase, as described below.

Recognition phase: Cells of the innate immune system possess receptors called "pattern recognition receptors" (PRRs). These recognize specific molecular structures (not present in the host) on pathogens called "pathogen-associated molecular patterns" (PAMPs) that are microbial activators of the immune response. The main PRRs involved in the immune response against parasites are Toll receptors (TLRs) and C-type lectin receptors (CLRs), expressed by many cell types such as mucosal surface cells, antigen-presenting cells (APCs), T and B lymphocytes, macrophages, mast cells, neutrophils, and dendritic cells. Both PPR types identify PAMPs and DAMPs, which are molecules released by tissue damage or cellular stress (McRae et al., 2015). Likewise, they induce the inflammatory response, and PAMPs trigger the release of cytokines and other molecules that function as intracellular signals of the adaptive immune response (Balic et al., 2000; Balic et al., 2002).

Effector or response phase: After the parasite is recognized, to prevent the establishment and its pathogenic action, complement activation and fixation is initiated, leading to an inflammatory response, activation of phagocytosis by neutrophils/macrophages, and activation of B lymphocytes for the initiation of the humoral response (McRae et al., 2015). The complement system consists of about 30 proteins found in plasma and are activated by one of three pathways known as classical, alternative, and lectin. During activation, there are consecutive cascade reactions that generate active products, which also has biological actions such as assembly on the surface of the microorganism of the membrane attack complex (MAC) by forming ion and water permeable channels, stimulating lysis of the foreign agent, as well as the release of proinflammatory products that attract other effector cells of the immune system such as mast cells and basophils (Vijayasarathi et al., 2015).

However, the efficacy of these mechanisms against GIN may be weak due to the cellular components of the nematodes, such as lipids, chitin, surface and excretion, and secretion products that contribute to the evasion of the immune response.

Acquired immunity

Acquired immunity develops from cell signaling of the innate response and is characterized by the response specificity and generation of immunological memory (McRae et al., 2015). For the study, the three phases of the adaptive immune response are antigen recognition, lymphocyte activation, and effector response.

Antigen recognition: APCs are a key element in the immune response, by capturing pathogen-specific peptides/proteins which they present to Major Histocompatibility Complex class II (MHC II) molecules, specialized subpopulations of T lymphocytes (cells belonging to the "Cluster of Differentiation 4+", CD4+), to attract specialized cells such as T-helper (T_H) and cytotoxic (Tc) lymphocytes (Hein et al., 2010). APCs, macrophages, PMNs, contribute to the activation of cytokines that lead to the differentiation of T_H lymphocytes into T_H1 or T_H2.

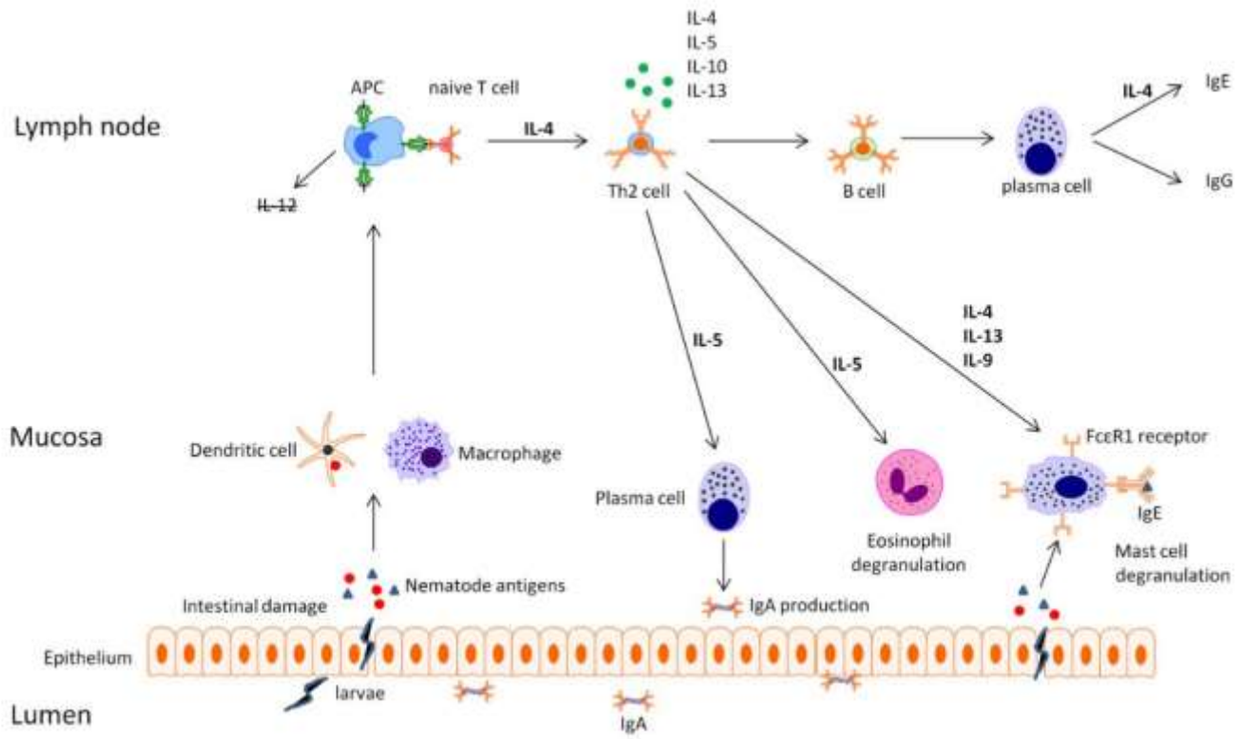
Lymphocyte activation: As specialized cells, lymphocytes are activated by specific antigens through B and T lymphocyte receptors (BCR, B cell, and TCR, T cell receptor). B lymphocytes are located in the blood and lymphoid organs and are responsible for the humoral immune response. In addition, they are characterized by synthesizing immunoglobulins (Ig) with action on antigenic receptors to send co-stimulatory signals from complement receptors or by T_H lymphocytes. The secreted Ig bind to the antigen and other cells of the immune system for pathogen neutralization (Balic et al., 2000; McRae et al., 2015).

Effector response: The T_H1 response is involved in infections caused by bacteria, protozoa, and viruses, but in recent years it is also associated with helminths, including gastrointestinal and pulmonary nematodes (Costa-Rodrigues et al., 2017). This pathway produces immune response genes such as interleukins 1, 2, and tumor necrosis factor-alpha (TFNα). Likewise, increased messenger RNA transcripts of immune system genes have been found in GIN susceptible/resistant sheep (Gill et al., 2000; Estrada-Reyes et al., 2017). The dominant immune response in GIN infections is mainly controlled by T_H2 class cytokines such as *IL-4, 5, 9, 10*, and *13* (Alba-Hurtado and Muñoz-Guzmán, 2013; McRae et al., 2015; Estrada-Reyes et al., 2017).

Development of resistance against *Haemonchus contortus* and other GIN

Resistance to nematodiasis is the ability of the individual to interact with and regulate parasite infection through the immune response (Stear et al., 1999). Numerous studies with GIN infected sheep have reported immunity against GIN associated with T_H2 cell response characterized by increased cytokines (*IL-4, 5, 13*), PMNs, mast cells, globular leukocytes, and IgA (Figure 1.2) (Shakya et al., 2009; Bowdridge et al., 2013). The small ruminants exhibit diverse mechanisms that control nematodiasis by reducing larval establishment through cell damage and adult fecundity (Rowe et al., 2008; Ortolani et al., 2013).

Figure 1.2 Immune response to GIN challenge in sheep. Image by McRae et al. (2015)



The immune response to gastrointestinal nematode challenge in sheep. Incoming larvae damage the intestinal mucosa, which leads to local inflammation and mast cell degranulation. Nematode antigens are taken up by APCs such as dendritic cells and macrophages. These cells subsequently migrate to the regional lymph nodes, where they present antigens to naïve T cells. T-cell differentiation results in the release of T_H2-associated cytokines and the recruitment of effector cells such as eosinophils and mast cells to the site of infection. It also initiates the adaptive immune response and the production of nematode-specific antibodies by plasma cells. Cytokines promoting a process are shown in bold.

Immune response against L_3

When *Haemonchus contortus* L_3 invades the abomasal mucosa, there is an increase in CD4+ T cells, TCR, and BCR during primary infection, which occurs approximately five days post-infection (Balic et al., 2000). In contrast, during repeated infections, significant recruitment can be observed in only three days (Balic et al., 2002), indicating a protective immune response. Consequently, parasitized animals show changes in the abomasal mucosa and local lymphoid tissue due to the effect of *IL-4, 5, 9, 10,* and *13* for their role in controlling nematodiasis.

IL-4 and *IL-13* are essential to maintain the T_H2 response and act as inducers of inflammatory processes. *IL-5* promotes the development of eosinophils and increases their toxicity, and indirectly is involved in the production of IgE together with *IL-9* to favor the growth of T_H lymphocytes and mast cells and potentiating the effects of *IL-4* in the production of IgE. *IL-10* has regulatory activity because it inhibits the synthesis of T_H1/T_H2 cytokines involved in inflammation. In addition, local and systemic production of IgA, IgE, and IgG is linked with the presence and control of nematodiasis (Gill et al., 1992). It is important to consider that depending on the parasitic invasion, it will be the described elements that are expressed in the animal's immune system which make it possible to describe two types of response: rapid expulsion (or immune exclusion) and delayed expulsion (Nisbet et al., 2016).

Rapid expulsion (or immune exclusion): This response occurs in animals hypersensitized by repeated larval infections over a prolonged period resulting in the expulsion of L_3 within 48 hours, e.g., before being implanted in the abomasal tissues (Balic et al., 2000). This response is characterized by a type 1 hypersensitivity reaction in the mucosa by degranulation by mast cells and globular leukocytes of proinflammatory mediators (proteases, prostaglandins, leukotrienes, histamine, and serotonin). These principally act by increasing mucosal permeability, increasing peristalsis, and facilitating the arrival of complement factors and antibodies to the intestinal lumen (Balic et al., 2002).

Eosinophils also play a relevant role in this type of response. An increase in the excretion of galectin-14 (a mediator released by eosinophils) in the mucus has been found, which promotes cell adhesion and increased viscosity, helping to prevent larval migration, and contributing to the rapid expulsion of infective larvae (Young et al., 2009).

Delayed expulsion: This response is characterized by the recruitment of eosinophils that destroy the L_3 through antibody-mediated cellular cytotoxicity, which occurs after about five days, e.g., after the establishment of larvae in the abomasal mucosa. The response is regulated by T_H2 cytokines, IgA, IgE, and IgG, which are directly involved in the expulsion of the larvae, thus decreasing the number of parasites in the abomasum (Balic et al., 2006).

Immune response against L_4

The development of L_4 in tissue is vital to continue the biological cycle of nematodes such as Haemonchus and Teladorsagia, because hypobiosis allows them to evade immune mechanisms by decreasing their metabolism (Gibbs, 1986).

Hypobiosis: Hypobiosis, also known as "tissue arrest," is a genetic faculty of the fourth stage of Haemonchus/Teladorsagia governed by chemotaxis of external and internal environmental factors of the host to modify the life cycle. During hypobiosis, there is a latency period with decreased metabolism observed in the L_4 in the abomasal mucosa where they accumulate. When there are adequate conditions for their development, they leave the mucosa in large numbers causing a very serious infection. The immunological response of the host and the presence of adult nematodes in large numbers creates overcrowding that inhibits L_4 by hypobiosis (Balic et al., 2000). An association has been observed between L_4 in hypobiosis and IgA as immunized animals developed hypobiosis, and non-immunized animals did not (Henderson and Stear, 2006).

Control of length and fecundity by IgA: Studies in *Telodorsagia circumcincta* have found that increased secretion of IgA specific for L_4 excretion/secretion products is associated with reduced L_4 length and thus decreased fecundity in the adult stage of the parasite (Ellis et al., 2014).

Galectin-11 in the control of L_4 growth: Galectins are lectin-like proteins with numerous biological functions such as regulation of immune response as lymphocyte adhesion and cytokine production. Preston et al., (2015) *in vitro* studies were the first to demonstrate that galectin-11 can bind to the pharyngeal region of L_4 of *Haemonchus contortus*, thereby inhibiting L_4 feeding, reducing its size and viability. They also found that galectin-11 affects adult nematodes, but not L_3. With these findings, new lines of research are being developed to study the mechanisms of action of galectin-11 in parasitic stages of GIN that will probably lead to vaccines (Laing et al., 2013).

Immune response against adults

The indications of resistance against adult *Haemonchus contortus* and other GIN are mainly expulsion and cell damage of adults and reduced fecundity of females.

Nematode expulsion: Expulsion of adult parasites usually happens after repeated larval infections and occurs through a non-specific mechanism of rapid rejection, or immune exclusion, or by the mechanisms of acquired immunity (Vijayasarathi et al., 2015).

Reduction in size and fecundity of females: The main manifestation of acquired immunity by the host against adult GIN is morphological change. As a result, they reduce their fecundity. The reduction in nematode size is associated with increased production of abomasal IgA specific for L_4, which correlates with a reduction in the length of adult females present and reduced fecundity, as demonstrated by a decrease in fecal egg count (Sinski et al., 1995; Stear et al., 1999). Female length is estimated to correlate between 60 and 70% with the number of eggs present in the uterus of female *Teladorsagia circumcincta* and *Trichostrongylus colubriformis* (Gruner et al., 2004). The mechanism involves eosinophils that have receptors for IgA and IgG and low-affinity receptors for IgE. Binding to IgA provides the most potent stimulus for degranulation of inflammatory mediators and cytokines such as *IL-5* that potentiate their cytotoxic effect (Balic et al., 2006).

Factors influencing resistance against GIN

Many factors influence the resistance of sheep to *Haemonchus contortus* and other GIN, some of which are host-specific, such as genetic constitution, breed, age, reproductive status, sex, and nutrition.

Genetic constitution: Genetic variation in resistance to *Haemonchus contortus* and other GIN has been confirmed in several studies, so genetic selection of naturally resistant individuals represents an option for the control of parasitic infections (Bishop, 2012; Emery et al., 2016).

Breed: Several breeds have developed natural resistance to GIN infections, such as Blackbelly, St. Croix, Florida Native, Gulf Coast Native, Thin Tail, Garole, Pelibuey, and Red Masaai (Amarante et al., 2009; Saddiqi et al., 2010; Jacobs et al., 2018; Estrada-Reyes et al., 2017). All have been studied to understand the immunological components involved and identify genes associated with resistance. Two quantitative trait loci (QTL) have been identified that have candidate genes, one on chromosome 3 near the interferon-gamma *(INFγ*) locus and another on chromosome 20 adjacent to the MHC encoding MHC II proteins involved in antigen presentation described above (Saddiqi et al., 2012; Karrow et al., 2014).

Age: Lambs aged three to six months are more susceptible to parasitic infections than adults. However, the high prevalence rate and the problem of anthelmintic resistance make it difficult to control nematodiasis in young and adults. The immunosuppression mechanisms observed in young ruminants are due to the poor response of CD4+ T lymphocytes, CD8+ T lymphocytes in lambs concerning adults (Miller and Horohov, 2006; Alba-Hurtado and Muñoz-Guzmán, 2013). In addition, it has been reported that IgA begins to be expressed from five months of age, confirming deficiencies in the T_H2 response in young animals (Shaw et al., 2013). However, in general, small ruminants are more susceptible than large ruminants to nematodiasis due to the delayed immune response observed. Therefore, it is important to select individuals with higher genetic potential against these pathogens.

Reproductive status: Temporary loss of immunity (decreased resistance) to GIN has been found in ewes close to lambing and during lactation manifested by elevated fecal egg counts that contaminate pastures, exposing newborn lambs to infection. This behavior is attributed to increases in progesterone and glucocorticoid concentrations during peripartum, nutritional factors, and lactation stress (Saddiqi et al., 2010; Emery et al., 2016).

Sex: Males are more susceptible to GIN infection than females. However, this difference does not occur before puberty. Immunity in males develops gradually from birth to adulthood, whereas resistance increases considerably after puberty in females. This susceptibility of males is attributed to androgens that modulate various aspects of host immunity (Toscano et al., 2019).

Nutrition, nutrigenomics, and epigenetics in the gene expression of the immune response against gin in sheep

Nutrition

Nutrition is vital for the development of immunity against GIN. We know that the quality of the feed influences the host's immune response and is under genetic control. Basically, feed with high protein content is essential to acquire maturity in the immune response. Under this priming, animals can meet their basic requirements for maintenance, growth, reproduction, and development of immunity. At the same time, those with poor nutrition will cause more individuals to be susceptible to GIN infection (Coop and Kyriazakis, 2001). Numerous studies have shown that protein-rich diets improve the host's ability to respond to the adverse effects of parasitic infection (Torres-Acosta et al., 2012).

GINs affect animal productivity through the reduction of voluntary intake, reduced diet digestibility, and inefficient absorption of metabolized nutrients. It has been proven that in small ruminants, as long as there is at least 80% of its metabolizable energy requirements, resistance to GIN is not compromised. On the other hand, alterations in protein metabolism are known to occur where there is a significant loss of endogenous protein in the digestive tract (Houdijk et al., 2012). There is evidence that immune system cells metabolize some non-essential amino acids (alanine and glutamine) (e.g., the host can synthesize them) to obtain energy to function. Apparently, it is an evolutionary advantage of the immune system not to depend on external sources of energy (Cruzat et al., 2018). Table 1.1 shows the nutrients and their relationship with the animal's immune function.

Table 1.1 Role of important nutrients in immune function. Adapted from Paul y Dey (2015)

Nutrient	Immunological function
Energy/lipids	Caloric malnutrition reduces cell-mediated immunity and antibody response. Changing the fatty acid composition of immune cells through diet affects phagocytosis, signaling in T lymphocytes, and antigen presentation capacity.
Protein/amino acids	Protein is necessary for the maturation of immune system organs. Specific amino acids are required for optimal immune function of gut-associated lymphoid tissue.
Zinc	It is crucial for the normal development and function of immune system cells (neutrophils, NK cells, phagocytosis, and cytokine production).
Copper	The deficiency affects the innate immune system.
Chromium	It reduces cortisol and increases immunoglobulins (especially IgM).
Iron	The deficiency involves the peripheral lymphoid system.
Selenium	They catalyze oxidation-reduction reactions and protect the host from oxidative stress.
Vitamin E	Influences the antibody-mediated neutrophil immune response. Stimulates lymphocytes.
Vitamin A	It influences the cellularity of lymphoid organs. Retinoic acid is essential for the migration of T and B lymphocytes to the intestine.
Vitamin D	It has inhibitory effects on the acquired immune response and a stimulatory effect on monocyte proliferation.
Vitamin C	Protects membranes against lipid peroxidation damage. Relieves the suppressive action of corticosteroids on neutrophils.
Vitamin B / Carotenoids	Riboflavin deficiency harms macrophage activity. It prevents oxidative damage in immune system cells. It is important in cell-mediated immunity and cytotoxicity.

In conclusion, adequate protein and energy intake, along with avoidance of micronutrient deficiencies (vitamins and minerals), are keys to strengthening animal immunity (Colditz, 2002: Paul and Dey, 2015).

Nutrigenomics

Nutrigenomics is an emerging science that studies the molecular relationships of dietary components that modify gene expression and/or structure. Thus, dietary nutrients can: a) act as ligands for the activation of transcription factors that favor receptor synthesis, b) be metabolized by primary or secondary metabolic pathways, altering the concentration of substrates or intermediates, and c) influence cell signaling. Nutrigenomics uses technologies from functional genomics (transcriptomics, proteomics, and metabolomics), bioinformatics, and molecular biology, with established nutritional and biochemical techniques (Benitez et al., 2017). We will look at some basic concepts for better understanding (Loor et al., 2015; Osorio et al., 2017).

– *Genome:* Complete set of genes of an organism or its organelles.

– *Transcriptomics:* Study of the transcriptome, e.g., the set of all RNA molecules, including mRNA, rRNA, tRNA, and non-coding RNA produced in cells, tissues, or organs.

– *Proteomics:* Study of the proteome, e.g., the whole set of proteins produced by a cell, tissue, or organ.

– *Metabolomics:* Study of chemical processes involving metabolites in a cell, tissue, or organ.

In recent years, studies have been conducted on the effect of nutrients on immune system gene expression. Ciliberti et al. (2015) investigated the effects of polyunsaturated fatty acid supplementation in the diet of dairy sheep. They evaluated gene expression in mononuclear cells, finding an overexpression of *IL-6*, an interleukin with proinflammatory and stimulatory functions for B lymphocytes in antibody production.

Elgendy et al. (2017) studied the effects of a high-zinc diet on the transcriptome of 15 sheep. The results indicate that 154 different genes were overexpressed in the transcriptome of sheep that received the treatment relative to the control. These genes were related to the immune system, various transductional signals, and processes related to membrane permeability. Elgendy et al. (2016) investigated the effect of dietary supplementation high in organic selenium on the transcriptome of 10 sheep. Blood samples were taken at the beginning and end of the experiment, from which RNA was obtained. Using qPCR, they found overexpression of T and B lymphocyte receptors, cytokine binding signals, and interleukins. The findings suggest that, in sheep, high dietary selenium supplementation leads to expression changes of several genes involved in immune system mechanisms (both acquired and innate) and provides further information on the transcriptional modulation capacity of selenium.

Epigenetics

Epigenetics studies heritable changes in DNA structure and organization that do not involve sequence changes and modulate gene expression in cells. Through epigenetic mechanisms, cells can mark which genes should be expressed, to what degree, and at what time. Moreover, epigenetic changes are not static and can be modified throughout the life of a cell. One of the main characteristics of epigenetic modifications is their reversibility (Murdoch et al., 2016).

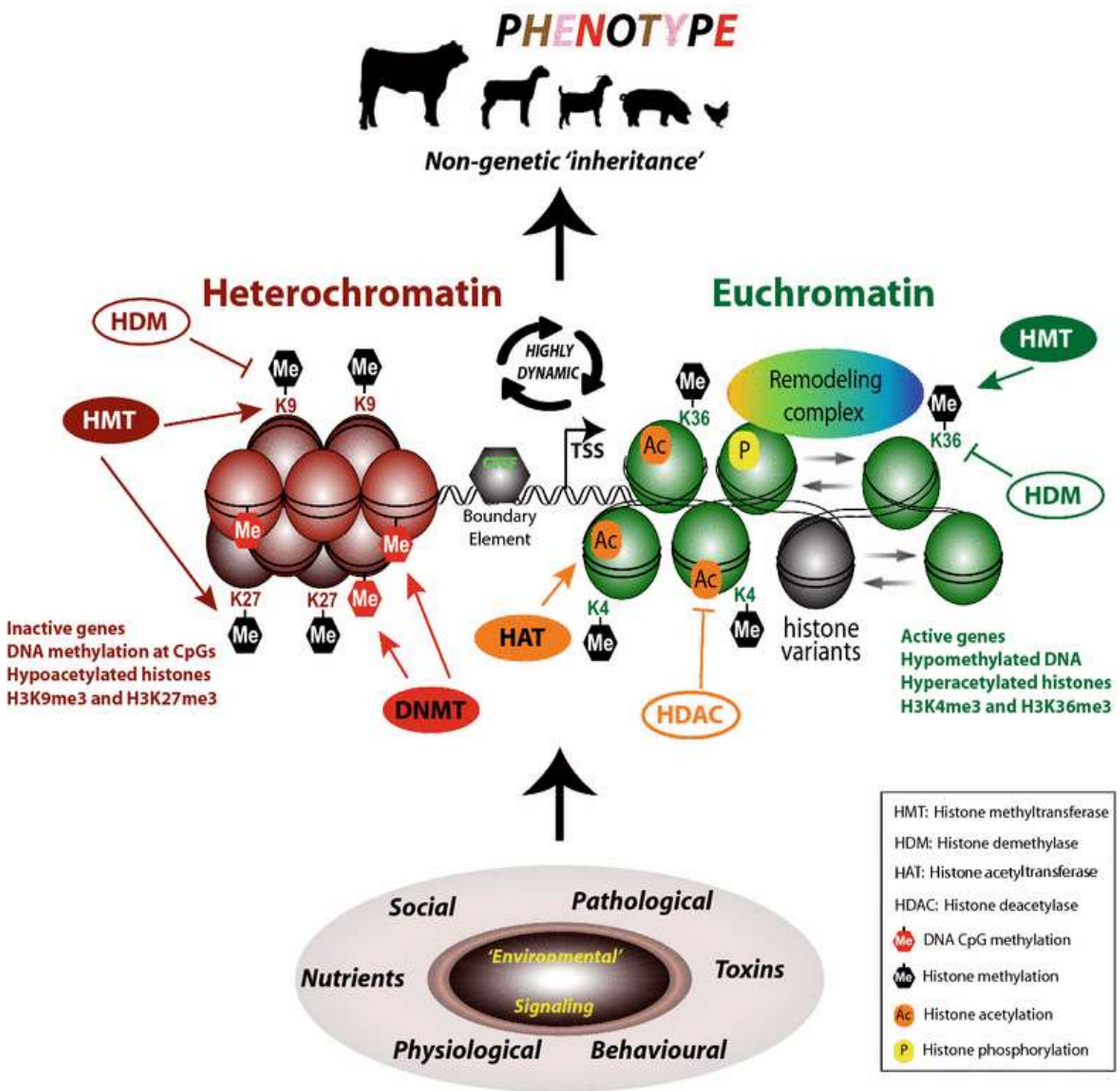
The epigenome (set of all epigenetic elements) can be influenced by environmental factors such as diet or stress and result in heritable changes in the phenotype (Figure 1.3). Epigenetic processes involve DNA methylation, chromatin remodeling, histone modifications, regulation of gene expression by non-coding microRNA, genome instability, and any other forces that modify the animal phenotype. These processes alter gene expression and can affect cell fate and phenotype plasticity as well as behavior. Several molecular mechanisms are involved, including paramutation, markers, imprinting, gene silencing, transposon silencing, X-chromosome inactivation, position effect, reprogramming, transvection, and maternal effects (Triantaphyllopoulos et al. 2016).

DNA methylation: Consists of adding a methyl group to the nucleotides (mainly cytosine) that make up the DNA sequence; these methyl groups act as recognition signals on the DNA, favoring the recruitment of proteins involved in the regulation of gene expression.

Histone modification: These proteins are involved in the compaction and organization of DNA within the cell nucleus. So specific amino acids of histones can be modified by adding acetyl, methyl, or phosphate groups, with combinations of histone modifications defining chromatin conformation and influencing gene expression.

microRNAs: These are small RNA that can silence genes by interfering directly in the transcriptional promoter regions of DNA or by binding to proteins to form transcriptional silencing complexes.

Figure 1.3 Chromatin modifications and remodeling events in livestock. Different environmental exposures trigger signaling pathways, which affect chromatin structure, thereby affecting gene expression leading to altered phenotype



Source: Image from Triantaphyllopoulos et al. (2016)

The effect of diet on epigenetic parameters in ruminants has not been explored much. Sinclair et al. (2007) investigated the effects of diet restricted in vitamin B6, vitamin B12, folic acid, and methionine in embryo donor ewes. The results indicate that the offspring of these ewes exhibited higher blood pressure, increased tendency to obesity, and insulin resistance compared to controls. They analyzed 1400 CpG sites (regions with a high concentration of cytosine and guanine pairs linked by a phosphate represented by p). They found that 4% (57 loci) were altered in more than two ewes on the restricted diet and 88% of these loci were unmethylated compared to controls. They concluded that reducing specific nutrients in the diet during the period close to fertilization could lead to alterations in DNA methylation in the offspring and modify their disease resistance.

Paibomesai et al. (2013) investigated the epigenetic mechanisms by which DNA methylation affects the adaptive immune system response (T_H1/T_H2) in peripartum female cattle. Concanavalin A was applied to CD4+ lymphocytes isolated from cows before and after parturition. Also, Concanavalin A plus dexamethasone was applied to CD4+ lymphocytes from mid-lactation cows. The response variable was interferon-gamma production (T_H1) and *IL-4* production (T_H2). The results indicate a decrease in DNA methylation in the gamma interferon promoter region and an increase in the *IL-4* promoter region. They conclude that the production of CD4+ lymphocytes is partially controlled through epigenetic modifications.

Conclusion

Nutrition modulates the expression of genes involved in the immune response of sheep infected with GIN, and the application of immunogenomic analysis to infection may lead to new treatment approaches. These new phenotypic markers can identify animals resistant to gastrointestinal parasites that affect sheep production worldwide.

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Chapter 2 Social representation of violence in a sample of students and teachers at UACAM

Capítulo 2 Representación social de la violencia en una muestra de estudiantes y docentes de la UACAM

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Abstract

The meaning of violence and school conflicts within the teaching-learning process shared by students of the Autonomous University of Campeche (UACAM) at the undergraduate level was found and conceptually analyzed, in order to structure its own meaning according to the idiosyncrasy of the folksy; The normalization of the phenomenon is demonstrated, and the use made of it as a form of empowerment of teachers towards students within the teaching-learning process, the technique of semantic networks was used as a methodological tool to obtain the psychological meaning of 6 defining words: Power, Violence, Conflict, Aggression, Teacher, Student, in a sample of students and professors from the Faculty of Engineering and Humanities. Even when symbolic violence is recognized in the data obtained, 670 students and teachers, both students and teachers, see the phenomenon as part of the hierarchical process of the institution that has rules and regulations that govern school life in all its aspects.

Social representation, Semantic networks, Violence

Resumen

Se encontró y analizó conceptualmente el significado de la violencia y los conflictos escolares dentro del proceso de enseñanza aprendizaje que comparten los estudiantes de la Universidad Autónoma de Campeche (UACAM) en el nivel de licenciatura, con el fin de estructurar un significado propio de acuerdo a la idiosincrasia del campechano; se demuestra la normalización del fenómeno, y el uso que se hace de éste como una forma de empoderamiento de los profesores hacia los alumnos dentro del proceso de enseñanza-aprendizaje, se utilizó la técnica de las redes semánticas como herramienta metodológica para obtener el significado psicológico de 6 palabras definidoras: Poder, Violencia, Conflicto, Agresión, Profesor, Alumno, en una muestra de estudiantes y profesores de la facultad de ingeniería y de Humanidades. Aun cuando se reconoce la violencia simbólica en los datos obtenidos, estudiantes 670 y docentes tanto alumnos como docentes ven el fenómeno como parte del proceso jerárquico de la institución que tiene normas y reglamentos que rigen la vida escolar en todos sus aspectos.

Representación social, Redes semánticas, Violencia

Introduction

The phenomenon of violence and its invisibility is an issue that occupies the whole society, in its different aspects and areas such as the school where not only teachers, parents and students are involved but also the whole administrative area of the different educational levels, which manifests itself in the most diverse ways. The conceptualization of the subjects themselves and the way they live with the phenomenon on a daily basis gives it a varied meaning for those who are immersed in it. It is necessary to recognize from violent acts due to the polysemy of the term through social representations, which are measured using the technique of semantic networks to obtain the psychological meaning of the concept to be measured, to the violent practices that are lived on a daily basis in all areas of life, such as institutions or the family and community environment.

The review of the genesis of this phenomenon, its implications and perverse power games and abuses that in a situation of violence can arise, become a challenge for those who are faced with studying this plot of interpersonal relationships that happen in and during the teaching-learning process and daily in their school and social environment (Fardella & Niño-Gutiérrez, 2018). Improving communication and interpersonal relationships between the collectives that make up the teaching community and the student community (Valencia, Niño-Gutiérrez & López, 2018), translates into the need to raise intervention procedures in quality education (Niño-Gutiérrez, et al., 2021), at any of its levels to prevent the phenomenon of school violence and improve coexistence in educational centers, with full respect and understanding of the Mayan culture from which much of the UACAM student body comes from.

Addressing the need for information about the phenomenon, the recognition of the problem as a daily occurrence not only in others but also in themselves, and the management of double talk by adults or by the academics or young people themselves, will raise awareness about the management of power and conflict resolution through dialogue, and if a positive use of the latter is made, it will result in personal growth of all actors involved within an institution, in this case the family or the school, as well as in our social environment.

It is important to point out that changing attitudes is not easy, it is a slow process, it can even take years, because we have been immersed in the normalization of violence practically since we are born, or attend school, on the other hand, the mass media not only magnify or minimize the problem in the best of cases, but also repeat stereotypes, prejudices or social roles and indirectly offer solutions from a patriarchal vision, modeled as "natural". The school, with the use of technology, can have a quicker impact on this process, although this also implies that it is the teachers who take the solution to this problem called school violence into their own hands.

The theory of social representation

According to Moscovici S. (1988), social representation is:

A form of specific knowledge, common sense knowledge, whose contents manifest the operation of socially characterized generative and functional processes. That is to say, it designates a form of social thought that constitutes modalities of practical thought oriented towards communication, understanding and mastery of the social, material and ideal environment, presenting specific characteristics at the level of organization of contents, mental operations and logic. In addition, three important aspects of social representations are pointed out: meaning, creativity and autonomy. Farr (1988), adds that the content of language makes it possible to "represent" an invisible or absent object, a past or a future because they have a signifying character since they always mean something to someone and when they are verbalized something appears to the listener, i.e. representations have a double function: to make the "strange" seem familiar and the invisible perceptible; since the unknown for a person is threatening when there is no category to classify them, this allows us to understand why it is so difficult for young people to recognize the violence that they may face daily in any aspect of their lives, whether as students, children, girlfriends, or pedestrians.

On the other hand, there is a correspondence between social structure and mental representations, which can be compared with the relationship established between cognitive and thought structures and social structures, since the latter result from the incorporation of the former, according to Bourdieu 1990. In this order of ideas, the categories, schemes or mental "maps", or the forms of organization of thought, i.e. the social representations are a historical product as well as the sociocultural order. Thus conceived, cognitive structures are a historical product, they have a double historicity: on the one hand, in ontogenesis (socialization process) and in phylogenesis (historical work of successive generations). That is to say, reason and its categories are not transhistorical, they lack transcendental "aprioris", in other words, the social imaginary is acquired by the person from birth and develops as he grows up being immersed in a culture and goes from the individual to the collective, coinciding thoughts and values among people. It is not surprising that beliefs are shared and continuously replicated from generation to generation, transmitting erroneous attributions.

If we consider that social determinations and circumstantial situations are interpreted differently by each receiver and the responses generated, which, although they depend on a personal history, cannot be separated from a closely predictable reaction within the social and cultural framework where they occur. Such responses crystallize in a particular form of behavior that is immersed in and reflects a form of behavior expected, recognized and accepted by the group in which the individual is inscribed. That is to say, the capacity for choice and action is determined by the limits of the social structure and by the cultural sphere to which one belongs, because individuals behave coherently within a specific social framework with its respective classification systems that refer to rules, norms, obligations and prohibitions that not only regulate individual and social behavior, but fundamentally divide reality in thought through forms and structures, and it is mainly the presence of an order, the very definition of "things" within a socially constructed reality that defines and legitimizes the nature of experiences and of existence itself.

Power and violence as a characteristic of social relations

In every human process of interaction there is always someone who "knows or claims to know" and someone who "does not know", this implies the establishment of hierarchical relationships sometimes based on the knowledge, experience or lack of knowledge and inexperience of the participants, also influenced by symbolism, age, kinship, social environment, etc. and it is from social representations that power or violence have been anchored in society.

Hernández (2000) says that power has been represented in three ways that can be differentiated, although they are not completely different: I) power understood as a capacity that is available or lacking, II) power conceived as an institution that to be legitimate presupposes the consent of those over whom it is exercised, and III) power analyzed as an inherent characteristic of the diverse social relations that take place in society. In the first point and from the school vision the teacher is the one who has the power and the student lacks it, in the case of the institution it is the school in this case the university who legitimizes the use of this power and in the third section in all social relations the use of this resource is implicit regardless of whether they are in a hierarchical relationship teacher-student or between student-student pairs, or teacher-teacher because power supposes the recognition of the other as someone who acts or is capable of acting and, being understood as a relationship, it is in operation and action in all social institutions, starting in the family, being the flow that produces the dynamic or passive movement of society. It can be said that power and violence accompany all daily interactions and that it circulates in the environment since power relations are established between dominators and dominated and oppression, authoritarianism and discrimination appear, every situation of violence is a situation of power, Foucault (1985) quoted in Hernández (2000) points out that there are social networks in which power circulates and has been modified throughout history.

In another order of ideas, violence has become an everyday occurrence to the point that only physical aggression or attacks against property are considered as such; faced with this reality, human beings have developed myths and prejudices to understand it because they lack answers to face this reality and overcome it; however, before speaking of violence, an important distinction must be made with aggression, since the term is used as a synonym without being so. Thus Warren (1989:8) defines aggression as the aspect of the will to power that implies treating other individuals as if they were simply objects to be used to achieve a goal, and aggressiveness as the type of behavior characterized more by the disposition to attack than by the tendency to avoid dangers or difficulties.

This aggressiveness is necessary to overcome the obstacles that the environment presents, in this positive case it is not an evaluative but a descriptive concept, it has an interpersonal dimension, its forms are dissimilar, motor, verbal, gestural, postural, etc. because it has an origin, a destination, a directionality and an intentionality. The point to emphasize is that it is not synonymous with violence and is not genetically determined, but is part of human behavior, it is not negative in itself but positive and necessary as a force for the physical and psychological self-affirmation of the individual and is determined by the cultural processes of socialization. Thus, aggressiveness fulfills two complementary functions: first, it constitutes an active force for the development and affirmation of the self, and second, it is an instrument to defend one's own identity from everything that threatens it.

On the other hand, the World Health Organization (2002), defines violence as: The intentional use of physical force or power, threatened or actual, against oneself, another person, or a group or community, that causes or has a high likelihood of causing injury, death, psychological harm, developmental disturbance, or deprivation, and divides violence into three general categories, according to the characteristics of those who commit the act of violence: (a) self-inflicted violence (suicidal behavior and self-injury), (b) interpersonal violence (family violence, which includes minors, intimate partners, and the elderly; as well as violence between unrelated persons), and (c) collective violence (social, political, and economic). The three points imply that violence can be found in all personal and social spheres, the characteristics of which are:

- A dynamic concept because it acquires multiple interpretations according to the spatial, temporal or disciplinary context.
- It is relational because it is a relational phenomenon that becomes a reality and is reproduced in social inter-subjectivity.
- It is a communicative act that shows human interrelation and the denial of this, that is, the denial of the other alongside oneself.
- It is a historical phenomenon because it is born with man and expresses the characteristics of the society in which it emerges.

Imberti (2001), points out that structural violence is in the foundations and is part of the scaffolding of society, which sustains and justifies it, being hierarchical, authoritarian in which there is a difference in power between men and women, with the aim of perpetuating this difference in power. Redorta (2005) also argues that structural violence originates in institutions, in the assignment of hierarchies, based on social class, race, sex, disability, sexual preference, the place that each person occupies in the family, or in the unequal distribution of legislation.

For this, gender must be taken into account, because it is constructed simultaneously with other systems of social differentiation and is perceived differently, which is equivalent to saying that men and women are socialized according to the roles assigned by society, so that we play different functions or roles in society, the place of men being the public sphere (politics, paid work, positions of power and responsibility) and that of women the private sphere (home, family, care and upbringing of children, etc.). Since gender is a social construct, which manifests itself through communication processes, it is transmitted in subtle ways during the processes of upbringing and education. Therefore, it allows us to glimpse the origins of the existing inequality between men and women, and it is necessary to review the impact of the culture that generates the mechanisms that subordinate the "submission" of women or the "control of men" through patriarchy.

In another order of ideas, the University as a school system offers education at the higher and postgraduate level; students are trained to exercise a profession, providing them with theoretical and practical tools, which have been planned in advance and are known by professors and students because they are in official documents, but they are also endowed with attitudes, myths and prejudices (hidden curriculum), whether referring to a behavior, a way of dressing, speaking or acting, these aspects are not official and depend on the actors involved, especially the teachers, however, in this development there is a whole series of factors worthy of being taken into account; Thus, to say University, is to think of an institution that regardless of the size or physical infrastructure that composes it, includes a series of elements such as a teaching staff in all its modalities as researchers, full time, part time, subject teachers, adjuncts, etc., the administrative staff at all levels, the administrative staff in all its levels, and the administrative staff in all its levels. administrative personnel at all levels, from the rector to the intendant, through the entire hierarchy of administrative positions, students, unions of both administrative staff and teachers. Student groups, etc.

Within this universe there is constant human interaction mainly as symbolic communication that acquires different connotations according to the meanings and values of those involved in the process, the direct or indirect personal treatment between the different social actors, personal relationships at all levels and of course the power relations both implicit and explicit, which are socially accepted because complex task-oriented groups require a hierarchical organization if they want to perform their tasks efficiently.

Zarzar Charur (1983) says that the teaching-learning process is an inseparable unit in which all those involved in this process learn and teach in a reciprocal manner. In this perspective teaching can be characterized as a process of interaction between people in which the subjects-teachers and students establish interrelationships through which they form a group with its own dynamism (Valencia, Niño-Gutiérrez & López, 2019). Thus, the characteristics and peculiarities of each of the participants intervene, which is why no two groups are ever the same, regardless of whether the teacher teaches the same subject and the students share characteristics of age, school level or cultural processes. Furthermore, Imberti (2001), refers to the function of the school's hidden curriculum as a reinforcement of basic norms such as coexistence or discipline that favor privileged groups and surround the nature of conflict and its uses, postulates a network of assumptions that once internalized by students establish the limits of legitimacy. As if it were a collective memory that is achieved through routine and repetition of behaviors by generations of students and teachers.

School relationships are mediated by norms, hierarchies and bureaucracy either at the institutional or classroom level, at the institutional level, the community of teachers maintains its own consultation circles such as academies and departments, they are organized and respond to an immediate superior, regarding the classes they teach in addition to the other activities they perform and that correspond to the school.

In the school, the traditional roles of teacher and student establish that the teacher knows and teaches and the student learns, this stereotype is reproduced either visibly or subtly and protects both actors from the anxiety of excessive anxiety. When it is not overcome, conflicts appear within the learning groups, rejections, or the focus on certain students to the detriment of the rest of the group. In this way the teacher and the student establish relationships with each other and it is important that they communicate and interact, that they share experiences to make learning possible by being part of a group, within the group there are internal and subtle power struggles; thus, the degree of collaboration or competence, communication, the influence of the teacher, the acceptance of the subject being studied, the willingness to change and attitudes will allow success or failure within this process, all determined by the initial commitment that is established within a classroom. As for the students, within the classroom they not only have to abide by the rules of their teacher, but also by the institutional ones, in addition to this, among pairs of students, there may be segregation towards some of them, either for being the first or the last in the classroom or for not sharing hobbies of their community.

Sús (2005) mentions that the teacher is a representative of the law, is legally vested with authority and must contribute to compliance with the rules of the institution not only in terms of coexistence but also in those of a pedagogical nature where his professionalism is based and on which his labor contract is based, and although many teachers do not like this role of being vigilant, they are responsible for maintaining discipline in a classroom and with their teachings they transmit not only knowledge, but also a series of attitudes that involve values or reasons. Traditionally, the teacher has been assigned the task of setting learning objectives, selecting methods and resources, directing work sessions, drawing conclusions and evaluating learning results, providing the opportunity for the group to participate in these stages of the teaching process (Moreno 2003). He/she is also responsible for the trust, respect and tolerance that he/she must instill in the students for a better development in the community. Therefore, the role played by the teacher in society is extremely important, because he/she is the person who imparts knowledge, values and provides a series of tools to society so that learners can be better citizens, and some of his/her functions are:

- Ethical and social function: the teacher imparts to students a series of values, and attitudes that help students to make a reference about what should or should not be done in society.
- Manager: it is necessary that the teacher seeks to manage student learning so that students use formulas that allow them to play an active and participatory role within the community.
- Technician: to help students adequately to use the technological tools that are appearing over time.
- An interdisciplinary role, allowing them to work in collaboration with other professionals with educational links.

On the other hand, a learner is a person who wants to learn in a formal way and attends school, engages in relationships with another person, in this case a teacher, who is supposed to be trained and a teaching professional. Like any person, the student comes from a family, a community environment and also has myths and prejudices about his or her role as a student. Within the school, the functions of a student are to be responsible, know how to work in a team, be able to self-direct, monitor and evaluate himself (this in the case of homework to be completed at home) in addition to possessing self-learning skills that can be useful for the rest of his life and being able to resolve conflicts that arise at all times, as this will define his adult life.

- Academic skills: these are the abilities that allow a better understanding of the subjects spoken in class, for example, reading, retentiveness, communication, etc.
- Attitude: each student has his or her study limits, however, most have the attitude and initiative to seek out new topics, those that most catch his or her attention and motivate him or her to continue learning on a daily basis. Some subjects are more flexible than others and improve the student's retentiveness and concentration. It is all about willingness and responsibility.
- Discipline: although many think that all students are disciplined, in reality this is a characteristic that only the most applied or focused students possess. Discipline is the basis for study, not only in behavior, but for the ability to store important information. Discipline and responsibility go hand in hand and this is something that all students and people in general should keep in mind throughout their lives.

The teacher-student binomial not only establishes an interpersonal, attitudinal and value relationship but is also immersed in the pedagogical process of teaching-learning where each of them learns and teaches from their cognitive position, the language they use and the use of tools, especially digital tools that have revolutionized the way students learn, however the personal factor continues to model and transmit the behaviors of both social actors.

The semantic network

People throughout their lives develop psychological structures of knowledge (cognitive structures), such as beliefs, opinions, expectations, hypotheses, theories, schemas, etc., which they use to interpret stimuli selectively and their reactions are mediated by these interpretations. Social cognitive psychologists explain perception and behavior as a reaction to the psychological meaning of the situation, mediated by the individual's cognitive functioning, an active process by virtue of which meaning is given to the world of stimuli and not by simple learning or instincts (Morales et al., 1994) cited in Vera Noriega et al. (2005). The technique of semantic networks offers an empirical means of access to the cognitive organization of knowledge. Therefore, it can provide data concerning the internal organization and interpretation of signifiers. It also indicates how the information was perceived individually in the course of the composition of social learning and the semantic network is used when we do not know or have doubts about the meaning of a community, either because of its heterogeneity or because of the generalization we want to give to the results, or because previous observations indicate that it is a controversial or polysemic concept, the stored information is organized in the form of networks, in which words, events or representations form relationships that together produce meanings (Figueroa, 1976). These meanings do not remain static, they are dynamic and susceptible to change; they can be modified by processes of identity and acculturation, which allow the individual a differential adjustment to the new group of belonging or to the same group with new social referents.

This technique is used to evaluate the psychological meaning of the concepts, understanding these as that set of concepts chosen by the memory through a reconstructive process, which allows the subjects to have a plan of actions, as well as the subjective evaluation of the events, actions or objects, thus achieving a representative network of the organization and distance of the information obtained at the level of semantic memory and thus the meaning of a concept Valdez (2005). The concepts obtained can be of the most diverse nature because they can refer to specific characteristics of the concept, functions, logical relationships, places, or affectivities of this, which allow us to have a clear idea about the representation that we have of the information in the memory and that refers to the meaning that a particular concept has. Due to the semantic richness of the Spanish language and the multiple regionalisms or idioms that are used in the Yucatecan peninsula (some expressions in Mayan) the networks can be highly complex or simple with many meanings that mean the same, it can also have terms that are conceptually opposed but that people use them as synonyms, likewise the degree of schooling affects when applied to young people or adults, precisely because of the experience and cultural background of the students and in the case of young people we obtain terms that are used for a certain generation and then disappear.

Methodology to be developed

Population: teachers and students of the Faculty of Engineering and the Faculty of Humanities of the UACAM, because it is necessary to consider that they bring together the bulk of the population of men in the first case and women in the second. The total number of teachers in these two faculties is 112: of these, 69 are men and 43 are women. The total number of students is 1349 subjects and a random process was used to select subjects according to the different groups that exist in the faculties.

Faculty of Engineering divided into 4 undergraduate programs: Civil Engineering, Computer Systems, Mechanical and Electronic Engineering with a total of 626 students of which 515 are male and 111 are female and 63 teachers between full time, part time and subject teachers, whose ages fluctuate between 28 and 57 years old.

Faculty of Humanities divided into three undergraduate programs: History, Literature and Psychology, with a total of 723 students, of which 168 are male and 555 are female, and 52 full-time, part-time and subject teachers. The ages of these teachers vary between 32 and 45 years old, in this case there are teachers with older age, but they did not want to participate.

Sample

Teachers: Humanities: 53 teachers: participants: 12; 7 men and 5 women.

Engineering: 59 teachers: participants: 39; 30 males and 9 females in total we worked with 40% of the teaching population, the remaining 60% of the teachers, did not return the questionnaire, returned it with an incomplete filling or did not want to participate.

Students: A random sample of 160 students was used, that is, 12% of the population, which in absolute numbers corresponds to 1,349 students. Although it is a small sample, it is representative of the selected population since it corresponds to seven bachelor's degrees, four in engineering and three in humanities.

Technique. Natural Semantic Networks by Figueroa Nazuno J. and Valdez Medina, (2005).

Instrument: Questionnaire see (annex #1) with 6 defining words or stimulus: Power, Violence, Conflict, Aggression, Teacher and Student that had to be solved by students and teachers.

Participants:

To begin, the subjects were informed that they should remain quiet and not speak, concentrating on the task. Upon hearing the signal, they will begin to write and at the end of each word the subject must remove and turn over the answer sheet and wait for the others to finish, which will take a maximum of one minute. They are informed that it is desirable to complete all ten lines, but it is not always possible. When the ten words are finished or when there are no more words to write, the person should remove the booklet or sheet and wait to continue with the task. In a second moment, people are asked to look at the booklet and order or rank the words, placing the number one to those they perceive as closest to the meaning of the word or concept and it will be worth 10 points, 2, 9 points and so on until ten or until the number of words they have been able to associate. It is suggested to emphasize in the instructions that pronouns, articles and articulations should be avoided, using nouns, adjectives, verbs or combinations of up to three words, but cannot use phrases or sentences.

This instrument allows obtaining four values to analyze the information provided by the subjects.

J-value. It serves to define the stimulus and results from the sum total of the defining words generated by the subjects and indicates the semantic richness of the network.

M value - This indicates the semantic weight obtained for each of the defining words obtained and is obtained by multiplying the frequency of occurrence by the hierarchy obtained for each of the words. For example, the word that the subject assigns the category of 1 is worth 10 points, number 2, 9 points, and so on until reaching No. 10, which is equivalent to 1 point.

FMG value. This value is obtained for all the defining words through a rule of three, the word with the largest M value will represent 100%, this value is an indicator in terms of percentage, of the semantic distance between the different defining words that made up the SAM set.

SAM set. Indicates which were the defining words that make up the central nucleus of the semantic network. In this case, 15 words were used, according to Bravo 1991, mentioned in Valdez (2005), as being more representative of the meaning of a concept.

Procedure: The questionnaires for the teachers were sent via official letter to the directors of the two faculties and the instructions were written on a sheet attached to the instrument; the coordinators of the faculties gave them the instruments and once they were completed, they were returned to the researcher via official letter.

This process took approximately two weeks, due to the fact that the subject teachers do not come every day to teach classes; likewise, permission was requested from the teachers to apply the questionnaires in the classroom with the students selected to participate in the study. Once the instruments were collected, a database was created in Excel and the data obtained were analyzed.

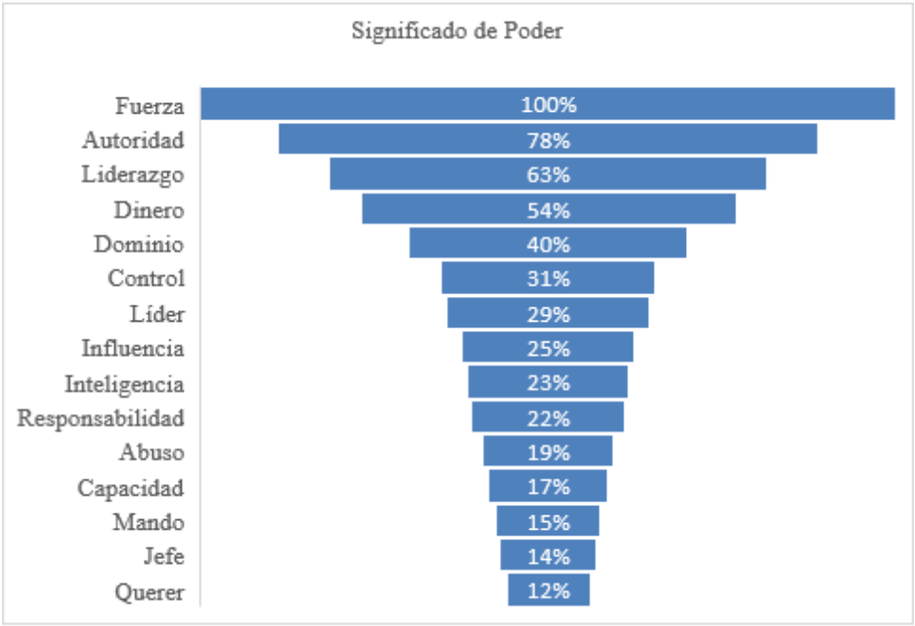
Results

For each questionnaire a total of 60 defining words were obtained, according to the valid sample of 160 participants, a total of 9600 words were analyzed for the students and 3060 for the teachers, once the total number of words was obtained, a synonymy was made (we searched and found the words that had the same meaning although different expressions), Many of them were synonyms, however, it was also observed that words are used to express the same meaning of a certain word, without being so, even with contradictory expressions, this is part of the richness of the Spanish language and the personal form of expression of each individual. Likewise, local expressions were obtained that have a meaning for the sample, but not for another type of population outside the context of the Yucatecan peninsula; an example is the word "cúlero" which will be analyzed in the item corresponding to schooling. In general, both students and teachers share 70% of the expressions about the definitions we requested, this was independent of the degree and level of studies, ranging from undergraduate to graduate studies in the case of teachers.

A first analysis was made, in a hierarchical way by students of the two faculties, as was done with teachers, then the general and generic analysis was made and the 15 categories obtained by the word stimulus and a graph that represents the psychological richness of the network in terms of words and percentages that mostly fluctuate between 12 and 100%, divided by students and teachers which are shown below.

Results obtained by students:

Graph 2.1 Semantic categories for the word Power



Source: Own Elaboration based on the results obtained

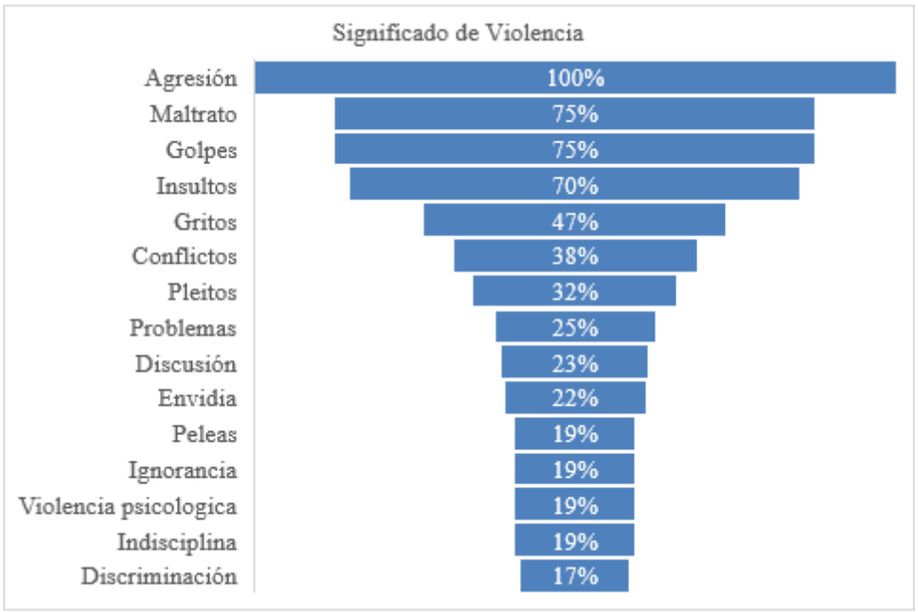
1. Power

15 representative semantic categories were obtained and reduced to 348 J-value words, observing an amplitude of variation of the percentages from 12 to 100% and indicating the richness of the network, as well as the psychological meaning of the same, according to the social perception of the young people in the definers that make up the core of the network. positive characteristics of the stimulus word power are obtained, such as authority, leadership, leader, responsibility, capacity, and data associated with power are obtained, such as force, money, influence, dominion, control, abuse, boss, which denote the negative characteristic of this stimulus, the word intelligence, apparently out of context, however, indicates the personal characteristic that the person who holds this power must have, and the category want, suggests that the students, being in formation, do not yet have this element in their personal life. Besides showing the totality of the semantic network shared and managed by the students of two faculties of the UACAM.

2. Violence

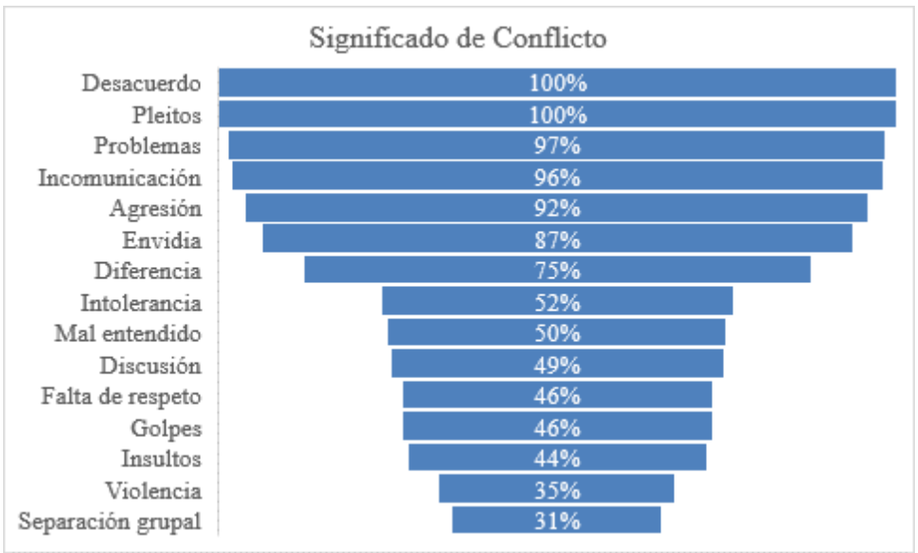
Violence is understood as aggression in a first term in this case, both terms are used indistinctly without being synonyms and this implies that the magnitude of the problem is not established, the different manifestations of the same are also observed, especially those related to physical and psychological violence, the category of conflict barely appears with 38% which implies that this does not necessarily have to be present and the dialogue problems that can occur in a relationship between two people or within a group for violence to occur, regardless of hierarchies. The outstanding point is that the category Indiscipline appears as a synonym for violence, without being able to determine whether this category is a cause or a consequence of violence.

Graph 2.2 Semantic categories for the word Violence



Source: Own Elaboration

Graph 2.3 Semantic categories for the word Conflict

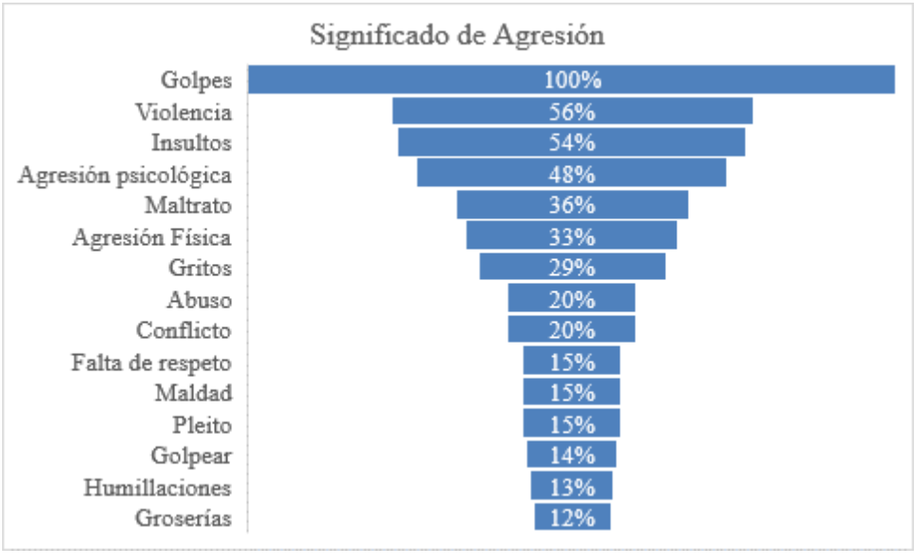


Source: Own Elaboration

3. Conflict

According to Pallares cited in Jares (2001), the categories of disagreement and quarrels obtained 100%, problems and lack of communication obtained 97% and 96% respectively, four categories scored very high and this would be the positive vision of conflict since they can be overcome through dialogue between people and five categories were also obtained corresponding to the manifestations of violence in their negative vision, although conflict and violence are not synonyms strictly speaking, the social perception of the young people gives a specific weight to this normalized and culturally accepted tendency, being students, the category of group separation arises, which could be due to how they perceive their school group with respect to the other groups of the same degree or of other careers.

Graph 2.4 Semantic categories for the word Aggression



Source: Own Elaboration

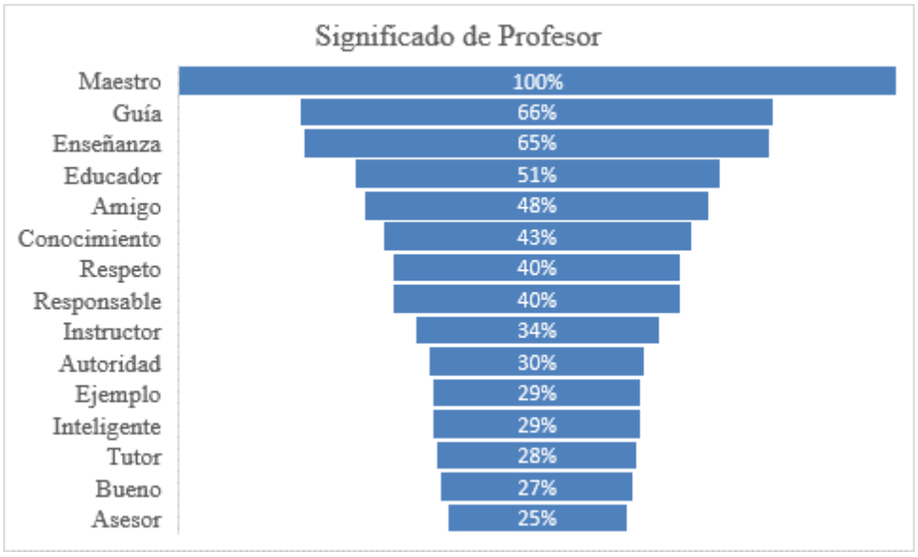
4. Aggression

What stands out in this graph is that the categories obtained correspond to blows with 100%, the category violence with 56% and the different manifestations of violence fluctuate from 54 to 12%, whether physical, psychological or emotional, as well as the deterioration in face-to-face relationships, if taken from the strict theoretical aspect, however, in this case, it could be explained as something "natural" because it is an accepted behavior in the cultural environment surrounding young people, However, in this case, it could be explained as something "natural" because it is an accepted behavior in the cultural environment that surrounds the young people, in accordance with the patriarchal system in which the society of Campeche is found.

5. Teacher

The first category that appears is teacher with 100% and guide with 66%, which implies the importance of the teacher in the classroom, and in the case of the humanities students 6 synonyms were found referring to the figure and the traditional perception generalized by society of what a teacher is, in addition personal qualities such as responsible, intelligent, knowledge, wisdom, or corrupt, etc., are observed, it is interesting that the category friend only appears in the responses of engineering students in 65% and at the same time the category of cúlero, (bad vibe, cabrón, jodón, ojete, corrupto) appears, this word is widely used in the yucatecan peninsula and is practically a regionalism, and it is a seemingly contradictory term with a negative connotation, being a friend or a "cúlero" varies according to the behavior of the teacher, especially when evaluations are applied, whether it is work or exams, that is, if the teacher helps you, he/she is being a "friend" otherwise he/she is a "cúlero". This last category did not appear in the responses of the humanities students, which implies that it is part of the male perception that corresponds to the interpersonal treatment established between males. Only three categories referred to the teaching-learning process and they were teaching, educator and knowledge, with the understanding that this is the role of the teacher in the classroom.

Graph 2.5 Semantic categories for the word teacher

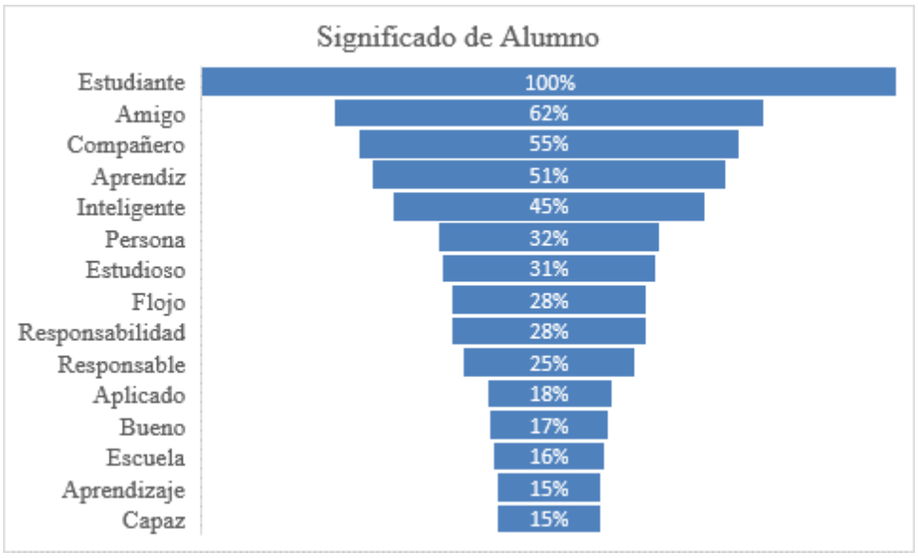


Source: Own Elaboration

6. Student

It is observed the characteristics that describe the students from their position, there are opposite value categories such as studious and lazy, what stands out is that the students consider themselves as people with virtues and defects and not a number of enrollment, it is also observed that they consider themselves as apprentices, as young people in training in 50% this category is more referred to the type of practices (manual, field, observational, research etc.) that they perform throughout the career as social service, professional practices or volunteering and not to the theoretical term since they look at themselves from a traditional vision.

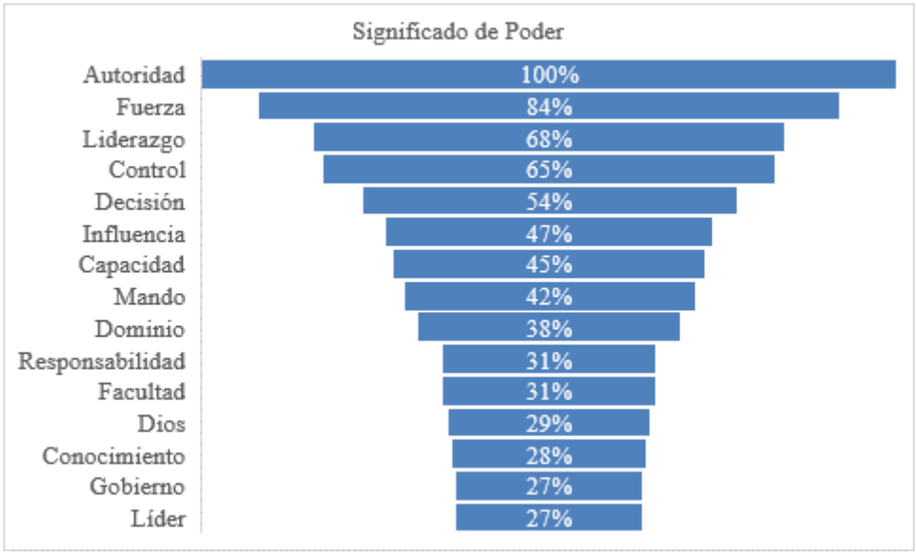
Graph 2.6 Semantic categories for the word "student".



Source: Own Elaboration

Regarding the results obtained by the teachers, the following was obtained:

Graph 2.7 Semantic categories for the word Power



Source: Own Elaboration

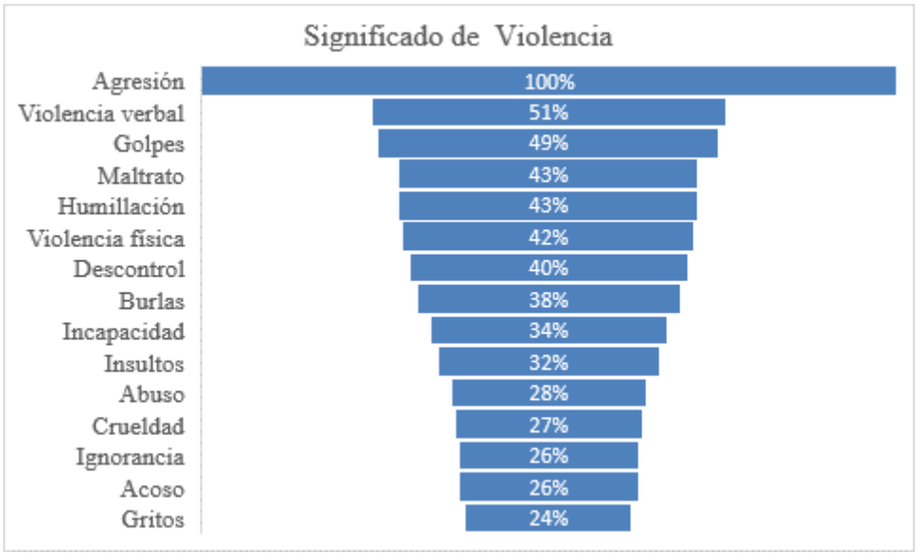
7. Power

The richness of the network in the case of teachers is more compact than that of students, possibly because the total number of teachers was 51 participants. It is observed that the first four categories are those of authority, strength, leadership and control. Likewise, for humanities teachers, power is a responsibility, but not for engineering teachers who see power as control, and this knowledge can be explained because the complexity of logical or mathematical knowledge is acquired with the development of the individual's abstraction and the acquisition of knowledge, which does not necessarily go hand in hand with the chronological development of the person. In addition, the concept of God appears with a religious connotation in the definitions of engineering teachers.

8. Violence

All the teachers agreed that violence is equal to aggression in 100%, which, as mentioned, is not the case. Humanities teachers, as well as engineering teachers, define violence according to its typology, whether physical, psychological or emotional, however, power, abuse and discrimination towards another person stand out. The lack of control, incapacity, frustration and resentment as personal aspects of those who exercise violence, according to Waley Sánchez (2001), although the category of ignorance appears, its percentage is very low 26%, which indicates that this aspect is not the univocal cause of the problem. It is observed in this category that teachers recognize to a greater extent the phenomenon of violence when describing its typology and manifestations and identify it in a general way as a concept.

Graph 2.8 Semantic categories for the word Violence

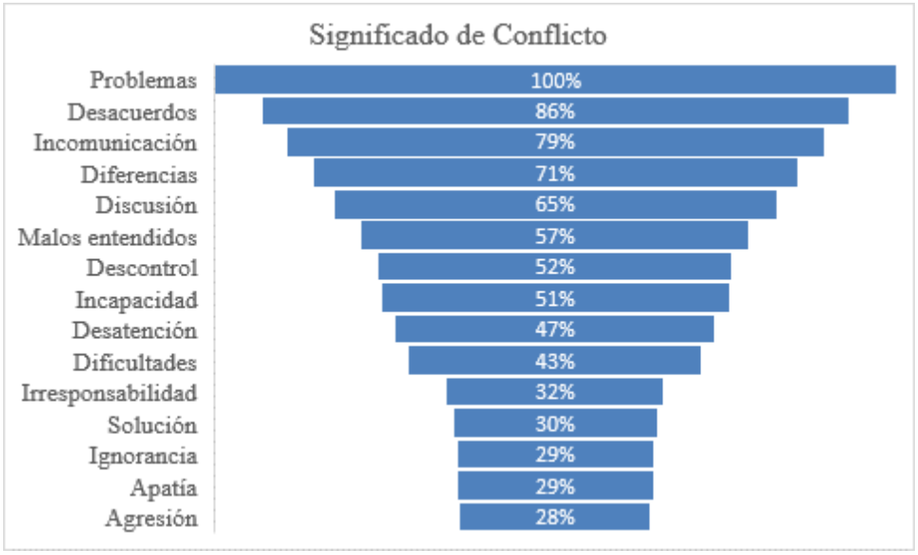


Source: Own Elaboration

9. Conflict

Conflict is represented as problems mainly of a communicational type, because communication problems, disagreements or misunderstandings appear, something characteristic and/or normal of the concept and five positive concepts of conflict are observed, also the categories of irresponsibility, ignorance and apathy appear as negative elements on the other hand, competence, growth, tolerance, natural and solution, and in this last category, there is a relevant difference with that obtained with the students, which also implies the degree of cognitive maturity that the teachers have to solve the conflicts they face daily in their academic life.

Graph 2.9 Semantic categories for the word Conflict

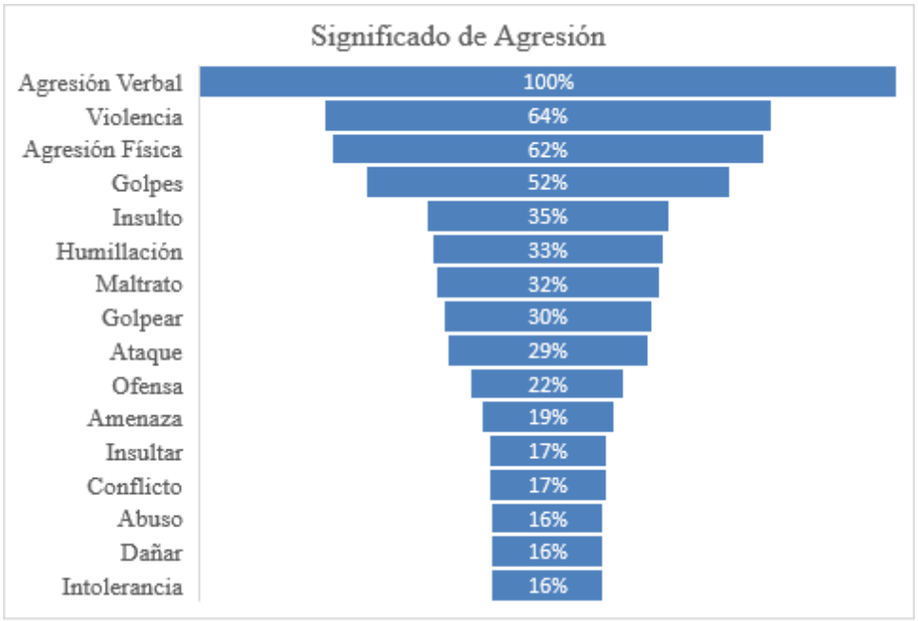


Source: Own Elaboration

10. Aggression

It is observed that aggression is considered as symptomatology and manifestations of violence, this is shared and congruent with the results obtained by the students, which indicates that culture is what determines the conceptualization of the different stimuli, since there is no substantial difference for the teachers as well as for the students, violence and aggression are synonyms.

Graph 2.10 Semantic categories for the word Aggression

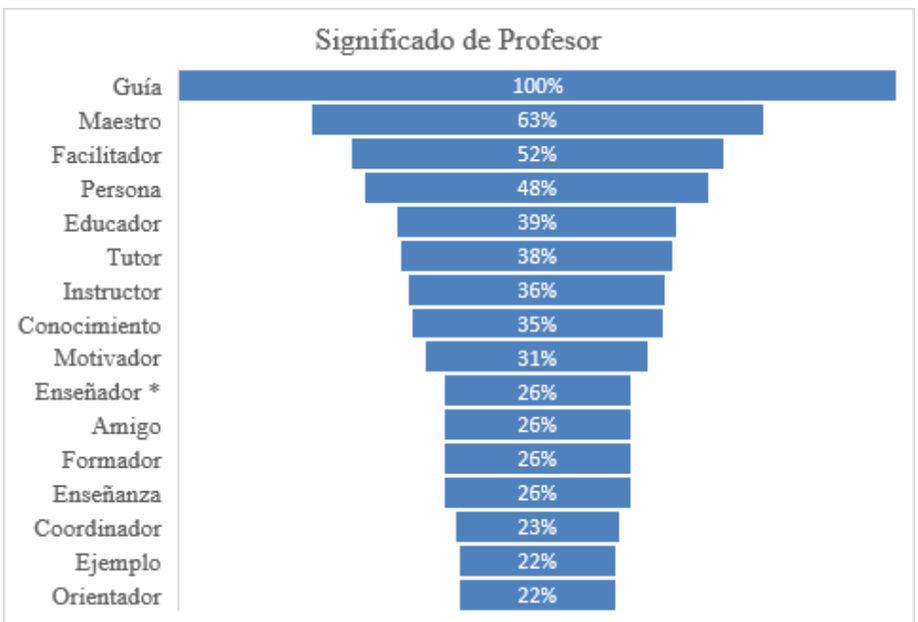


Source: Own Elaboration

11. Teacher

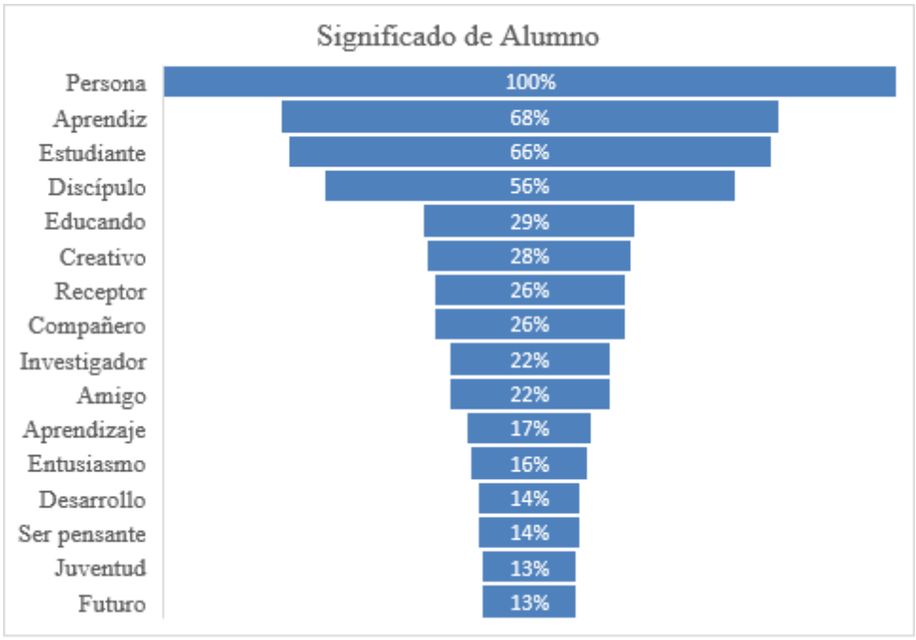
The teacher is defined by teachers as a guide, teacher, facilitator, educator, tutor, etc., concepts attributable to the classical vision that also shows him/her with personal aspects of commitment, responsibility, knowledge and example to follow. However, the categories of motivator, coordinator or counselor also appear, categories that although they appear between 22 and 31%, quite far from the main category, are more in line with the competency-based model promoted by UACAM. This aspect is interesting because although the participants are young teachers, it can be observed that the traditional model of teacher-teacher and student-learner still prevails in these teachers. On the other hand, the concept of "friend" appears in the definitions of the engineering teachers, but not in the humanities teachers, probably because the stimulus used was masculine, and it must be taken into account that most of the teachers of both faculties were male and because this term is not frowned upon among students and educators, in the case of female teachers the term does not appear because it could lend itself to "bad" interpretations.

Graph 2.11 Semantic categories for the word Professor



Source: Own Elaboration

Graph 2.12 Semantic categories for the word Student



Source: Own Elaboration

12. Student

The teachers define the student first as a person, and later as a learner, student or disciple, they give them important aspects such as being creative, researchers, enthusiastic, young and in development, although they still have the traditional vision of the student who must be guided, the fact that they recognize the above mentioned aspects is important because they see them as people and not as a number of enrollment, probably because the UACAM is still a small institution where most teachers and students know each other. Once the categorizations had been made and the semantic networks for students and teachers had been obtained, we proceeded to perform the general analysis, which is presented below.

Results

In the definer or stimulus word power the word that appears in first place corresponds to a typical definition, others such as leadership, leader, intelligence, capacity and responsibility correspond to personal attributes rather than to a relationship between two people, the word want is striking, because it implies that an individual decides for himself his actions and behaviors, even though he may not realize the decisions he makes on a daily basis and the word money is definitely a word conditioned to hierarchies, however to exercise power you do not need to meet the economic requirement, because it is a personal face-to-face relationship.

For the word violence, the representation of aggression is shared, as a synonym of violence, even when it is not, mistreatment, blows, in its physical modality, insults and shouts as verbal violence and ignorance as something cultural, this point is important because it is observed that violence is not recognized as such, as a phenomenon and it is minimized as an aggression, fights and problems are part of a conflict whose inadequate management can lead to violence, When the word indiscipline appears under the heading of violence, it is recognized as a manifestation of violence; however, due to the level of studies, this aspect is practically not important, the student decides the forms of indiscipline, which may consist of not doing the tasks or work assigned, not attending school, not entering the classrooms, or not participating actively as a resistance to learning.

Within the word conflict, disagreements, miscommunication, differences and misunderstandings appear, as such, the other words are manifestations of aggression in its negative version, always associated with violence, it does not appear in its positive vision that could generate personal or group growth.

Here it is observed that conflict is something daily and is not recognized, when making a decision, no matter how minimal it may be, conflicts us internally, depending on the importance of this, within the school there are no conflicts, because things are not negotiated or discussed, they are given and must be obeyed, always within a power relationship, superior-subordinate, which is not recognized even in the discourse, much less in actions. In the word aggression, the definers correspond to manifestations of violence, whether visible or emotional.

The definers of violence, conflict and aggression share words whose manifestations are something "normal", justifiable and most importantly are shared social representations, assimilated and managed as part of society, difficult to change, because that is how we have been taught, it is a way of "educating" children and young people.

Table 2.1 Categories: teacher and student obtained by students

No.	Student	
J =15	Definer: Teacher/Student	
1	Master	Student
2	Guide	Friend
3	Teaching	Partner
4	Educator	Apprentice
5	Friend	Intelligent
6	Knowledge	Person
7	Respect	Studious
8	Responsible	Loose
9	Instructor	Responsibility
10	Authority	Responsible
11	Example	Applied
12	Intelligent	Good
13	Tutor	School
14	Good	Learning
15	Advisor	Capaz

Source: Own Elaboration

According to Table 1, it is observed that these two definers correspond to the representation of what a teacher and a student are, the first point to highlight is that the word teaching appears in third place and learning even in 14th place, this undoubtedly explains the educational model where professional training is focused on teaching, a traditional method that has been followed since the beginning of the university, the teacher is an authority and must be respected, in general terms, the meaning of the word teacher is very positive, besides being seen as a friend, to whom one can turn to at any given time.

This result is relevant because it is assumed that the educational model promoted by UACAM is centered on competencies and student self-learning, however, what is observed is that the weight is still given to teaching and not to self-learning by the student, This may be due to the inertia and the traditional model with which the students arrive and the most frustrating thing is that with the new technologies where there is a lot of information available to the student, instead of taking what is necessary, reflecting on it and appropriating the knowledge, what he/she does in most cases is copy and paste the information without a previous process of reflection.

If we contrast with the four previous definitions, it explains why neither conflict, aggression or violence is recognized as such, the teacher is a role model, regardless of his teaching style, he is almost a second father or mother to be obeyed, because he is a figure of authority and knowledge, this may be because we are in a small society, where the family institution is still very strong; Although mothers have entered the world of work, grandmothers continue to perform the work of mothers, only now it is through the raising of grandchildren, the social function for which this figure appeared in human evolution according to Campillo Álvarez (2005).

When comparing the results obtained by the teachers, it is found that many definers are shared, both by the teachers and by the students; the exceptions may be enlightening, as shown below:

In the case of the definer Power, there are words that are not shared with the students, one of them is God and the other is Government this is due in the first place to the greater experience that teachers have, age and cultural background, decision making is given at another level based on a knowledge or empowerment, which is not reflected in the definers given by the students.

In the case of violence, two words are recognized: lack of control and incapacity, both related to the emotional aspect that students do not take into account because they are still in the process of acquiring their own authority and freedom.

In the case of the word conflict, irresponsibility and apathy stand out, taking into account that conflicts can be solved if there is the will to do so, otherwise they can grow out of control in all the manifestations observed in the other definers.

Finally, all the definitions given for the word aggression correspond to the different manifestations of violence.

It can be said that 70% of the social representations about the phenomenon of violence are shared, the differences obtained are related to the greater cultural background and years of experience of the teachers, in comparison with the students who are younger and are in the process of professional training. It should be emphasized that most of the students are single, and are still children of families, whose main responsibility is to study and obtain passing grades in order to complete their educational process and enter the labor market.

Like the students, they share a social representation of what a teacher and a student are, and the youth of the students and the knowledge of the teachers are highlighted.

Results obtained by gender

In the case of women, according to the women who defined power, 8 words are shared, the important differences are in the subjectivity of the social imaginary, thus in the case of female students, abuse, manipulation and money are considered as representative of power, but the need for this power also appears, the subordinate role they have is very clear, not so the teachers who do not mention these characteristics, it is considered that they exercise this power from their various roles they have as teachers, professionals, that is, as people with a certain hierarchy.

For the item of violence, it is interesting to see that only the words aggression, mistreatment and ignorance are shared, the latter as if it were a necessary antecedent for its manifestation; however, if it is considered that the questionnaire was applied to young people in higher education, already with a defined abstract thinking, it could be thought that the generalized idea about the lack or few formal studies remains valid for violence to occur, despite the cognitive resources with which the students already have, due to their academic training.

The teachers mention verbal violence, which makes us suppose that they exercise it, and recognize physical violence as a theoretical construct, but not the students who mention all the manifestations of violence but do not theorize it, which makes us suppose that they are witnesses or receivers of violence, following parental models is observed, they are educated with physical punishment or scolding to prevent them from being bad people in the future, this allows us to infer that the students were or are receivers of violence, especially psychological violence, a very subtle form that is not recognized as such.

As for the conflict, only problems, differences and aggression are shared and it is practically reduced to a communication problem either by a lack or bad communication, it occurs at various levels that allows inferring both in hierarchical relationships and in the peer relationship, because they belong to the same culture, so their experiences are similar through an affective communication, therefore it is not considered a problem.

When reviewing the category of aggression, only words referring to blows and violence are shared, this allows us to assume that if there are no visible traces, violence does not occur.

Women do not consider themselves as conflictive, aggressive or violent, although physical aggressions are not particular to girls, they are not fragile and are perfectly capable of protecting or defending themselves when faced with conflict situations, despite the fact that teachers consider that aggression is persistent as a demonstration of strength (power) but they can defend themselves. In this way, the teachers recognize verbal aggression in the first place, and the students recognize psychological aggression either as active or passive subjects; verbal expression is favored over physical expression.

As for teachers, they only share the idea of being a guide, tutor and knowledge on the part of the teacher. It is striking that while the teacher is considered a friend, the female students do not even mention him, this could be due to the fact that the word to be defined was teacher in masculine, in the same way they consider themselves creative actors with an integral vision, and the female students do not consider him in this way, the perceptions are very different.

On the other hand, for the word student, it is shared that he/she is a person, intelligent, learner or student, and while the teachers consider them active and creative with possibilities for being committed; the students themselves do not take into account these characteristics, and are considered as receivers or lazy, although they are also responsible, hardworking and studious, they do manage to see both sides of the coin, the positive and the negative, but not the teacher who only considers the positive part. The teacher assumes that we are all capable of learning since we are in one of the last school levels and if we have reached this point it is obviously because we have the qualities, skills and sufficient merit.

In the case of men

According to the definers provided by them, the following results were obtained, in the construct power 6 definers are shared, however, the teacher expresses words such as government, arrogance, mandate and corruption, which could be explained by the treatment he has with the different hierarchical levels of the institutions of any level, not so the student who does not take into account this aspect.

In the case of violence, teachers mention two types of violence, physical and verbal, as well as its different manifestations, since they share words such as aggression, blows, mistreatment, discussion and insults, while students mention conflict and indiscipline, and the word "relaxation" appears as a possible manifestation of violence.

Regarding conflict, problems, disagreements, discussions, misunderstandings and miscommunication are shared; students talk about exams, which would suggest some kind of failure in the teachers' form of evaluation.

The most representative case is that of aggression, since 8 definers are shared, all corresponding to violence, both teachers and students do not recognize themselves as violent but as aggressive, which is a masculine attribute accepted by society and expected in males.

For the word teacher, 9 definers are shared, the students recognize that he is a responsible authority worthy of respect and in the case of the word students, 6 definers are shared, the teacher visualizes the student as a creative and enthusiastic person and the student has positive and negative perceptions.

Conclusions

Although conflict can be a trigger for student learning, in the specific case of the results of this study it was not found, which allows us to consider that the traditional model is followed where the teacher is conceptualized and has the social representation that the teacher is the guide and is not questioned, serves as a support, advisor and at a certain moment is a friend, regardless of his teaching style. Students, for their part, expect to learn and although they are beginning to see glimmers of greater participation on their part, there are still few who have taken learning into their own hands, without taking teachers into consideration or daring to question them openly to produce a debate of ideas, they tend not to get into trouble, because they seek to obtain a certification in a certain degree to enter the working world, they are very clear that the teacher is the one who has all the power to support or slow down their intellectual development, but this is not really true, because it involves not only the knowledge but also the negotiation skills of the students who do not recognize in themselves this ability.

Structural violence is totally assumed as a form of education, since it is shared in a significant percentage of collective representations, as was seen in the results of the semantic network analysis, generic roles are still deeply rooted in both adolescents and adults, regardless of their chronological age; attitudes and behaviors that in the discourse can be recognized as violence in daily practice is not so, it can be said that it is a totally normalized phenomenon, for the same reason violence and its manifestations are not seen unless they are serious.

Another important point is that when students enter higher education they have already left behind many classmates who could not continue, either for lack of knowledge or economic resources; in the same way, their transitional stage of adolescence is practically at the end, so hierarchies are recognized and they seek to avoid problems of any kind, both personal and school or social, the authoritarian forms of teachers are tolerated as if it were a teaching style or a form of leadership of the same, this works for both males and females.

There is a double discourse between word and action; since violence is a normalized phenomenon, it is tolerated based on the beliefs and customs of gender attributions; conceptually, the individual is sensitive to the problem, but not in practice. Another important point to note is that it is women who maintain and promote stereotypes, including married teachers who work double or triple shifts, which they themselves do not recognize. The use of power and leadership as synonyms when they are not, despite the fact that they are part of inter and intrapersonal relationships, is reflected when students let themselves go without questioning in different facets of the teaching-learning process. Although they are sensitive and cognitively know that a change of structures is necessary, all social actors tend to repeat the parental models with which they have grown up and feel comfortable, they try to avoid changes that generate resistance and internal conflicts.

The teaching-learning process still follows traditional models, where the teacher is the one who teaches and the student is the one who learns, despite the fact that UACAM follows the competency-based educational model, it is difficult for the student to take charge of his own learning and for the teacher to function as a facilitator of the process and break with the traditional scheme. The rigidity of administrative processes has a negative impact on learning and generates conflicts that often go unresolved because they are part of the unrecognized structural violence.

It is important to point out that at the local level and particularly at UCAM, the meanings of power, violence, conflict and learning process are still often subject to norms and collective representations of value and respect, which somehow allows students and teachers to function with and despite the types of violence that are latently allowed and manifested in the university community.

To conclude, it is important to point out that education in fulfilling its social function will allow a new relationship between students and teachers during the elaboration and practice of their learning, free of violence and giving fulfillment to the pillars that support educational action, where daily coexistence and tolerance, will procure a more humane and healthy society.

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Annex 1 Questionnaire for students

Semantic networks. Format 1A.

Age _____ Sex_____ Degree _____Semester_____

Instructions: write in the left column the ten words that best define the concept presented. And in the right column number them from 1 to 10 according to their importance to you. This is for research purposes. Please answer all concepts. For your participation and support THANK YOU.

Stimulus word or concept. **Power**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Violence in the classroom**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Conflict in the classroom**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	

	9	
	10	

Stimulus word or concept. **Aggression**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Student**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Teacher**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Annex 2 Questionnaire for teachers

Semantic networks. Format 1P.

Age._____ Sex_____ initial training _____Grado_____
Years of service_____ hrs./sem/month_____ specialty in which you teach your major teaching load_____

Instructions: write in the left column the ten words that best define the concept presented. And in the right column number them from 1 to 10 according to their importance to you. This is for research purposes. Please answer all concepts. For your participation and support THANK YOU.

Stimulus word or concept. **Power**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Violence in the classroom**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Conflict in the classroom**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Aggression**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Student**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Stimulus word or concept. **Teacher**

Defining words		Hierarchies
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	

Annex 3

Information emptying sheet for semantic networks.

Format 2. It is the same for students and teachers.

Hierarchies											
Semantic values											
Definers											VMT

Obtaining the main results:

J-value: corresponds to the total number of the defining words. It is an indicator of the semantic richness of the network.

M-value (VMT): results from the multiplication of the frequency of occurrence (FA) by the hierarchy (VS) obtained for each of the defining words.

SAM set: this is an indicator of the defining words that make up the central core of the network. Once the total M values have been obtained for each of the defining words, the SAM set is determined, which can be of 10 or 15 words.

FMG value. This is obtained for all the defining words that make up the SAM set. The one that has obtained the largest M value will correspond to 100% and through a rule of three the remaining values will be determined. It indicates the semantic distance between the different defining words of the SAM set.

Annex 4

SAM Set Format 3

SAM set obtained for the word_____		
SAM Set	MT value	FMG Values

Chapter 3 Livestock system for milk production and trade: An analysis of economic and zootechnical indicators for food security and sustainability

Capítulo 3 Sistema ganadero para la producción y comercio de leche: Un análisis de indicadores económicos y zootécnicos para la seguridad alimentaria y la sustentabilidad

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N. Niño, M. Valencia and M. García. (AA. VV.) Productive System, Territory and Sustainability. Handbooks-TIII-©ECORFAN-Mexico, Guerrero, 2021.

Abstract

The objective of this paper is to examine the livestock system regarding the production and trade of milk, through overall management of the national and international market to an analysis of the main economic and zootechnical indicators, in order to understand how these, affect the permanence of Mexican companies in the livestock sub-sector of cow's milk production. Thus, an updated bibliographic synthesis on the production and trade of milk, to know the commercial context in which companies compete with each other, was carried out. This paper also contributes to information on the production and reproduction parameters of dairy cattle, good feeding, and housing management practices of dairy animals. This information will support any person who is engaged in, or has a relationship with, the sustainable production of dairy cows.

Livestock system, Production and reproduction parameters, Good feeding, management practices of dairy animals

Resumen

El objetivo de este capítulo fue caracterizar el sistema ganadero para la producción y comercialización de leche, a través del manejo integral del mercado nacional e internacional y un análisis de los principales indicadores económicos y zootécnicos, para comprender cómo éstos afectan la permanencia de las empresas mexicanas, en el subsector ganadero de la producción de leche de vaca. En este sentido, se realizó una síntesis bibliográfica actualizada sobre la producción y comercialización de leche, para conocer el contexto comercial en el que las empresas compiten entre sí. El capítulo también aporta información sobre los parámetros productivos y reproductivos del ganado lechero y buenas prácticas de alimentación y manejo de instalaciones para animales lecheros. Información que servirá de apoyo a toda persona que se dedique o tenga relación con la producción sustentable de vacas lecheras.

Sistema ganadero, Parámetros productivos y reproductivos, Buenas prácticas de alimentación, Manejo de animales lecheros

Introduction

In 2013, the World Organization for Animal Health (2014) defined a Dairy Production Unit as a commercial livestock production system which purpose involves the breeding, reproduction, and management of livestock for milk production. Furthermore, the Food and Agriculture Organization of the United Nations (2021b), together with the Organization for Economic Co-operation and Development (2020), indicate that in different territories of the world it has been noted that, between large and small Dairy Production Units, there are productivity gaps, understood as the differences between milk production per cow in the herd, per hectare, per wage, or per year.

These productivity gaps reflect the integrated management of anthropological factors, land and animal components, physical factors, feeding, health, milking, reproduction, and livestock management sub-systems (Luik-Lindsaar *et al.*, 2019). The integration of these zootechnical and economic indicators leads to establishment and profit-making (Gaworski *et al.*, 2018), quantifying the exchange relations between the Dairy Production Unit and the market and reflecting the balance between investments, such as direct and indirect labor and livestock inputs (Bokusheva and Čechura, 2017). However, different cow milk production systems present particular problems of productivity, competitiveness, and sustainability, each associated with their own characteristics, regions, and management. Thus, in order to maintain or increase the productivity of cattle herds, it is imperative to characterize and integrate these zootechnical and economic indicators as a viable and practical proposal that allows farmers to participate successfully in national production (Bewley *et al.*, 2017).

This paper reviews: i) International production and trade of milk and dairy products; ii) Domestic production and trade of milk and dairy products; iii) Productive and reproductive parameters of dairy cattle; iv) Good feeding practices for dairy cattle; and v) Good management practices for dairy animal facilities. This information will support anyone involved in, or related to, sustainable development in intensive dairy cattle production.

References for acronyms and abbreviations

AI	Artificial Insemination at Fixed Time
AU	Animal Unit, 450 kg Bovine Equivalent
BI	*Bos indicus*
BT	*Bos taurus*
CH_4	Methane
CP	Crude Protein
D	Day
DM	Dry Matter
DPU	Dairy Production Unit
FAO	Food and Agriculture Organization of the United Nations
FIRA	Fideicomisos Instituidos en Relación con la Agricultura
ha/AU/year	Hectares per Animal Unit per Year
kg	Kilogram
L	Liter
LW	Live Weight
mL	Milliliter
mov/min	Movements per Minute
NPN	Non-Protein Nitrogen
OCDE	Organization for Economic Cooperation and Development
Odepa	Oficina de Estudios y Políticas Agrarias
pH	Potential of Hydrogen
PWM	Powdered Whole Milk
rep/min	Repetitions per Minute
SC	Somatic Cells
SCC/mL	Somatic Cell Content per Milliliter
SENASICA	National Service for Agri-food Health, Safety, and Quality
SMP	Skim Milk Powder
t	Ton
t, milk eq.	Tons of Milk Equivalent
U.S.	United States of America
USD	United States Dollar
USDA	United States Department of Agriculture
ZVD	Zootechnician Veterinary Doctor

1. Production and international trade of milk and dairy products

Despite market movements related to the SARS-CoV-2 Coronavirus pandemic, during 2020, world milk production increased 1.4% over last year (Food and Agriculture Organization of the United Nations, 2021b), reaching 860 million t of milk equivalent (Table 3.1), with a global *per capita* human consumption of 111.4 kg/year – i.e., an increase of 0.3% over 2019 (Food and Agriculture Organization of the United Nations, 2021a).

Table 3.1 International Milk Production Market 2018-2020 Period, Million Tons of Milk Equivalent

	2018	Years 2019	2020	Change from 2019 to 2020
	million t. milk eq.[a]			%
World Balance				
Total Production	840.3	848.0	860.1	1.4
Total Trade	76.0	76.8	77.9	1.5
Human Consumption *per capita*				
World (kg/year)	111.3	111.2	111.4	0.3
Trade. Share of Production (%)	9.0	9.1	9.1	0.0

[a] milk equivalent: the weighted average, calculated on a milk fat basis and a nonfat milk solids basis, with conversion factors equivalent to:

- 1,000 mL. * 11.8% total solids for whole milk
- 1,000 mL. * 8.5% nonfat solids for skim milk
- 1,000 mL. * 6.5% milk solids for whey
- 1,000 mL. * 3.5% milk solids for cream

Source of reference: Based on (Food and Agriculture Organization of the United Nations, 2021a)

Increases were seen in major milk producing countries (e.g., India) where management is sustained by monsoons and the resilience of its network of village cooperatives (Vivek *et al*., 2020), or in the European Union and the United States (**U.S.**), which are supported by their yield improvements and government assistance, maintained stable economic margins for producers (Kutkowska *et al.*, 2020).

In this context, due to biological and cultural diversity, the milk consumed by humans comes from different species (Table 3.2) (Domínguez-Salas *et al.*, 2019) and the key elements that determine its maintenance are feed, water, and climate (Osei-Amponsah *et al.*, 2020).

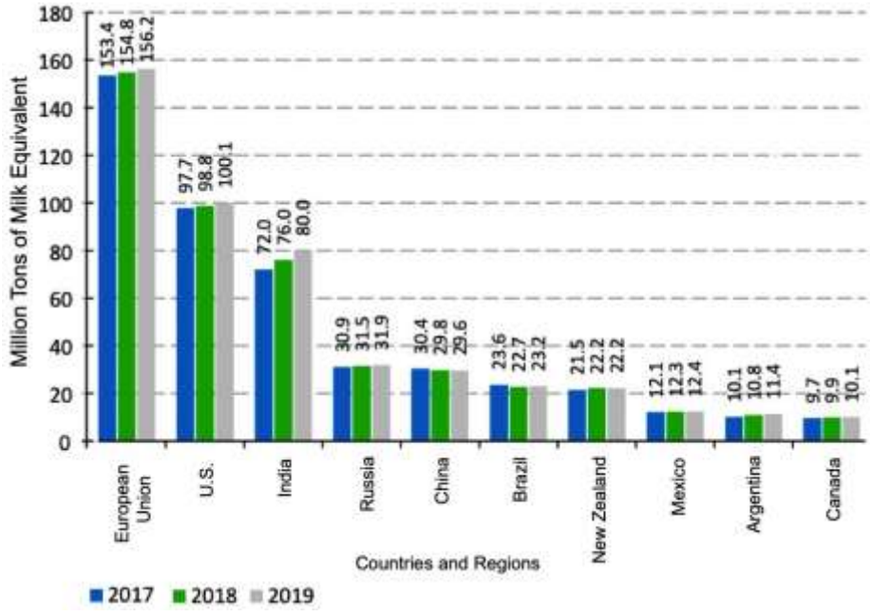
Table 3.2 International Milk Production by Species, Year 2020, Million Tons of Milk Equivalent

Species	Volume Produced	Percentage
	million t. milk eq.	%
Bovine	696.6	81
Bubalino	129.0	15
Goats	17.2	2
Sheep	8.6	1
Other	8.6	1
Total	860	100

Source of reference: Based on (Food and Agriculture Organization of the United Nations, 2021b)

Among such species, cattle (e.g., Holstein, Jersey, and Brown Swiss) stand out, with an average annual growth of 0.9%, and an estimated inventory of 141.7 million head, with which 81% of the world's milk production is achieved (Fideicomisos Instituidos en Relación con la Agricultura, 2019). This is followed by Bubalino (e.g., Murrah, Nili-Ravi, Surti, and Mehsana) with 15%; Goats (e.g., French Alpine, Saanen, and Toggenburg) with 2%; Sheep (e.g., Manchega, Churra, Hidango, and East Friesan) with 1%; and the remaining share comes from other dairy species (e.g., Yaks) (Food and Agriculture Organization of the United Nations, 2021b). The United States Department of Agriculture (2021) reported production of 156.2 million t of milk equivalent, 23.2 million head, and a share of 30.6%. The European Union stood out in 2019 as the main bovine milk producing region (Figure 3.1), with Germany acting as main producer with 20% and a dairy herd that exceeded 4 million head, followed by France with 15%. In third position was the United Kingdom with 10%.

Figure 3.1 Major Producers of Cow's Milk in the World During the Period 2017-2019, Million Tons of Milk Equivalent

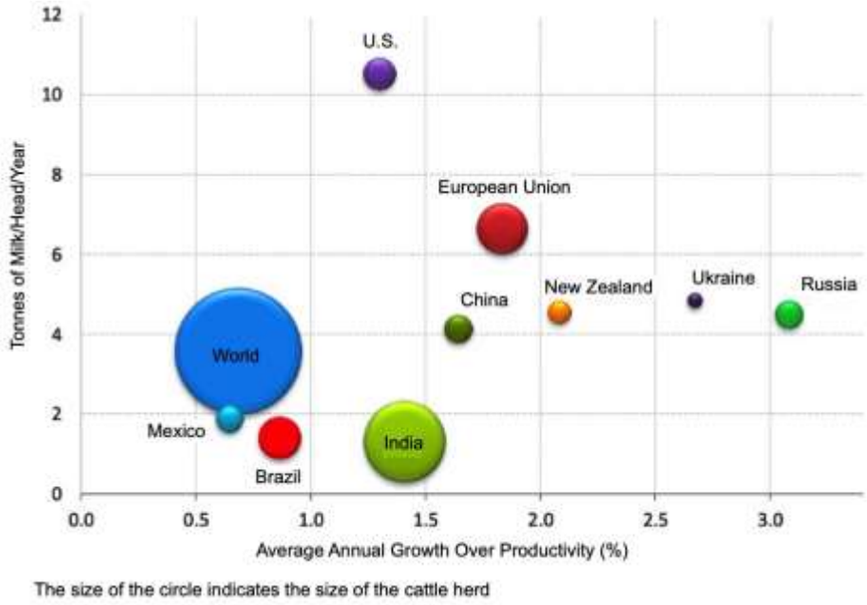


Source of reference: (United States Department of Agriculture, 2021)

With an estimated 9.3 million head count, the highest productivity among countries (10.5 t of bovine milk/head/year), and with 100.1 million t of milk equivalent, the U.S. (Figure 3.2) is the second largest producer of bovine milk during 2019. California, Wisconsin, Idaho, New York, and Pennsylvania are the five U.S. states that account for 50% of the country's production (Fideicomisos Instituidos en Relación con la Agricultura, 2021). In India, milk production during 2019 represented 27.9% of the world's milk supply, with 80.0 million t of bovine milk equivalent, an estimated inventory of 58.5 million head (Kutkowska *et al.*, 2020), and the lowest productivity among countries (1.3 t of bovine milk/head/year) (Domínguez-Salas *et al.*, 2019).

However, it is appropriate to note that the bubalino population represents its main source of production (Vivek *et al.*, 2020). So much so that when considering the combined production of cows and buffaloes, India would rank as the largest milk producer in the world (Organization for Economic Cooperation and Development, 2020).

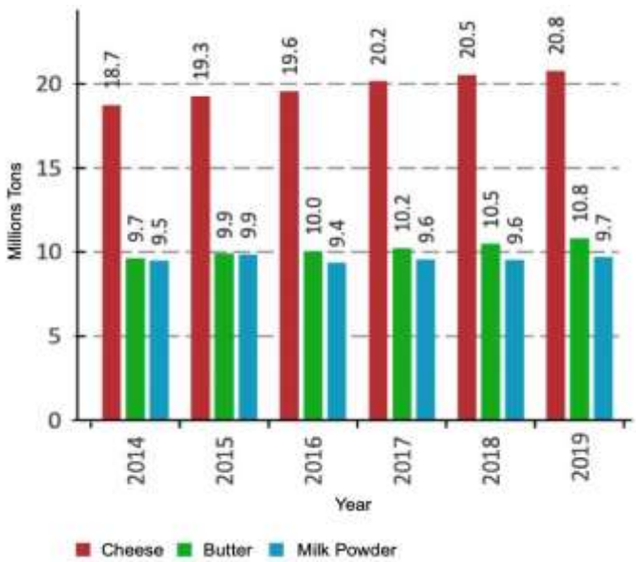
Figure 3.2 Dairy Herd and Global Productivity in Milk Producing Countries, Year 2019



Source of reference: (United States Department of Agriculture, 2021)

Regarding its distribution during 2019, industrial consumption accounted for 70% of the world's total, while human consumption used 29.2%, and animal consumption used the remaining 0.8% (Kutkowska *et al.,* 2020). Furthermore, the Organization for Economic Cooperation and Development (2020) noted that, during 2018, the U.S., accounted for 16.3% of the world's consumption. It should be remembered that in the U.S., 77% of total milk consumption is used for the production of cheese, butter, and in the powdered milk processing industry (United States Department of Agriculture, 2021). The Food and Agriculture Organization of the United Nations (2021a) indicated that during 2019, the international production of dairy derivatives reached 41.3 million t. Cheese was the product with the highest volume produced, with 20.8 million t, equivalent to 50.6% of the total (Figure 3.3); butter accounted for 25.8%; and powdered whole milk (PWM) and skim milk powder (SMP) combined for 9.7 million t, equivalent to 23.5% of the total (Fideicomisos Instituidos en Relación con la Agricultura, 2019).

Figure 3.3 International Production of Main Dairy Derivatives, 2014-2019 Period, Million Tons

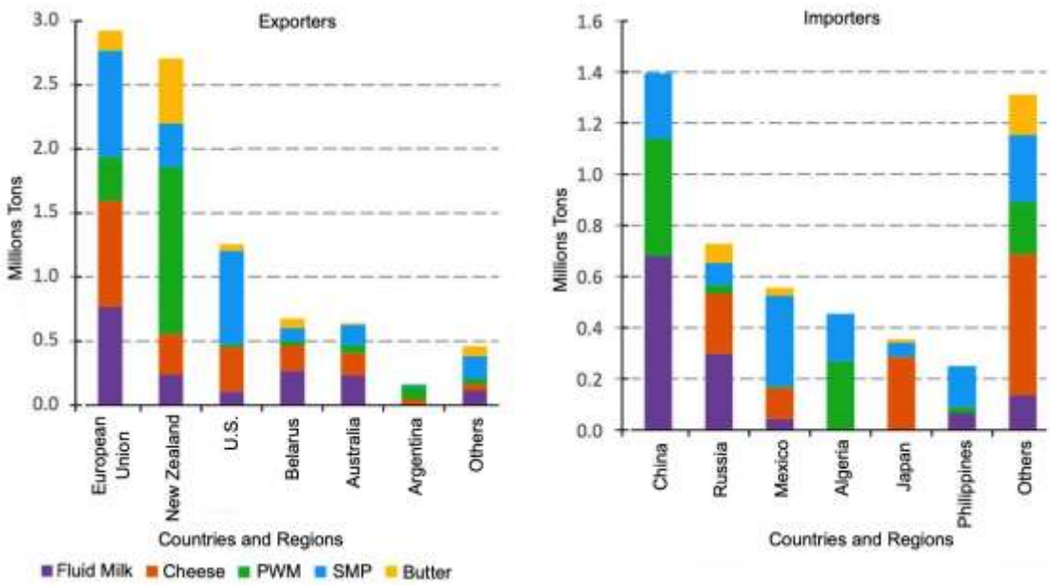


Source of reference: (Fideicomisos Instituidos en Relación con la Agricultura, 2019)

The European Union is the number one largest producer of dairy products, with cheese as its main product, accounting for 67.5% of its total volume (Domínguez-Salas *et al.*, 2019). Cheese is also the most significant dairy product produced in the U.S., at 75.5% of its total volume (United States Department of Agriculture, 2021). Meanwhile, international consumption of dairy products at the end of 2019 stood at 37.3 million t, 3.3% higher than in 2018. The products that showed the highest annual growth in global consumption were cheese, with 52.7% of total consumption, followed by butter with 26.5% (Organization for Economic Cooperation and Development, 2020).

In the international dairy derivatives market, 80% of world exports originate in the European Union, New Zealand, and the U.S. (Figure 3.4). Mexican imports in 2018 accounted for 11% of the total volume, making Mexico the third largest importer of dairy derivatives worldwide (Cámara Nacional de Industriales de la Leche, 2021). Additionally, the U.S. supplied Mexico with 99% of its milk powder imports (Fideicomisos Instituidos en Relación con la Agricultura, 2021). For its part, China is the largest importer of dairy derivatives, its demand during 2018 being 1.39 million t (Food and Agriculture Organization of the United Nations, 2021b). It is worth noting that, compared to cereals and meat, the international price of dairy derivatives has presented its highest growth during the last five years (Organization for Economic Cooperation and Development, 2020). Placing PWM and SMP as benchmarks for setting international prices, due to their importance as inputs in the dairy industry (Kutkowska *et al.*, 2020), during 2020 in Northern Europe (Table 3.3), the minimum price of PWM was 3,300 USD/t, and in Oceania during the same year, the minimum price of SMP was 2,925 USD/t (Oficina de Estudios y Políticas Agrarias, 2021).

Figure 3.4 International Trade of Dairy Derivatives, Year 2018, Million Tons



Source of reference: (United States Department of Agriculture, 2021)

Table 3.3. International Prices for Milk Powder During 2018-2020, USD/t

Year	PWM[a]		SMP[b]	
	Northern Europe	Oceania	Northern Europe	Oceania
	USD/t			
2020	3,300	3,200	2,525	2,925
2019	3,375	3,075	2,775	2,800
2018	3,000	2,550	1,700	1,925

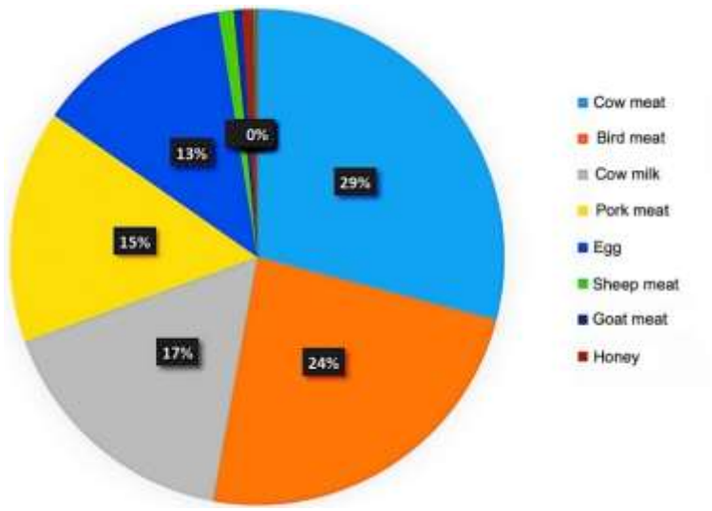
[a] Powdered whole milk. Fat content between 26% and 42%, maximum water content 5%, minimum protein content in lean milk solids 34% (CODEX STAN-207, 1999)
[b]Skim milk powder. Fat content 1.5%, maximum water content 5%, minimum protein content in milk solids-non-fat 34% (CODEX STAN-207, 1999)

Source of reference: (Oficina de Estudios y Políticas Agrarias, 2021)

2. Domestic production and trade of milk and dairy products

In Mexico, milk is defined as the product obtained from the secretion of the cow's mammary gland without colostrum, which must be subjected to thermal treatments or other processes that guarantee its safety. It may also undergo other operations, such as clarification, homogenization, standardization, or others, as long as they do not contaminate the product and comply with the specifications of its denomination (NOM-155 - SCFI, 2003). The Mexican dairy sector is the third most important agricultural activity with 17%, and a contribution of 24% to the Gross Domestic Product (Figure 3.5), behind beef production with 29%, and chicken meat production at 24% (Cámara Nacional de Industriales de la Leche, 2021).

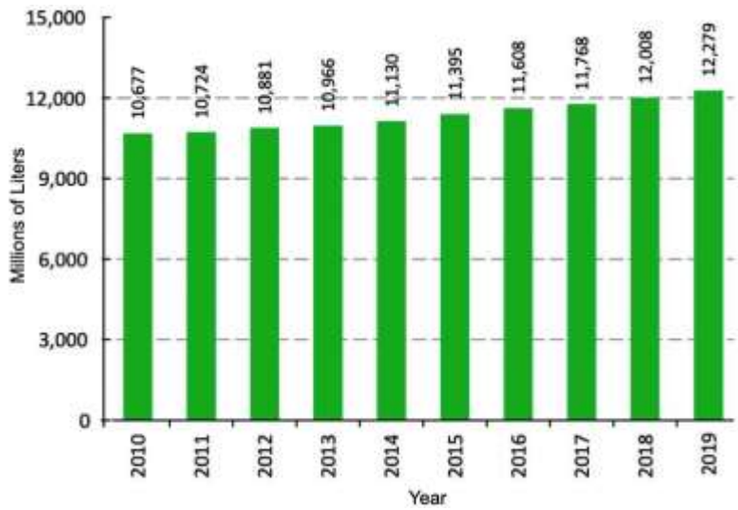
Figure 3.5 Major Agricultural and Livestock Activities in Mexico, Year 2020, Percentages



Source of reference: (Cámara Nacional de Industriales de la Leche, 2021)

According to the Servicio de Información Agroalimentaria y Pesquera (2019), the value of cow's milk production in Mexico, during the period between 2010 and 2019, went from 51 billion pesos to over 79 billion pesos. Moreover, according to data from the Cámara Nacional de Industriales de la Leche (2021), during the same period (Figure 3.6), the production of fluid milk in Mexico grew around an additional 1,331 thousand tons of fluid milk, from 10,677 million liters in 2010 to 12,008 million liters in 2018, representing 16th place in world production of bovine milk.

Figure 3.6 Cow's Milk Production in Mexico, Period 2010-2019, Millions of Liters

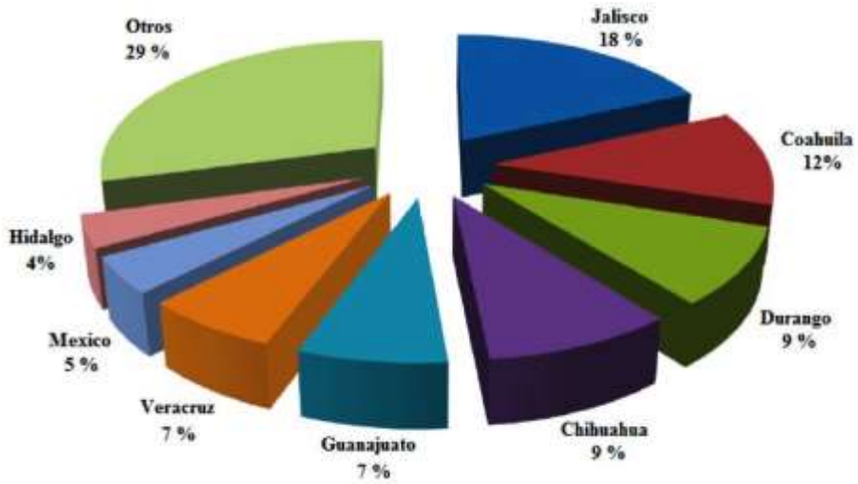


Source of reference: (Cámara Nacional de Industriales de la Leche, 2021)

In Mexico, bovine milk production is higher during the summer (June-September); that is, during the rainy season, when forage availability for cattle feeding is higher (Theusme *et al.*, 2021). It is also heterogeneous from a technological, agroecological, and socioeconomic point of view, including the great variety of climates, reproductive systems, forage quality, and feeding (Food and Agriculture Organization of the United Nations, 2021a). Additionally, the Oficina de Estudios y Políticas Agrarias (2021) indicated that, during 2019, fluid milk production reached 12,279 million liters, with a livestock inventory of 2,563,822 head.

The Confederación Nacional de Organizaciones Ganaderas (2020) indicated that most of the production in 2019 was contributed by 13 states, with Jalisco ranking as the largest producer of cow's milk in Mexico (Figure 3.7), accounting for 2,541,915 thousand liters (equivalent to 18% of the total volume), a livestock inventory of 374,411 heads, and a stocking rate of 8.50 ha/AU/year. This is followed by Coahuila, with 1,394,913 thousand liters (equivalent to 12% of the total volume), a livestock inventory of 244,750 heads, and a stocking rate of 26.02 ha/AU/year.

Figure 3.7 Cow's Milk Production by State, Year 2019, Percentages



Source of reference: (Cámara Nacional de Industriales de la Leche, 2021)

Durango contributed with 1,242,953 thousand liters (equivalent to 9% of the total volume), a livestock inventory of 303,001 head, and a stocking rate of 15.70 ha/AU/year (Confederación Nacional de Organizaciones Ganaderas, 2020). Chihuahua produced 1,160,432 thousand liters, with a livestock inventory of 294,629 heads, and a stocking rate of 20.07 ha/UA/year (Cámara Nacional de Industriales de la Leche, 2021). The rest of the production for 2019 was covered by the states of Guanajuato, Veracruz, State of Mexico, Hidalgo, Aguascalientes, Puebla, Chiapas, Michoacán, and Querétaro (Servicio de Información Agroalimentaria y Pesquera, 2019).

At this point, it is appropriate to mention that the main municipalities that combined for just over 29% of national production were: i) Gómez Palacio, Durango (6.9%); ii) Matamoros, Coahuila (4.6%); iii) Delicias, Chihuahua (3.5%); iv) Francisco I. Madero, Coahuila (3.0%); v) Encarnación de Díaz, Jalisco (2.3%); vi) Torreón, Coahuila (1.9%); vii) San Miguel el Alto, Jalisco (1.9%); viii) Tepatitlán de Morelos, Jalisco (1.8%); ix) Lagos de Moreno, Jalisco (1.8%); and x) Tizayuca, Hidalgo (1%) (Confederación Nacional de Organizaciones Ganaderas, 2020).

In Jalisco, Coahuila, Durango, and Chihuahua (Figure 3.8), intensive or specialized production systems prevail, where animals are kept in stalls and their feed is offered at the trough (Reyes and Rosales, 2018). Farming for forage production and milking in the vast majority of the Dairy Production Unit (DPU) with this system are highly mechanized, with average yields/cow of 5,000 L/lactation, with a calving interval between 12 and 13 months, and a lactation period that fluctuates between 210 and 305 d/year (Camacho *et al.*, 2017).

Figure 3.8 Intensive or Specialized Production System – Delicias, Chihuahua

Source of reference: Personal photo

In Guanajuato, State of Mexico (Figure 3.9), Hidalgo, Aguascalientes, Puebla, Michoacán, and Querétaro, with stocking rates of 10.20, 9.33, 6.41, 11.56, 7.82, 7.00, and 13.49 ha/AU/year respectively, semi-intensive or semi-specialized production systems prevail, where cattle are kept in semi- stabulation during the hottest hours of the day, going out to graze in the cooler hours of the afternoon (Camacho *et al.*, 2017). In most of the stabulation system, feeding is variable, as it depends on agricultural production complemented with cut forages and concentrates, with average yields/cow of 2,500 L/lactation, and a calving interval close to 16 months (Fideicomisos Instituidos en Relación con la Agricultura, 2021).

Figure 3.9 Semi-Intensive or Semi-Specialized Production System – Texcoco, State of Mexico

Source of reference: Personal photo

As for Veracruz and Chiapas, with stocking rates of 1.81 and 1.80 ha/AU/year respectively, dual-purpose cattle ranching predominates, with average yields/cow of 800 L/lactation, weaning calves at 8 to 10 months of age with 156 kg of LW, and a calving interval between 17 and 20 months (Albarrán *et al.*, 2015). Dual purpose cattle ranching (Figure 3.10) has Simmental, Brahman, and crosses of specialized European or Creole *Bos taurus* (BT) breeds with *Bos indicus* (BI) breeds, in order to increase productive potential through the inclusion of BT genes, while BI genes will give the new genotype adaptations to tropical conditions (Reyes and Rosales, 2018).

Figure 3.10 Dual Purpose Production System – Tlapacoyan, Veracruz

Source of reference: Personal photo

Regarding the climatic conditions for cow milk production in the 196,717,300 ha of the national territory, the Secretaría de Medio Ambiente y Recursos Naturales (2021) has established a typology that considers its distribution by agro-ecological-livestock regions (Table 3.4).

Table 3.4 Agro-Ecological-Livestock Farming Regions for Cow's Milk Production in Mexico

Region	States
Arid and Semi-Arid 94,992,673 ha	Baja California Norte y Sur, Coahuila, Chihuahua, Durango, Nuevo León, San Luis Potosí, Sinaloa, Sonora, Tamaulipas, and Zacatecas
Temperate 46,036,751 ha	Aguascalientes, Guanajuato, Hidalgo, Jalisco, State of Mexico, Michoacán, Morelos, Puebla, Querétaro, Tlaxcala, and Mexico City
Humid and Dry Tropical 55,687,876 ha	Campeche, Colima, Chiapas, Guerrero, Nayarit, Oaxaca, Quintana Roo, Tabasco, Veracruz, and Yucatán

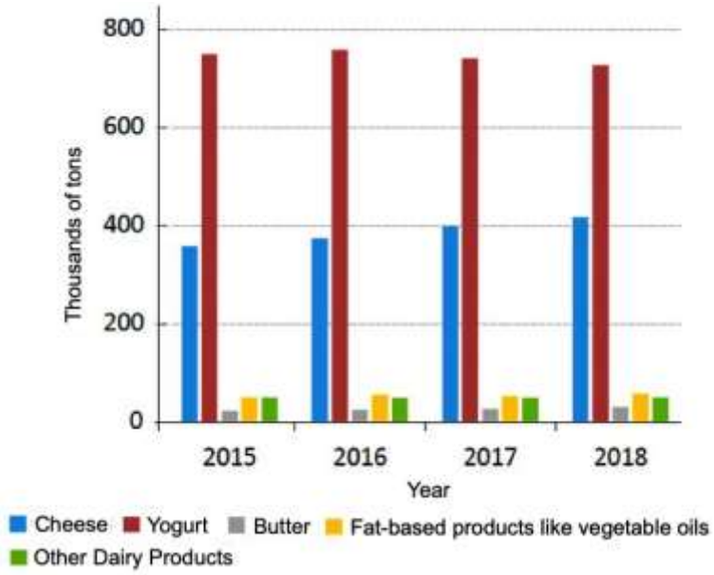
Source of reference: (Secretaría de Medio Ambiente y Recursos Naturales, 2021)

Due to its importance in the national milk supply, the Cámara Nacional de Industriales de la Leche (2021) highlighted the Comarca Lagunera in the arid and semi-arid agro-ecological-livestock region, formed by 16 municipalities: 5 in Coahuila, and 11 in Durango and Chihuahua, including its links with milk companies (e.g., Grupo Lala[MR]).

In the temperate agro-ecological-livestock region, the work is carried out by the municipalities of Texcoco, Zumpango, Teoloyucan, Jilotepec, Aculco, Polotitlán, Tequixquiac, and Acolman, all in the State of Mexico, and their links with milk collection companies, such as Nestlé[MR], stood out. This is further enabled by the Tizayuca Agricultural and Industrial Complex in Hidalgo State, and its links with milk collecting companies (e.g., Ganaderos Productores de Leche Pura-Alpura[MR] and Santa Clara[MR]).

Even though the region with the greatest availability of water in the country is the humid tropics, it should be noted that its climatic conditions have apparently not been the determining factors in the productivity of its states, since Coahuila and Durango, located in the arid and semi-arid region of the country, are in second and third place in production (Confederación Nacional de Organizaciones Ganaderas, 2020). Regarding the processing of dairy derivatives, during 2018, 1.42 million t were produced, with a total value of 52,262 million pesos (Fideicomisos Instituidos en Relación con la Agricultura, 2021). Yogurt is the most produced dairy derivative in Mexico (Figure 3.11), representing 43.6% of the total volume. 29.6% corresponded to cheese, and 16.9% to powdered milk, with the remaining 9.9% attributed to butter and other products (Instituto Nacional de Estadística y Geografía, 2021).

Figure 3.11 Production of Dairy Products During 2015-2018, Thousands of Tons



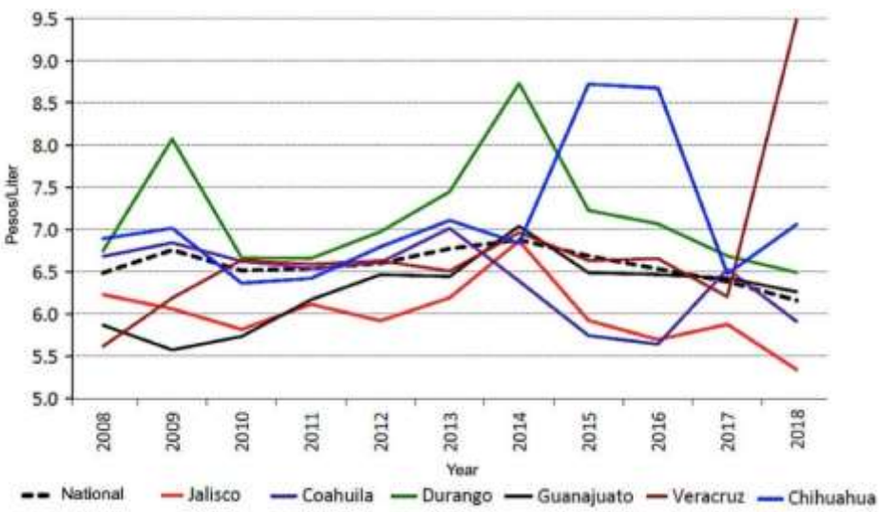
Source of reference: (Instituto Nacional de Estadística y Geografía, 2021)

In the national trade of milk and dairy products, Mexico ranks 8th in milk consumption worldwide (Servicio de Información Agroalimentaria y Pesquera, 2019). During 2018, apparent national consumption stood at 15,288 million L; only 78.5% of that volume was supplied from the 12,008 million L produced nationally (Confederación Nacional de Organizaciones Ganaderas, 2020), being insufficient to meet the total demand of the population. The remaining 21.5% was supplied by imports, mainly powdered milk from the U.S. (United States Department of Agriculture, 2021).

For its part, the Consejo Nacional de Población (2018) indicated that the annual *per capita* consumption of milk was 122 L; cheese consumption was 4.3 kg; powdered milk consumption was 3.6 kg; and butter consumption was 2 kg – values below *per capita* consumption in developed countries (e.g., the European Union and the U.S.).

The Federal Government implemented the Guarantee Price Program for Basic Food Products, which included milk (Confederación Nacional de Organizaciones Ganaderas, 2020). Due to this program, Liconsa purchases milk mainly from producers with a livestock inventory of up to 100 head, setting the base price at 6.2 $/L during 2018 (Figure 3.12). It also specifies bonuses (Table 3.5) according to the lipid and protein concentration of the milk, and its bacteriological quality (Liconsa, 2019).

Figure 3.12 Price per Liter of Fluid Milk in Mexico, 2008-2018, Pesos/Liter



Source of reference: (Fideicomisos Instituidos en Relación con la Agricultura, 2019)

Table 3.5 Economic Stimulus per Liter of Fluid Milk in Mexico, Pesos/Liter

Stimulus				$/L
Quality	Physicochemistry	Fat	3.00 to 3.29 g/100 mL	0.05
			3.30 to 3.39 g/100 mL	0.10
			≥ 3.40 g/100 mL	0.20
		Protein	3.00 to 3.09 g/100 mL	0.05
			≥ 3.10 g/100 mL	0.10
	Bacteriological	Somatic Cells (SC)*	Class 3: 501,000 to 749,000 SCC/mL	0.05
			Class 2: 401,000 to 500,000 SCC/mL	0.10
			Class 1: ≤ 400,000 SC/mL	0.15
		Reductase	120 to 179 min	0.05
			180 min or more	0.10
		Antibiotic	Negative	0.05
* Specifications on somatic cell content in raw milk (NMX-F-700-COFOCALEC, 2012)				

Source of reference: (Liconsa, 2019)

3. Productive and reproductive parameters of dairy cattle

Identifying the parameters of the cattle herd is of vital importance, since they are zootechnical indicators that indicate whether the animals are expressing their productive and reproductive potential (Recinos *et al.*, 2017). If this is not achieved, the producer must carry out specific strategies in nutrient balance, animal and paddock management, sanitation, etc., all based on the productivity biotype (Table 3.6) of his/her cattle (De-la-Barra *et al.*, 2019), ultimately understanding this as the correlation between the external conformation (rectangular parallelepiped), with its aptitude for meat production (triangular angular), and with its aptitude for milk production and/or their combinations (Bewley *et al.*, 2017).

Table 3.6 Main Characteristics of Bovine Biotypes Used in Mexico

	Birth Weight (kg)	Daily Weight Gain (d/kg)	LWF[1] (kg)	Carcass Yield[2] (%)
Angus	28.0	1.17	482	59.1
Brahman	40.4	1.13	499	62.1
Brangus	35.1	1.13	485	60.9
Beefmaster	37.4	1.19	504	61.7
Charolais	39.2	1.25	527	61.0
Brown Suiss	37.5	1.18	504	60.6
Holstein	35.0	1.24	521	60.5
Simmental	38.6	1.17	495	59.1
[1]Final weight of the animal at the end of its life; [2] Final weight of the carcass of cattle slaughtered at the slaughterhouse, from which the head, skin, viscera, and carcasses have been removed				

Source of reference: (Boichard et al., 2015)

Similarly, it is important to identify the stocking rate, or average number of animal unit (**AU**) equivalent to a 450 kg LW bovine (Table 3.7), which are assigned to an area for a given grazing period (Benevenute *et al*., 2020), the carrying capacity or degree of forage production, which allows the pasture plants to recover after said grazing period (Vásquez *et al.*, 2019), and the stocking rate, or area necessary to sustain one AU/year permanently and without deteriorating natural resources (Alcalá-Galván *et al.*, 2018).

Table 3.7 Type of Animal and Its Equivalents in Animal Unit, Calculated Based on Metabolic Weight

Type of Animal (average in kg)	Animal Unit Equivalents on a Liveweight Basis
Weaned animal < 360	0.75
Young animal between 360 and 400	0.85
Cow between 400 and 500	1.00
Cow between 500 and 600	1.15
Cow > 600	1.25
Bull < 900	1.50
Bull > 900	2.00

Source of reference: (Buchanan and Lenstra, 2015)

Milk production in different regions of the world develops independently. However, the development and adoption of a series of production parameters (Table 3.8) allowed a significant increase in milk production (Callejas *et al.,* 2017; Camacho *et al.,* 2017). At the same time, other scientific advances related to the identification and use of physiological constants (Table 3.9) were incorporated in order to maintain metabolic checkpoints in herd health (Hoffmann *et al.,* 2019).

Table 3.8 Dairy Cattle Production Parameters

Size	Birth	Suckling	Weaning	Puberty	Breeding (natural or AI*)	First Calving (24 months)
Big[a]	35 kg of LW[†]	3 months	70 to 100 kg of and a concentrate consumption of 650 to 750 g/d	6 to 10 months with 300 kg of LW	12 to 14 months with 350 kg of LW	550 kg of LW
Median[b]	25 kg of LW					450 kg of LW
	1st Lactation	Dry Period	End of 1st Lactation (2nd calving)		End of 2nd Lactation (3rd calving)	
Big[a]	305 d	60 d	650 kg of LW		750 to 800 kg of LW	
Median[b]			550 kg of LW		650 kg of LW	
	Puberty	Breeding	Calving	Peak Production	2nd Third of Lactation	Dry Period
CC[+]	2.5	2.5	3.5	2.7	3.0	3.5

[a]Holstein; [b]Jersey; *Artificial Insemination at Fixed Time; [+]Body Condition; [†]Liveweight

Source of reference: (Camacho et al., 2017; Rivera et al., 2016)

During milk production, many metabolic and endocrine adaptations occur that, if ignored, will have a negative economic impact on the DPU (Castellón, 2015) by increasing the incidence of pathologies during the transition and postpartum period, and increasing the calving interval, due to an inadequate return to estrus (Britt *et al.,* 2018; García *et al*., 2020).

Table 3.9 Physiological Constants in Cattle

Physiological Stage	Temperature (°C)	Heart Rate (mov/min)[1]		Respiratory Rate (rep/min)[2]		Ruminal Movements (mov/2 min)[3]
Adult	37.7 - 38.5	40 - 80		10 – 30		2 - 3
Young	38.5 - 39.5	80 - 110		15 – 40		
	Milk	Urine	Blood	Ruminal Liquid	Abomasal Fluid	Saliva
pH[a]	6.5 -7.0	7.4 - 8.4	7.3 - 7.4	5.5 - 7.0	2.0 - 3.0	7.9 - 8.5

[1]Movements per minute; [2]Repetitions per minute; [3]Movements per two minutes; [a]Potential of hydrogen

Source of reference: (Hoffmann et al., 2019)

This is so much so that researchers and specialists in dairy cow reproduction recognize the importance of reproductive parameters (Table 3.10), in order to: i) Ensure the correct development of the feto-placental unit (García *et al.,* 2019); ii) Maintain an appropriate body condition (Mulligan and Doherty, 2008); iii) Prepare the mammary gland for the next lactation (Bruckmaier and Gross, 2017); and iv) Optimize milk production (Goff, 2006).

Table 3.10 Reproductive Parameters of Dairy Cattle

Physiological Event	Duration
Lactation	305 d (10 months)
Interval between births	Between 12 and 13 months
Age at first calving	24 months (2 year of life)
Days open	85 to 100 d (3 months)
Services per conception	1.0 to 1.65
First lactation	Between 2nd and 3rd year of life
Gestation	9 months: 2 embryonic development and 7 fetal development
Embryo implantation	35 d
Peak milk production	From the 6th to the 8th week postpartum
Dry period	60 d (2 months)
Percentage of fetal mortality	< 5 %
Metestrus	2 d
Diestrus	15 d
Proestrus	3 d
Estrus	18 to 24 h
Puerperium	30 to 50 d

Source of reference: (Davidson and Stabenfeldt, 2014b; Fails and Magee, 2018)

In general, these metabolic and endocrine adaptations reflect physiological changes that occur to facilitate the process of parturition (Davidson and Stabenfeldt, 2014a), prepare the mammary gland for colostrum and milk synthesis (García *et al*., 2020), and develop folliculogenesis to achieve a new conception (Jaffe and Egbert, 2017).

4. Good feeding practices in dairy cattle

Animal nutrition is the branch of zootechnics that deals with the distribution of food, with the objective of replenishing the cellular losses incurred by the activity of the organism (Weiss and Tebbe, 2018). Transforming the energy contained in food into heat, movement, work, and production (Galyean *et al.*, 2016), the balance of nutrients in the DPU significantly impacts milk production and the concentration of milk solids (e.g., protein) (Tedeschi *et al.,* 2017).

Those strategies that optimize rumen function use the classification of ruminant feeds, indicated by the National Research Council (2001), which distinguish three main groups of feeds: i) Energy feeders or feeds containing large amount of usable energy/unit weight (e.g., feed grains, molasses, fats and oils, brewery by-products, roots and tubers, beet and citrus pulp, bakery wastes, and oleins) (Parihar *et al.*, 2018); ii) Protein feedstuffs or feeds containing more than 20% of their weight as crude protein (**CP**) (e.g., meals of animal origin, protein of single cell origin or single cell protein, and non-protein nitrogen (**NPN**)) (Mulligan and Doherty, 2008); and iii) Fibrous feedstuffs or feeds containing high crude fiber content (e.g., dry hay or haylage, straw or stubble, and wet silage) (Jardstedt *et al.,* 2018).

In dairy cows, the transition period (21 d before and 21 d after calving) is the most critical physiological stage in milk production (García *et al*., 2020). During this time, significant amounts of energy inputs are incorporated into the diet (Reddy *et al.,* 2008). When this happens suddenly, the amylolytic bacterial flora is increased, and a high amount of lactic acid is produced (Kraut and Madias, 2010). In the rumen, lactic acid-consuming bacteria metabolize lactic acid to acetic, propionic, and butyric acid (Calsamiglia *et al*., 2008). However, the development of these bacteria is slow, resulting in delayed development of ruminal papillae, as they are primarily dependent on the presence of propionic (Aschenbach *et al.,* 2019), compromising nutrient supply to the mammary gland, and negatively impacting milk production (Tedeschi *et al.,* 2017).

Therefore, proper nutritional management practices are necessary, including: i) Maintaining the average hay [cut material, with 15% moisture and 85% dry matter (**DM**)] that requires an AU/d close to 3% of its LW (Figure 3.13), equivalent to 13 kg DM/d (National Research Council, 2001); ii) Maintaining the average silage (cut and fermented material with 60% moisture and 40% DM) that requires an AU/d close to 2% of its LW, equivalent to 9 kg DM/d (Jardstedt *et al.,* 2018); iii) Maintain the forage/concentrate ratio required to stabilize milk fat percentage, close to 40% forage and 60% concentrate (Bewley *et al.,* 2017); iv) Conserve average straw or stubble (remains of grass stalks, such as wheat and oats left on the ground after cutting the crop), which requires an AU/d close to 1% of its LW, equivalent to 4.5 kg DM/d (National Research Council, 2001);

Figure 3.13 Corn Silage (*Zea mays*) and Alfalfa Hay (*Medicago sativa*)

Source of reference: Personal photo

v) Employ yeast cultures to stabilize the rumen environment and improve fiber digestion (Dias *et al.*, 2018); vi) Maintain the average water required by an AU/d close to 10% of its LW, equivalent to 45 L divided in four periods, (plus 5 L/L of milk, if in production) (Bewley *et al.*, 2017); and vii) Use ionophores (e.g., monensin produced by a *Streptomyces cinnamonensis* strain) to inhibit the growth of $Gram^+$ bacteria in the rumen, enhance carbohydrate fermentation, increase propionic acid production (Kozerski *et al.*, 2017), and decrease methane (**CH_4**) production by -12 ± 6 g/d in dairy cows and -14 ± 6 g/d in beef cattle (Appuhamy *et al.*, 2013). These recommendations are only a practical guide, as there are other factors that also impact dairy cattle nutrition, such as rumen pH, and the type and physical form of dietary ingredients (Bewley *et al.*, 2017).

5. Best management practices for dairy animal facilities

For the establishment of a DPU, it should be in places where there is no interference with areas exposed to physical, chemical, and microbiological contamination (e.g., landfills, wastewater canals, industrial and urban areas), in order to minimize the introduction of hazards that affect safety during milk production (Gasque, 2008). The facilities should allow for daily activities (e.g., movement of cattle), considering their zoometry (Table 3.11) and social space, cleaning of infrastructure, and supply of incoming and outgoing inputs (Hernández *et al.*, 2017).

Table 3.11 Zoometry of Cattle, Social Space

Age	**Length** (cm)	**Width** (cm)	**Height at Withers** (cm)
	Calves		
14 days	118	25	81
3 months	132	32	89
6 months	173	44	107
1 year	210	59	125
2 years	220	63	131
	Cows		
600 kg of LW*	230	65	138
700 kg of LW*	240	70	144
*Liveweight			

Source of reference: (Hernández et al., 2017)

Housing, aisles, corrals, floors, and drainage must provide a healthy and comfortable environment for cattle, safeguarding their five freedoms of animal welfare: i) Freedom from hunger and thirst; ii) Freedom from fear and distress; iii) Freedom from pain, injury, or pathology; iv) Freedom from discomfort; and v) Freedom to express animal behavior (Kelly and Ryan, 2016). It should also facilitate favorable conditions for operators, and be integrated into the sub-systems of feeding, milking, and manure management (Secretaria de Agricultura Ganadería Pesca y Alimentación, 2014). The dimensions of the pens should adapt to the given number of cows, their production levels, age, and need for replacement (Gasque, 2008). To determine these dimensions, it is necessary to know the recommended area/cow, and the recommended space for housing (Servicio Nacional de Sanidad Inocuidad y Calidad Agroalimentaria, 2020):

- Area for dry weather pen: 12 to 12.5 m^2/cow;
- Area for wet weather pen: 12 to 20 m^2/cow;
- Space for earthen pen: 45 to 55 m^2/cow;
- Individual free-access cubicle space for paved pen: 9 m^2/cow; and
- Individual free-access cubicle space for dirt pen: 31 m^2/cow.

The shade orientation should be from north to south, with a variation of 11º and 5% slope, especially in climates with defined and abundant rainy seasons (Figure 3.14), with a minimum height of 3 m above ground level (Hoffmann *et al.*, 2019). To determine the shaded area, it is necessary to know the characteristics of the animals (Secretaria de Agricultura Ganadería Pesca y Alimentación, 2014).

- Shaded area for animals with 400 to 600 kg LW: 2.5 to 3.0 m^2/cow;
- Shaded area for steers with 300 to 400 kg LW: 2.0 to 2.5 m^2/head; and

– Shaded area for steers < 300 kg LW: 1.8 to 2.0 m^2/head.

Figure 3.14 Shades for Climates with Defined and Abundant Rainy Seasons, Paved Pens

Source of reference: Personal photo

Each feeder should have a 1.8 to 2.4 cm sidewalk towards the inside of the pen, to avoid floor wear and waterlogging (Gasque, 2008). The size of the trough should be adjusted to the number of animals housed in the pen, and the linear space/animal (Figure 3.15) should be proportional to their LW (Servicio Nacional de Sanidad Inocuidad y Calidad Agroalimentaria, 2020):

– Linear trough spacing for animals with < 270 kg LW: 45 to 55 cm/head;
– Linear trough spacing for animals with 270 to 350 kg LW: 55 to 66 cm/head;
– Linear trough spacing for animals with > 350 kg LW: 60 to 75 cm/head; and
– Linear feeding space for adult cows: 67 to 76 cm/cow.

Figure 3.15 Linear Feeding Trough Space for Dairy Cattle

Source of reference: Personal photo

Adult cattle require, on average, 45 L of water/d, divided into four periods (plus 5 L/L of milk, if in production) (Bewley *et al.,* 2017). Therefore, a 1 m linear trough can supply 25 AU/year, if a daily supply of 1,125 L is guaranteed (Kelly and Ryan, 2016). Consider 3 to 6 linear cm/animal (Figure 3.16), excluding the float and a height of 40 to 50 cm (Donworth, 2016).

Figure 3.16 Drinking Troughs in Paved Pens for Dairy Cattle

Source of reference: Personal photo

Silos are either trench-type (excavated) or bunker-type (above ground). Their capacity is adjusted to the programmed forage diet and, on average, require 2.1 m^3/t of stored forage (Servicio Nacional de Sanidad Inocuidad y Calidad Agroalimentaria, 2020). Haylofts (Figure 3.17) are sheds which are open on all sides or have a flat roof and, on average, require 5.44 m^3/t of stored forage in bales (Kelly and Ryan, 2016).

Figure 3.17 Hayloft for Storing Fodder in Bales

Source of reference: Personal photo

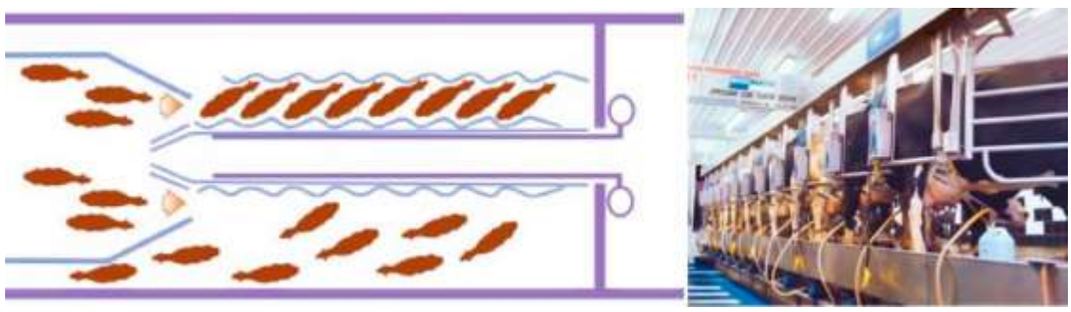
The DPU should have a calf hutch, outdoor or portable calf hutches (Figure 3.18), and individual pens with a covered and uncovered area (Donworth, 2016). Furthermore, there should be calving areas with individual cubicles that are well-protected and ventilated, with good drainage and adequate space (16 m2/cow), including individual feed and water troughs (Gasque, 2008).

Figure 3.18 Calf Hutch and Portable Calf Hutches

Source of reference: Personal photo

This should be specified according to herd size, DPU technification, type of cattle, available land and labor, five main milking parlors, and equipment used in the national territory: i) Herringbone, ii) Tandem, iii) Conventional stall, iv) Parallel, and v) Rotary or carousel (Bokusheva and Čechura, 2017). The herringbone parlor consists of two levels: On the first level, cows are accommodated in an oblique position, with 35º in relation to the longitudinal axis of the parlor (Figure 3.19), with the tail of the animals facing the milkers' aisle (Britt *et al.*, 2018); the second level is a pit with a depth of 75 to 80 cm, for the transit and handling of the milkers (Donworth, 2016). This type of milking parlor usually has feeding troughs for the supply of concentrate (Camacho *et al.*, 2017).

Figure 3.19 Herringbone Milking Parlor

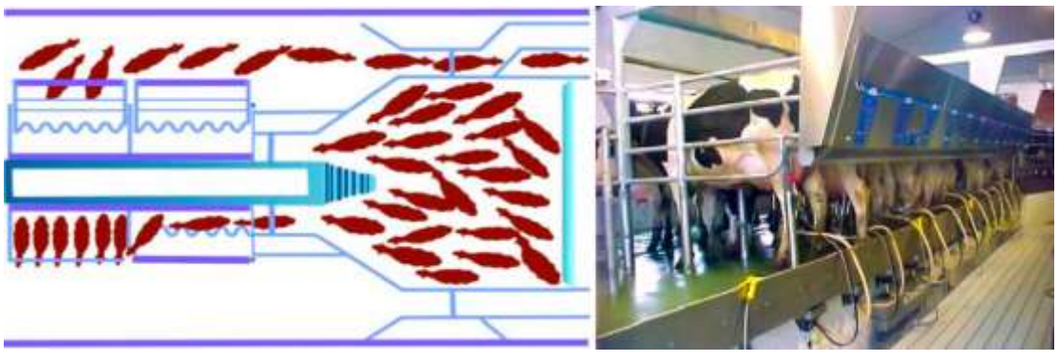


Source of reference: Personal illustration and photo

The tandem parlor, like the herringbone parlor, is a double-level parlor (Kelly and Ryan, 2016). Cows are handled individually, being immobilized in cages that are placed one behind the other in a linear fashion, with one entrance and one exit door (Gasque, 2008). The conventional stall room is a single row of stalls with only one level (Kelly and Ryan, 2016). Cows are placed parallel to each other and are immobilized by individual or collective adjustment chains (Servicio Nacional de Sanidad Inocuidad y Calidad Agroalimentaria, 2020).

The parallel parlor (Figure 3.20) has two levels: An aisle for the cows and a pit for the milkers (Gasque, 2008). The animals are handled in groups; they are perpendicular to the pit, and their exit is from the front (Secretaria de Agricultura Ganadería Pesca y Alimentación, 2014).

Figure 3.20 Parallel Milking Parlor



Source of reference: Personal illustration and photo

The rotary parlor or carousel is used to milk a high number of cows in a short time frame (Gasque, 2008). The animals are arranged on mobile platforms that can be individual or collective (Kelly and Ryan, 2016). In this milking system, cows are managed in groups, seeking to maximize the total yield of the facility (Servicio Nacional de Sanidad Inocuidad y Calidad Agroalimentaria, 2020). In all DPU, handling pens are necessary (Figure 3.21), equipped with chutes to allow proper flow of cows from one location to another (e.g., landing area to handling area, or to receiving pens with scales) (Donworth, 2016).

Figure 3.21 Handling Pens Equipped with Squeeze Chute

Source of reference: Personal photos

Finally, manure is a waste that favors the proliferation of potentially pathogenic microorganisms in the pens (Bewley *et al.*, 2017). In high concentrations, it releases ammonia (NH_3) into the environment (Rodwell, 2018), and in concrete pens, it causes slips, injuries, or infections in the feet (Rodríguez *et al.*, 2015). Therefore, if manure management is ideally structured, an area should be available for its deposition (pit with discharge chute), with adequate capacity for the rate of evacuation or use of manure by the DPU (Servicio Nacional de Sanidad Inocuidad y Calidad Agroalimentaria, 2020).

Conclusions

Between 2008 and 2018, global bovine milk production grew at an annual rate of 1.4%. The production of dairy derivatives (e.g., cheese, butter, and powdered milk, both skim and whole) continues to grow. In Mexico, cow's milk production grew at an annual rate of 2% to an all-time high of 12,279 million L during 2019. Although milk production continues to grow, it has not been sufficient to meet the requirements of the domestic market, revealing productivity gaps in Mexican Dairy Production Units. These productivity gaps reflect the integral management of livestock enterprises, considering nutrition, reproduction, facilities, animal welfare, and other zootechnical management practices.

However, the heterogeneity of the different cow milk production systems in Mexico gives rise to particular problems of productivity, competitiveness, and sustainability, all with their own associated characteristics, regions, and management. Therefore, this paper examines and integrates the international and national milk market, and the main zootechnical and economic indicators of its production, as a viable and practical proposal that allows cattlemen to participate successfully in national production in a globalized market where economies with unequal conditions are confronted. This information will serve as a support for anyone involved in, or related to, the sustainable production of dairy cows.

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Chapter 4 Territory and sustainability from municipal waste management programs: Piracicaba case, Sao Paulo, Brasil

Capítulo 4 Territorio y sustentabilidad desde los programas de manejo de residuos municipales: Caso Piracicaba, Sao Paulo, Brasil

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Abstract

The generation of solid waste is one of the greatest challenges of contemporaneity, specifically in Brazil, there was an increase from 67 million to 79 million tons per year, between 2010 and 2019. That said, in 2010 Law 12.305 / 2010, called National Solid Waste Policy (PNRS), which established, in order of priority, the non-generation, reduction, reuse, recycling, treatment and environmentally correct final disposal of waste, the Municipal Plan for Integrated Solid Waste Management (PMGIRS) in which describes the actions related to the management of urban solid waste and the strategies to protect human health and the environment. Given the importance of the PMGIRS for environmental management in the urban environment, the study of its applicability is justified, in which this article will address the city of Piracicaba, located in the interior of the State of São Paulo. In which, the objective of the research is to diagnose the practices related to agroforestry residues; evaluate the current state of the objectives proposed by the Municipal Solid Waste Plan; construction of a SWOT matrix; prepare a prospective analysis of agroforestry waste services and also an action plan for municipal waste. For this, the methodology used was the formal, exploratory, ex post facto, cross-sectional study in time, carried out from the prospection of articles, theses and dissertations in the Web of Science, SciELO and Digital Library of the main Brazilian universities . It can be concluded the concern of the municipality for the proper disposal of pesticide containers, in which the Cañeros Cooperative (COPLACANA) has a prominent role in practically all stages of reverse logistics in compliance with current legislation, however , the document did not comply with the guidelines for organic agroforestry waste, especially with regard to its reuse of energy and fertilizers.

Integrated Municipal Solid Waste Management Program, Municipality of Piracicaba, Sao Paulo; Agroforestry waste

Resumen

La generación de residuos sólidos es uno de los mayores desafíos de la contemporaneidad específicamente en Brasil, se registró un aumento de 67 millones a 79 millones de toneladas por año, entre 2010 y 2019. Dicho esto, en 2010 la Ley 12.305/2010, denominada Política Nacional de Residuos Sólidos (PNRS), que estableció, en orden de prioridad, la no generación, reducción, reutilización, reciclaje, tratamiento y disposición final ambientalmente correcta de residuos, el Plan Municipal de Gestión Integrada de Residuos Sólidos (PMGIRS) en el cual, se describen las acciones relacionadas con la gestión de residuos sólidos urbanos y las estrategias para proteger la salud humana y el medio ambiente. Dada la importancia del PMGIRS para la gestión ambiental en el medio urbano, se justifica el estudio de su aplicabilidad, en el que este artículo abordará la ciudad de Piracicaba, ubicada en el interior del Estado de São Paulo. En el cual, el objetivo de la investigación es diagnosticar las prácticas relacionadas con los residuos agroforestales; evaluar el estado actual de los objetivos propuestos por el Plan Municipal de Residuos Sólidos; construcción de una matriz FODA; elaborar un análisis prospectivo de servicios en residuos agroforestales y también un plan de acción para residuos municipales. Para ello, la metodología utilizada fue el estudio formal, exploratorio, ex post facto, transversal en el tiempo, realizado a partir de la prospección de artículos, tesis y disertaciones en la Web of Science, SciELO y Biblioteca Digital de las principales universidades de Brasil. Se puede concluir la preocupación del municipio por la adecuada disposición de los envases de plaguicidas, en la cual, la Cooperativa de Cañeros (COPLACANA) tiene un papel destacado en prácticamente todas las etapas de la logística inversa en cumplimiento de la legislación vigente, sin embargo, el documento no cumplió con los lineamientos para residuos orgánicos agroforestales, especialmente en lo que respecta a su reutilización de energía y fertilizantes.

Programa de Manejo Integrado de Residuos Sólidos Municipales, Municipio de Piracicaba, Sao Paulo; Residuos agroforestales

1. Introduction

Waste generation is inherent to modes of production throughout history, however, with the emergence and consolidation of the capitalist system and the development of mass consumption, waste generation has become one of the greatest environmental challenges today in various Latin American countries such as Mexico (Niño-Gutiérrez & Rosas-Acevedo, 2011), a particular case in waste management is the city of Acapulco (Niño-Gutiérrez & Rodríguez-Rodríguez, 2010).

Specifically with respect to Brazil, the industrialization process throughout the 20th century and its consequent economic development led to urban population growth from 10% in 1900 to 81% in 2000 (Brito, 2006). In this sense, population growth, the urbanization process, consumption growth and the inability of public administrators to manage the increase in waste generation and its respective socio-environmental impacts have increasingly highlighted the waste problem in Brazil. According to the Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE, 2020), according to the Panorama of Solid Waste in Brazil 2020, between 2010 and 2019, the generation of urban solid waste in the country registered an increase from 67 million to 79 million tons per year. In turn, per capita generation increased from 348 kg/year to 379 kg/year. Much of the MSW collected goes to landfill disposal, which saw an increase of 10 million tons between 2010 and 2019, from 33 million to 43 million tons per year.

However, part of this amount of waste is still destined for inadequate disposal, as controlled landfills grew from 25 million to more than 29 million tons per year, confirming the socio-environmental seriousness of the situation. That said, in 2010 the National Solid Waste Policy (PNRS) was approved, which established, in order of priority, the non-generation, reduction, reuse, recycling, treatment and environmentally sound final disposal of waste, the latter being when all waste is exhausted possibilities of reuse, with the aim of mitigating environmental impacts and avoiding risks to human health (Law 12,305/2010; Souto & Povinelli, 2013). In addition, the PNRS in which brings a set of concepts, tools, guidelines and objectives for the management and handling of solid waste in the country. Among these tools we can mention the Municipal Plan for Integrated Solid Waste Management (PMGIRS) (Chaves, Siman & Sena, 2020).

The PMGIRS, according to Law 12.305/2010, is:

A document that outlines and describes the actions related to the management of urban solid waste, which exposes aspects related to the non-generation, reduction, reuse, recycling and environmentally sound final disposal of waste. The PMGIRS also contains the general strategy of those responsible for waste generation, to protect human health and the environment, as provided for in Law 12.305/2010 and Decree 7.404/2010 that regulates it. See articles 3, 18, 19, 21, 26, 26, 31, 33, 35 and 36. The preparation of the PMGIRS is a mandatory condition for municipalities to have access to financial resources from the Federal Government, which are intended to invest in services related to urban cleanup and solid waste management.

Thus, the PNRS, specifically in its art.19, describes the minimum content required of the PMGIRS, which must include all aspects of management, such as: actions, procedures, controls, human, financial and material resources; and also the management aspects, which include all activities involved from waste generation to final disposal (Law 12.305/2010). In this sense, given the challenge of the management and handling of urban solid waste in Brazil, as well as the legal requirement for the elaboration of the PMGIRS by the country's municipalities and the same as an instrument of change in the solid waste scenario in Brazil, an analysis of this document is warranted. In this sense, the PMGRIS of the municipality of Piracicaba, a city in the interior of the state of São Paulo, was chosen as the object of study, and given the complexity of the document, the analysis of agroforestry waste was outlined, in order to allow a detailed analysis of the management, management, processes and their adequacy to the minimum content required by the PNRS of this waste.

Understanding that its implementation is as important as its elaboration, a diagnosis of this process was carried out, based on the successes and failures observed in terms of the objectives related to agroforestry waste, proposed by the municipality's PMGIRS. The present work aims to evaluate the management practices adopted by residents with respect to agroforestry waste in the municipality of Piracicaba, based on the requirements of the Municipal Solid Waste Plan, which is included in the Municipal Basic Sanitation Plan of Piracicaba, Sao Paulo, Brazil. In this sense, the following specific objectives are proposed: (a) Diagnose practices related to agroforestry residues in the municipality of Piracicaba, SP; (b) Evaluate the current status of the objectives proposed by the Solid Waste Plan in the area under study; related to agroforestry residues; c) Construct a SWOT matrix, representing strengths, opportunities, weaknesses and threats based on the diagnosis made, as well as the construction of actions and goals for the municipality for the year 2033 and d) Prepare a prospective analysis of services in agroforestry residues, as well as an action plan for the aforementioned residues in the municipality under study.

2. Method and materials

The present work, was classified as applied, since it aims to evaluate the Municipal Program for Integrated Solid Waste Management, specifically in what refers to agroforestry-pastoral waste, mainly in what, refers to aspects related to its management and handling in the municipality of Piracicaba, a city in the interior of the State of São Paulo in the light of the National Solid Waste Policy, with emphasis on its article 19, where the minimum content required for the PMGIRS is presented.

In addition, the present work is considered a formal study, since it aims to construct a matrix of strengths, opportunities, weaknesses and threats (SWOT), based on the diagnosis made, as well as the construction of actions and goals for the municipality for the year 2033, as well as to elaborate a prospective analysis of services in agroforestry-pastoral waste and an action plan for such waste in the municipality of Piracicaba.

As for the object of the study, it is exploratory, since it addresses a subject still little treated by the literature, specifically with regard to the analysis of a specific waste such as agroforestry and livestock waste, as well as of the municipality of Piracicaba. Table 4.1 summarizes the methodological descriptors.

Table 4.1 Methodological descriptors.

Category	Type
Degree of crystallization of the research question	Formal study
Object of study	Exploratório
Power of the researcher to produce effects on the variables studied.	*A posteriori*
Time dimension	Transversal
Research environment	Web

Source: Own Elaboration (2021)

To achieve the objective, qualitative research was adopted, mainly through consultation of the Municipal Program for Integrated Solid Waste Management of the Municipality of Piracicaba, published in 2019. The website of the Brazilian Association of Public and Cleaning Companies was also consulted, as well as, the National Congress, especially with regard to Law Number 12,305, of August 2, 2010, which instituted the National Solid Waste Policy. In a complementary manner, a bibliographic review was carried out by consulting articles published in journals indexed in the Scientific Electronic Library Online, SciELO, Web of Sience, Francis Taylor, Emerald and Springer Nature, as well as in the digital library of dissertations of Fundação Getúlio Vargas, Universidade de São Paulo, Universidade Estadual de São Paulo, Universidade de Campinas, Federal University of Minas Gerais, University of Brasilia and the websites of the Secretariat of Environment of the Municipality of Piracicaba, Cooperative of Sugarcane Planters of the State of São Paulo (COPLACANA), Cooperative of Rural Producers-Association of Sugarcane Suppliers of Coopercitrus and Capivari (CANACAP), in addition to master plans of rural areas in other latitudes such as Mexico (Niño-Gutiérrez, 2021).

With the information collected from the literature review, as well as from primary documents, discourse analysis was applied, in which the objective is to question the meanings established in diverse natures of scientific production, which can be verbal and non-verbal, provided that since their materiality produces meanings for interpretation (Caregnato & Mutti, 2006). In this sense, the summary of objectives, literature base, methods of data collection and analysis can be seen in Table 4.2.

Table 4.2 Summary of objectives and their respective rationale

Object of the article	Literary background	Method of collection	Data analysis
Diagnose the practices related to agroforestry residues in the city of Piracicaba, SP. Evaluate the current situation of the objectives proposed by the Solid Waste Plan of Piracicaba, SP, related to agroforestry waste; Construct a SWOT matrix, representing strengths, opportunities, weaknesses and threats, based on the diagnosis made, as well as, the construction of actions and goals for the municipality for the year 2033; Construct a prospective analysis of agroforestry waste services and an Action Plan for the municipality of Piracicaba.	PM GIRS (2019); Ley 12.305/2010	Study of articles and documents	Inductive-deductive analysis

Source: Own Elaboration (2021)

3. Results

According to Antenor and Szigethy (2020), Brazil is one of the countries that generates the most solid waste in the world, where part of it ends up being thrown outdoors, as well as dumped in the sewage system and burned. The current situation is even more serious, considering the legal and technological advances in the management of solid waste in the country, which would allow the economically viable treatment of this waste, especially the most complex, in which civil construction, agricultural, hospitals, industrial, mining and radioactive substances, but also those from domestic activities, urban cleaning classified as urban solid waste.

ABRELPE (2019), highlights that Brazilian cities generated about 79 million tons of urban solid waste in 2018, in which collection reached about 92% of this total, corresponding to about 72 million tons, of which only 43.3 million tons, 59.5% of what was collected, was properly disposed of in landfills. Of the remaining 29.5 million tons of waste, about 40% of what was collected was improperly disposed of in landfills and about 6.3 million tons generated annually remain uncollected, even though the legislation determines the destination of the treatment and the technology for it.

Translation made with the free version of the translator www.DeepL.com/TranslatorAunque, according to ABRELPE (2020), the gravimetric composition of municipal solid waste is 45.3% organic matter; 16.8% plastics; 14.1% tailings; 10.4% paper and cardboard; 5.6% textiles; leather and rubber; 2.7% glass; 2.3% metals; 1.4% multilayer packaging and 1.4% other classification subject to reverse logistics. According to Gouveia (2012), one of the consequences of inadequate MSW disposal is the serious social and environmental impacts, in which, in addition to living with a situation of increasing pollution rates, it will bear an increase in health expenditure and expand waste recovery and recycling actions, which brings waste of economic, natural and human resources. For Antenor and Szigethy (2020), this situation persists given the costs and lack of integration in the management of urban solid waste, which have been pointed out by specialists as the reasons for these results, which remain practically the same as before PNRS.

Agribusiness is one of the strongest economic sectors in the country. According to the Brazilian Confederation of Agriculture and Livestock, the Gross Value of Agricultural Production (GVP) will be 9.8% higher in 2020 compared to the previous year. However, this superlative agricultural production also influences waste generation. The residues of agricultural activity are composed of crop residues, such as straw and zootechnical activity, as well as organic residues that can be treated for subsequent use as fertilizer, both of which are considered to carry low concentrations of pollutants. Their seasonal production is determined by the maturity of the agricultural crop or the supply of raw material, therefore, wastewater mixed with other residues may be present (Rossol, 2012).

With respect to wastewater, it can be the result of washing, blanching, cooking, pasteurization, cooling and washing of product processing equipment and facilities. Regarding solid waste, it is processing leftovers, discards and packaging waste and sludge from wastewater treatment systems. (Gouveia, 2012). In addition, waste can be classified into organic and inorganic. Organic waste is produced both in the agricultural sectors such as coffee, sugar cane, soybeans, cocoa, bananas, beans, rice, corn and cattle from waste generated in livestock and effluents and waste produced in agribusiness, such as slaughterhouses and dairy products (Lima, 2016).

As for inorganic solid waste, it covers packaging produced in the pesticide, fertilizer and veterinary pharmaceutical input segments (Lima, 2016). Specifically with regard to, pesticide packaging, in 2018 the Campo Limpio system processed 44,261 tons of empty pesticide packaging, which represented about 94% of the total of this type of merchandise sold in Brazil (Silva, 2020). The mass of these recovered materials decreased by about 0.6% compared to 2017. Of this total processed, 93% went to recycling and 7% to incineration. With the reuse of these materials, between 2002 and 2018 the Campo Limpio System helped reduce around 688,000 tons of carbon dioxide emissions. In view of the current situation, the PNRS, for Pinto (2017) classifies agroforestry residues as those generated in agricultural and forestry activities, including those related to inputs used in these activities. In this sense, it is necessary to properly manage these residues in the generating agricultural properties.

Founded in 1767, on the banks of the river that bears its name, Piracicaba (Figure 1) had, according to the Brazilian Institute of Geography and Statistics (IBGE), about 407 252 inhabitants in 2020. Located in the interior of the state of São Paulo with South Latitude 22º 42' 30"'; West Longitude 47º 38' 01"' and Altitude of 554 meters; in the macro-region of Campinas, 164 km northwest of the state capital, it occupies a total area of 1 376 913 km², of which 31 573. 3 km² of urban perimeter and the 1 345 339 km² of rural area and the municipalities Rio Claro, Iracemápolis, Limeira, Rio das Pedras, Saltinho, Laranjal Paulista, Santa Bárbara D'Oeste, Anhembi, Águas de São Pedro and Charqueada as neighboring cities (IBGE, 2021; PIRACICABA, 2019).

Figure 4.1 Location of the Municipality of Piracicaba/SP

Source: Own Elaboration (2021)

According to the Prudente de Morais Museum (2020), the city became one of the first cities in Brazil to industrialize with the opening of metal-mechanical industries linked to the sugar-energy sector, which expanded with the strengthening of this economic segment in the country, especially during the National Alcohol Program (Proálcool). In 2012, it was the second most relevant sector of the city's economy, contributing R$3 248 627 thousand to the Gross Domestic Product (GDP), with emphasis on the metallurgical, metal-mechanical, textile, food and fuel sectors (petrochemical and ethanol production). In view of its industrial strength, in 2012, the city's GDP was the 14th largest in the state of São Paulo and 52nd in Brazil.

In terms of the agricultural sector, orange cultivation stands out, with 2 500 hectares, 49 000 hectares of sugar cane and 1 720 hectares of corn. In the livestock sector; the city has almost two million head, highlighting the herd of 50 000 head of cattle and 4 million poultry (Piracicaba, 2019).

In addition, Piracicaba is home to important Brazilian universities such as the Federal Institute of Education, Science and Technology of São Paulo, the Luiz de Queiroz School of Agriculture of the University of São Paulo, the School of Dentistry of Piracicaba, of the State University of Campinas, Methodist University of Piracicaba and School of Engineering of Piracicaba (Prudente de Morais Museum, 2020).

The Organic Law of the Municipality of Piracicaba was enacted on August 1, 1990, in which, among its various articles, discusses the obligation of the municipal government to address the issue in a legal, impersonal, moral, public and, above all, efficient manner, solid waste in the city, as can be seen in Article No. 204:

It corresponds to the Municipality, with respect to the public services of basic sanitation: VII. To plan, design, execute, operate and maintain the cleaning of public spaces, the removal, treatment and disposal of domestic garbage and other waste of any nature; VIII. To regulate and supervise the generation, conditioning, storage, collection, transportation, treatment and final destination of waste of any nature; IX. Establish forms of cooperation with other municipalities in the region, with the State or other government entities for the planning, execution and operation of actions related to the production of drinking water, treatment of sanitary sewage, drainage of rainwater and treatment and disposal of solid waste, given the characteristics of a function of common interest that such actions perform in the region (Piracicaba, 1990).

In addition, in its collection of articles, in particular numbers 209, 210 and 211 deal with the obligation, both of the public authorities and of society, of the correct disposal of waste, as well as its prior treatment, if it is classified as hazardous or harmful to public health and the environment:

The dumping of solid waste in the open air in public and private areas and in bodies of water is prohibited. Waste not generated in the Municipality of Piracicaba may not, under any circumstances, be deposited or treated on Piracicaban soil. Art. 210: The Municipality may require, under the terms of the law, and in accordance with the technical parameters it establishes, that the generating sources carry out prior treatment of the garbage and/or other waste produced by them. Art. 211: Garbage and waste considered hazardous to public health and harmful to the environment must be compulsorily subjected to prior treatment at the generating source, in accordance with the regulations established by the Municipal Government (Piracicaba, 1990).

In addition, the legal framework, particularly Article 217, defends, in the form of a law, the right of all citizens to live in a clean and healthy environment in which the quality of life is promoted in accordance with the Federal Constitution of 1988, and in this sense, the proper disposal of solid waste is mandatory. Every person has the right to an ecologically balanced environment, a good of common use of the people and essential for a healthy quality of life, imposing on the Municipal Government and the community the duty to defend, preserve and reconstitute it for present and future generations, in accordance with Article 225 of the Federal Constitution, being the Municipality responsible for: IX. Establish the intermediate zone, of at least two hundred meters, destined to the green area, separating the residential zones from the industrial ones. to install, as well as deposits of solid and/or liquid residues (Piracicaba, 1990).

Finally, the Municipal Organic Law concludes in its Article No. 224, which highlights the importance of the proper disposal of solid waste to better preserve natural resources, especially in this article the municipality's water collectors:

Art. 224. The Municipality shall participate in the Integrated Water Resources Management System provided for in Article 205 of the State Constitution, alone or in consortium with other municipalities of the same basin or region, ensuring for this purpose, financial and institutional means, being responsible for: IX. Promote the adequate disposal of solid waste to avoid compromising water resources, in terms of quantity and quality (Piracicaba, 1990). It can be concluded that the Municipal Organic Law, enacted in 1990, is in line with the Federal Constitution of 1988, as well as with the PMGIRS, aiming to materialize what the law advocates both at the federal level and at the level of the municipality of Piracicaba.

In 2014, the first Municipal Solid Waste Integrated Management Program (PMGIRS) was prepared for the municipality of Piracicaba, based on the data update of the 2009 Piracicaba Urban Solid Waste Sanitation Plan, published in 2011 from Decree No 14,206/2011 (Piracicaba, 2019). After four years of its implementation, an analysis of the guidelines, actions and objectives proposed in the original PMGIRS was carried out, which allowed the progress and efficiency of the actions to be evaluated, with the objective of updating the plan and consolidating the municipal waste policy based on the municipal reality (Piracicaba, 2019). According to Law 12,305/2010, agrosilvopastoral waste is generated in agricultural and forestry activities, including those related to inputs used in these activities. In which the main residues are: waste; waste water; dead animals; cultural and forestry residues and pesticide containers. Specifically, regarding pesticide containers, according to Law 12,305 of August 2, 2010 in the National Solid Waste Policy, specifically in its first paragraph of Article 33 states:

Art. 33. Manufacturers, importers, distributors and traders of: I - pesticides, their residues and packaging, as well as other products whose packaging, after use, constitutes hazardous waste, observing the hazardous waste management standards provided by law or regulation, in standards established by the bodies of Sisnama, SNVS and Suaa, or in technical standards (Law 12.305 / 2010).

In addition, according to Law 12.305/2010, reverse logistics is defined as:

Economic and social development instrument characterized by a set of actions, procedures and means aimed at enabling the collection and return of solid waste to the business sector, for reuse, in its cycle or in other productive cycles, or other environmentally appropriate final destination. Therefore, its operation is carried out on the basis of sectoral agreements in which it is a legal contract signed between the government and importers, manufacturers, traders, distributors, consumers regarding the implementation of the co-responsibility of the life cycle of certain products, such as, in this particular case, pesticides.

The Sectoral Agreement for the Implementation of the Reverse Logistics System for Packaging in General was signed on 25/11/2015 and aims to ensure the environmentally sound final destination of packaging. In this sense, the main actors in the pesticide supply chain, such as manufacturers, importers, traders and distributors, are committed to work together to provide an environmentally sound product for agrochemical packaging. Therefore, for its operationalization, the sectoral agreement includes support to cooperatives and partnerships with the commercial network for the opening of voluntary collection points (Ministério, 2018).

According to the PMGIRS of the municipality of Piracicaba, the packaging of pesticides, after their application in agricultural activities, the collection, transport and final destination of the packaging are the responsibility of the company that markets the pesticide, in the case of Piracicaba, the Producers. Cooperativa de Caña de Azúcar de Piracicaba y región (COPLACANA), which promotes the proper disposal of the containers. According to data from the COPLACANA Collection Center, between January 2014 and June 2019, 1 493 277 tons were collected, pesticide packaging (Piracicaba, 2019).

COPLACANA, with the objective of increasing efficiency and effectiveness in the collection of empty pesticide containers, established partnerships, through agreements with the Cooperative of Rural Producers (COOPERCITRUS) (Limeira) and the Cooperative of Sugarcane Planters of the Capivari Region Limited (CANACAP) (Piracicaba, 2019). In this sense, the packages received by COPLACANA, from customers, associates and representatives, are counted, weighed and classified according to size and class (contaminated or decontaminated).

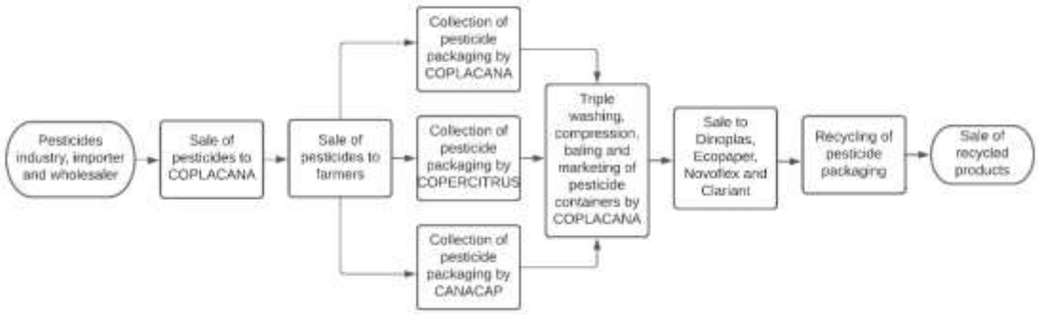
Subsequently, the material undergoes a triple washing, in accordance with Brazilian Regulatory Standard No. 13.968, in which the following steps are followed:

1. Emptying. The package is emptied and subsequently filled with clean water up to a quarter of its volume, the lid is replaced and tightly closed (INPEV, 2019);
2. Shaking. The package is shaken vigorously in all directions for 30 seconds to dissolve any product residue that has adhered to the internal surface of the package. The water from this first rinse is poured into the tank of the application equipment. The package remains over the tank opening for approximately another 30 seconds to allow all contents to drain. This rinsing procedure is repeated two more times (INPEV, 2019);

3. Disability. Finally, the package is rendered unusable, in which the bottom is punctured with sharp objects (INPEV, 2019).

Finally, the packages are compressed, packed and sold to recycling companies authorized by the National Institute for Processing Empty Containers (INPEV), where they are transformed into brooms, sewers, ducts, supermarket carts, and others, by companies Dinoplast (Louveira/SP), Ecopaper (Pindamonhangaba/SP), Novoflex (Várzea Paulista/SP) and Campo Limpo (Taubaté/SP). As for contaminated containers, they are incinerated at Clariant (Suzano/SP) and Essencis (Taboão da Serra/SP) (Piracicaba, 2019). Figure 4.2 illustrates the entire detailed procedure of the research.

Figure 4.2 Pesticide packaging flow diagram in the municipality of Piracicaba.



Source: Authors' Elaboration (2021)

Residues resulting from agroforestry activities cover a wide spectrum of biomass wastes, including manure, eggshells, chicken litter, wastewater, straw, fallen fruit and forest harvest residues. Each of these aforementioned elements will vary according to the volume of creation, planting, efficiency, management effectiveness and technologies used in the process. In this sense, the main indicators of agroforestry residues generated by the municipality of Piracicaba can be summarized in Table 4.3.

Table 4.3 Synthesis of agroforestry residues in the Municipality of Piracicaba in 2019.

Reproduction	Waste production	Quantity	
Poultry	Excrement	MS11 548t	MN24 644t
	Eggshell	69.4t	
	Broiler litter	MS 1 769.4t	MN 53 083.3t
	Dead birds	37 000 to 299000 birds	
Bovina	Manure	BL336 360t	BC4 565 728t
	Wastewater	20 835 000 a 33 336 000L	
	Dead animals	1 215 animals	
Piggery	Excrement	DL[5]20 898 000L	LDS[6]5 710.5t
	Dead animals	377 animals	
Sugar cane	Straw	637 000t	
Orange	Fallen fruit	11 767t	
Corn	Straw	19 917.6t	
Eucalyptus	Forest harvesting residues	290 500t	
Packaging of phytosanitary products	Packaging	300t	

Source: Piracicaba (2019)

[1] MS. Dry Matter
[2] MN. Natural Matter
[3] BL. Dairy Cattle
[4] BC. Cutting Bovine
[5] DL. Liquid Waste
[6] DS. Solid Waste

4. Discussion

In the analysis of the present PMGIRS, especially in the chapters referring to the diagnosis of agro-silvo-pastoral waste, the result of the implementation of the PMGIRS in the period 2014 to 2018 and the evolution of the plan indicators, the result of the implementation of the plan in the period 2014 to 2018, guidelines, goals and actions of the plan for the period 2019-2024, programs and actions for the participation of interested groups (cooperatives, associations, low-income people) and mechanisms for the formation of business sources, management of the plan: monitoring and evaluation of the plan and the municipality's waste indicators, waste management projections for the next 20 years and final considerations none were found related to the treatment of waste from the activities mentioned in Table V, except for pesticide containers. In addition, as can be seen, a significant volume of biomass waste generated can be considered, at this point there is a problem and also an opportunity. When not properly treated, this waste is a serious vector of environmental degradation, both for the soil and for the water catchment in the municipality and its surroundings. However, there are both legal frameworks and appropriate technologies for the reuse of such a volume of residual biomass, which can be converted into fertilizers, biogas and its use for electricity generation, fuel substitution and gas pipeline feed from the purification of biogas into biomethane.

Although this type of procedure is technically feasible, whether from digesters, motogenerators or cogenerators, the economic and financial viability of these projects varies according to the type of biomass, the economic scenario, the legal framework, public policies for the promotion of renewable energies and the efficiency of the biodigester and the motogenerator. Unfortunately, not only in the city of Piracicaba, but in Brazil as a whole, there are no policies that promote the energetic reuse of biomass residues, which means a triple loss: either because of the opportunity cost for agricultural producers, or because of the environmental impact of these residues on the surroundings and, finally, because of the non-creation of jobs, the latter being further enhanced by the economic, social, environmental and energy crisis that the country is going through, especially aggravated by the Sars-Cov-2 pandemic. Based on the analysis of the Municipal Program for Integrated Solid Waste Management of the Municipality of Piracicaba, as well as on the literature review, it is possible to formulate the SWOT matrix, which stands for strengths, weaknesses, threats and opportunities. For Sorensen, Engström and Engström (2004), SWOT analysis is an easy-to-use method, which allows obtaining a panoramic view of the environment and identifying areas for improvement and, in addition, aims to promote learning about the situation by reflecting on what can be done. Therefore, specifically for agroforestry-pastoral wastes, the SWOT matrix is shown in Table 4.4.

Table 4.4 SWOT matrix for agroforestry and livestock wastes

	Positive Factors	**Negative Factors**
Internal factors	**Strengths**	**Weaknesses**
	– Internal preparation and periodic evaluation of the PGRA; - Participation of a multidisciplinary team in the preparation and updating of the PMGIRS; - Control of waste generation and collection establishments; - Knowledge of current legislation on waste treatment. - Use of recycled and organic material; - Employees aware of their participation in the plan.	– Possible non-disposal of recyclable packaging waste for reverse logistics; – Possible non collection of waste for third parties; – Absence of guideline with justifications, goals, strategies, responsible parties, deadlines, indicators and results for agroforestry biomass waste; – Non-energy reuse of agroforestry biomass residues; – Non-compliance with PGRA guidelines by managers and employees. – PGRA guidelines by managers and employees.
External Factors	**Opportunities**	**Threats**
	– Encouragement of managers to promote generation reduction; – Increased visibility of cooperatives; – Investment in training and qualification of employees; – Investing in continuous improvement of the PGRA; – Reuse of organic waste to generate biogas for cogeneration (electricity and heat) and fuel substitution; – - Cogeneration of income.	– Contamination of water resources; – Soil contamination; – Risks to human health .

Source: Prepared by the authors (2021)

Based on the SWOT matrix prepared, as well as the PMGIRS and the literature review, a scenario analysis can be constructed, as well as actions and goals up to the year 2033. In view of what has been presented in this study, as well as what has been discussed with the literature review, actions and goals can be proposed for the year 2033, specifically for agroforestry residues, the subject of this disciplinary work. Even with the current financial and social crisis that Brazil is going through, agribusiness, in particular, is one of the least affected economic segments, since much of its production is exported to countries such as China, the United States, Japan and the European Union, in addition to Latin American countries (Niño-Gutiérrez, 2021) and how these nations are in the process of economic recovery from the crisis caused by the COVID-2019 pandemic.

In this sense, it can be assumed that there will be an increase in the demand for pesticides in the main agricultural units of the country, including the city of Piracicaba. Given that COPLACANA, together with partners COOPERCITROS and CANACAP, are responsible for the collection of agrochemical containers, the former being in charge of giving due treatment to such byproducts, as established by Law No. 12,305 of August 2, 2010 in accordance with NBR No. 13,968, it can be assumed the need to expand the structure from the reception of these packages to the triple washing process, as well as compartmentalization, packaging and commercialization.

In this sense the PMGIRS of the Municipality of Piracicaba in its chapter four, referring to the guidelines, goals and actions of the plan for the period 2019-2024, specifically in guideline 21 contemplates justifications, goals, strategies, responsible parties, deadlines, indicators and results, as can be observed:

Guideline 21. Develop and implement an agroforestry residue management program. Problem/Rationale: According to the PNRS and CONAMA resolution 458/2013, agroforestry waste is the result of activities linked to agriculture, animal production and forestry production. According to the draft version of the PNRS and the state solid waste plan, one of the main problems related to solid waste in rural areas is the packaging of inputs used in these activities, such as pesticides, fertilizers and veterinary products, and only pesticides are expressly cited in the law 12.305/2010 as mandatory the application of the reverse logistics system. The application of this guideline is intended to identify the agroforestry waste generated and propose actions for its correct management.

Define criteria and recommendations for the proper management of agroforestry and livestock waste. Approach: Actions: Incorporate members of the sector to the PMGIRS Review Commission and create specific WGs (suggestion: SEMA, CATI, EDA, NEA, ESALQ) for the elaboration of the program of actions for the destination of agroforestry and livestock wastes.

1.1 Carry out the diagnosis/inventory and elaborate the agroforestry and livestock waste program, quantifying and identifying the problems and needs for action.
1.2 Oversee the agrochemical container collection program.
1.3 Make ENP structures available in rural areas.
1.4 Implement an educational communication program. [RESPONSIBLE: PREFEITURA, COPLACANA, CATI, ESALQ and GENERADORES; PREFEITURA and ESTABLISHMENTS RESPONSIBLE FOR COLLECTION AND DESTINATION PREFEITURA. TIMEFRAME: 2019-024. RESULTS: Diagnosis of waste generated for disposal according to current environmental legislation; INDICATORS: Participation of the sector's representative in the PMGIRS Review Commission; Diagnosis of agroforestry and livestock waste (Piracicaba, 2021, p. 177).

Furthermore, with specific regard to residual biomass from agroforestry activities, an increase in its production can also be assumed, given the economic prospects of Brazilian agribusiness. However, unlike agrochemical containers, no reference to the energetic reuse of these residues was observed in the municipality's PMGIRS. However, in view of the emergence of environmental policies in central countries such as the United States with the Green New Deal and in the European Union with the European Green New Deal and the adoption by large transnational financial companies of the Environment, Social and Governance (ESG), the country should rethink its development model based on the promotion of renewable energies, especially biomass.

On this point, Piracicaba can become a pioneer by hosting one of the most traditional schools in the agricultural sector, such as ESALQ USP and also the Centro Tecnológico da Cana de Açúcar (CTC), as well as a government committed to environmental issues such as the Municipal Organic Law, enacted in 1990, which already covered the issue of solid waste, which only 20 years later became a national law, as well as the quality and democratic construction of the municipality's PMGIRS. In this sense, taking into account the previous analysis of the national agribusiness, and its correlation with the agroforestry activity in the city of Piracicaba, as well as the SWOT matrix and the PMGIRS,

Table 4.5 Prospective analysis of services in agroforestry residues

Indicator	**Current Scenario**	**Reference Scenario**	**Future Scenario**					
			Relationship to SDGs	Goals	Deadline/Quantification			
					Immediate	Short	Medium	Long
					2021-2023	2024-2026	2027-2029	2030-2033
Pesticide container collection coverage	100%	100%	2 Sustainable agriculture 12 Responsible production 14 aquatic life 15 terrestrial life	Maintain the collection at the current level and expand it in proportion to the increase in demand.	100%	100%	100%	100%
Proper handling of pesticide containers	100%	100%	2 Sustainable agriculture 12 Responsible production 14 aquatic life 15 terrestrial life	Maintain treatment at the current level and expand it proportionally to the increase in demand.	100%	100%	100%	100%
Proper disposal of pesticide containers	100%	**100%**	2 Sustainable agriculture 12 Responsible production 14 aquatic life 15 terrestrial life	Maintain destination at this level and expand with other partners	100%	100%	100%	100%
Lack of guidelines for agroforestry biomass residues	No data	100%	2 sustainable agriculture 7 clean energy 12 Responsible production 14 aquatic life 15 terrestrial life	Development of a guideline for agroforestry biomass residues	100%	100%	100%	100%
Energy reuse of agroforestry biomass wastes	No data	100%	2 sustainable agriculture 7 clean energy 12 Responsible production 14 aquatic life 15 terrestrial life	Harnesses the energy value of agroforestry residues	5%	25%	50%	100%
Reutilización energética de los residuos de biomasa agroforestal	No data	100%	2 sustainable agriculture 7 clean energy 12 Responsible production 14 aquatic life 15 terrestrial life	Harnesses the fertilizer value of agroforestry residues	5%	50%	75%	100%

Source: Own Elaboration (2021)

This is complemented with Table 4.6

Table 4.6 Action plan for agroforestry residues in the municipality of Piracicaba

Indicator	Goal	Deadline	Shares	Deadline
Pesticide container collection coverage	Maintain this pesticide container collection coverage.	Continua	Expansion of collection points in line with the increase in consumption	Immediate
Proper handling/treatment proper handling of pesticide containers	Maintain the current treatment of pesticide container collection.	Continua	Employee training	Immediate
			Expansion of transportation channels	Short
			Expansion of triple wash instruments	Short
			Expansion of compression instruments	Short
			Expansion of pressing instruments	Short
Proper disposal of pesticide containers	Maintain the current pesticide container collection destination.	Continua	Expansion of sales channels with INPEV-certified companies and in line with the increase in consumption	Inmediate
Directrices para los residuos de biomasa agroforestal	To achieve the elaboration of the agroforestry biomass residues guide.	Continua	Develop a guide for agroforestry biomass residues.	Immediate
			Permanent updating of this guide	
Reutilización energética de los residuos de biomasa agroforestal	Achieve full energy use of agroforestry biomass residues.	Medium and Long	Technical training for farm owners	Short
			Investments in biodigesters, boilers, motogenerators and biogas scrubbers	Medium and Long
			Biomethane and electricity trading	Long
Reutilización de fertilizantes de residuos de biomasa agroforestal	Achieving full utilization of fertilizer residues agroforestry biomass	Medium	Technical training for farm owners	Short
			Investments in biodigesters	Medium and long
			Commercialization of biofertilizers	Long

Source: Own Elaboration (2021)

5. Conclusions

The Municipal Program for Integrated Solid Waste Management is a fundamental tool for the diagnosis, planning, implementation and control of waste at the municipal level, which responds to the social and environmental challenges to be overcome in the 20th century, especially in Brazil, a country marked by social inequality, technological backwardness and environmental disrespect.

In this sense, the PMGIRS of the city of Piracicaba, prepared and reviewed by a multidisciplinary team, the most important institutions of the city and the state of São Paulo as the Secretariat of Environment of the Municipality, as well as the Luiz de Queiros School of Agriculture of the University of São Paulo, comes both in line with the organic law of the municipality and the Federal Law No. 12.305/2010 and allows public managers maximum efficiency in the management of municipal solid waste, consequently contributing to social and economic development in line with environmental preservation. Specifically regarding agroforestry and livestock waste, the document stands out for the clarity, methodology, data and information used and conveyed to the reader in which the concern of the municipality is highlighted especially with the proper disposal of pesticide containers, in which the sugarcane growers cooperative - COPLACANA has a leading role in virtually all stages of reverse logistics in compliance with current legislation, especially NBR No. 13,968, Federal Law No. 12,305/2010 and the Sectoral Agreement of 25/11/2015. However, no guidelines are observed in the document for agroforestry-pastoral organic waste, especially regarding its reuse for energy and fertilizer.

In this sense, a SWOT Matrix was prepared, as well as a prospective analysis of services in agroforestry-pastoral waste and an action plan for such waste in order to contribute, humbly, to the improvement in its future editions and, therefore, fulfilling the objectives described in the methodology of this work.

The municipality of Piracicaba is advanced in the practices of disposal and collection of agroforestry and livestock waste, having reverse logistics covering the entire urban area of the municipality. It is important to highlight the importance of a complete diagnosis of agroforestry residues, since it will serve as the basis for all proposals presented by the plan, such as programs, objectives and goals. It is necessary to know the local reality in order to effectively manage and administer agroforestry and livestock waste. Although the city of Piracicaba is well served by this service, it is still necessary to expand the inspection, either by the municipal, state and federal government, given the increase in pesticide consumption in the next decade.

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Chapter 5 Assessment in Higher Education

Capítulo 5 la evaluación en Educación Superior

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Resumen

El proceso de la evaluación no es un ente independiente de la enseñanza, son procesos indisociables, a lo largo de más de 20 años de experiencia como docente de nivel superior, he constatado de primera mano que el momento de mayor tensión para los alumnos se presenta en los periodos de evaluación, los exámenes generan un sin número de reacciones y las calificaciones propician comentarios que tiene focos comunes sin importar el semestre o licenciatura que se curse, se escucha que los alumnos no están conformes con las calificaciones que reciben, pues consideran que no son el reflejo de sus acciones, que no fueron equitativamente valorados, que los criterios de evaluación son incomprensibles, que los docentes califican de forma arbitraria. Por ende, el trabajo que se presenta es el resultado de una investigación documental que busca entender el descontento estudiantil, para brindar elementos teóricos y metodológicos a los docentes que permitan mejorar las prácticas evaluadoras y así, incidir de forma positiva en el desempeño de los alumnos. Iniciamos el abordaje indagando sobre el origen del término, se exponen los fundamentos, características y fines; así, como cada una de las etapas, se hace una descripción de la tendencia evaluadora en México y su herencia derivada del proceso de industrialización de los Estados Unidos con matices científicos con influencia del paradigma cuantitativo con enfoque tecnocrático y sumativo.

Evaluación, Enfoques de la evaluación, Instrumentos de evaluación

Abstract

The evaluation process is not an independent entity of teaching, they are inseparable processes, over more than 20 years of experience as a higher-level teacher, I have verified first-hand that the moment of greatest tension for students occurs In the evaluation periods, the exams generate a number of reactions and the grades lead to comments that have common foci regardless of the semester or degree being taken, it is heard that the students are not satisfied with the grades they receive, because they consider that They are not a reflection of their actions, that they were not equitably valued, that the evaluation criteria are incomprehensible, that teachers qualify arbitrarily. Therefore, the work that is presented is the result of a documentary investigation that seeks to understand student discontent, to provide theoretical and methodological elements to teachers that allow improving evaluation practices and thus, positively influence the performance of students. students. We begin the approach by inquiring about the origin of the term, the foundations, characteristics and purposes are exposed; Thus, like each of the stages, a description is made of the evaluating trend in Mexico and its inheritance derived from the industrialization process of the United States with scientific nuances influenced by the quantitative paradigm with a technocratic and summative approach.

Evaluation, Approaches to evaluation, Evaluation instruments

Introduction

Evaluation is a very complex human practice, and without a doubt, it is very likely that it appeared informally long before education. It probably contributed to the survival of the human species that were lacking the superior capacities and abilities that other species had. For example, other species such as the ancient hunters had to evaluate the necessary number of men they needed to be able to face their prey. The ancient kings evaluated if they had the capacity to face the enemy or if it would be more advantageous to establish a peace agreement. If we delve into the areas in which evaluation occurs, we will realize that it exists from religion to everyday life. It is not for nothing the great apostle St. Paul tells his disciple Timothy "Be diligent to present yourself approved to God." This notion refers us to an evaluative practice that consists of measuring the merits of a person around a predetermined objective and issue a pass or fail judgment. For example, in everyday life, a person's personal speed to cross a street and not be run over by an oncoming car; in the business context, corporations spend large sums of money annually to evaluate the relevance of launching new products on the market.

In the field of evaluation, the most stressful stage for students is the so-called evaluation or exam period. Regardless of the educational level or the type of school in which they study, every student has experienced that feeling of helplessness, frustration, and anger when they receive their grades and judge that they are not consistent with the efforts and activities that they performed.

Teachers sometimes do not have an easy time either, since they feel that the evaluation can provide elements to judge their performance in front of the students (especially in private schools). In light of such situations, an informal survey was conducted among a group of senior-level students in three schools (this exercise was part of a commitment to a subject of a doctorate that was studying at the IEXPRO University Center). The exercise in question used the tool in-depth interview and was applied to both teachers and students.

The results were analyzed in an automated way with the Atlas Ti program, and they were very revealing. It was noted that the teachers do not even know the meaning of the term evaluation, and they also show a pseudo-knowledge of the evaluation techniques and instruments. Something that attracted a lot of attention was that one of the students' suspicions was confirmed that the teachers grade arbitrarily for the following reasons: they use evaluation indicators but do not establish the criteria in a congruent, coherent, and systematic way. They often confuse the techniques with the instruments of evaluation and arbitrarily assign scores to indicators not established in the framework (which is certainly questionable) of the subject. On the other hand, the students do not have firm performance references, since the activities are rarely sanctioned according to a commonly established parameter. Also, sometimes they identify that the teachers do not keep systematic records of the evidence of the students' work.

In view of such revelations, the present document is not exhaustive nor absolute, but it aims to provide guidance at first of a theoretical nature and then to propose practical situations that will lead to an improvement in the evaluation activities developed by teachers which will consequently improve student performance.

1. The evaluation in Higher Education

1.1. The evaluation origins, foundations, characteristics, and purposes

1.1.1. Origins and development of the evaluation

Undoubtedly, trying to understand the teaching process independently of the evaluation can be irresponsible if one does not start looking at the origin of a term so often used but very misunderstood in education.

Etymologically speaking, evaluating means "determining the value that something has for the achievement of certain objectives" (Zarzar, 2010; Page vi) and from an administrative point of view, one of the four steps of the administrative process: defining objectives, planning, implementing, and evaluate. The online dictionary of the Royal Academy of the Spanish Language presents evaluation simply and plainly as "Action and effect of evaluating" (RAE, 2019; S / P), which is directly related to estimating knowledge, skills, and student performance.

In a query to the Webscolar dictionary, citing Popham (1990) and Ramos (1989), they define evaluation as an activity inherent to all intentional human activity that consists of determining the value of something through a systematic process of identification and collection or data processing in order to assess it. On the other hand, Fernández (2005), Doll (1989), and Rodríguez (2000) consider evaluation as a contextualized, systematized, continuous, and intentionally designed process to collect and inquire relevant, reliable, and valid information that allows an evaluative judgment to be made, often related to the measurement or verification of the degree of achievement of objectives.

For the international labor organization dependent of the UN, citing the OECD (2010), it considers that evaluation as a "systematic and impartial appraisal of an ongoing or concluded project, program or policy, its design, its implementation, and its results" (OIT, N/D; S / P). Of this definition, the characteristics of systematicity, continuity, and integrality are redeemable, which determines to what extent the previously determined objectives have been achieved, which include the incorporation of the study of processes, results, and impact. In another vein, Lafourcade (N/D) explains that evaluation is the stage of the educational process that seeks to systematically verify to what extent the objectives proposed in advance have been achieved. Adding to that, Macario, Pila, and Teleña (N/D) state that the evaluation consists of making a value judgment based on a set of systematically collected data, integrated into the educational activity with the aim of continuously improving through the most exact knowledge possible of the student in all the aspects information on the progress or the results of a student.

Mora (2004) gives a quantitative definition in which he says that evaluation is "a control phase that aims not only to review what has been done but also to analyze the causes" (Mora, 2004; Page 2) Once some conceptual references have been established, we proceed to a brief approach to the history of evaluation. Durkheim (1938), Judges and Díaz Barriga (1971 and 1993), cited by Hernández, Montes, and Delijorge, (2013), point out that evaluation dates back to an exam that was given in the Chinese bureaucracy to choose the mandarins who would administer the resources of the Dynasties from the year 2375 BCE which remained until 1905 CE, many insist on pointing out that this stage should be considered as the first or Pre-Tylerian. However, only taking into account the practices of the Chinese would be unfair to other parties in other parts of the world that also developed practices that contributed to the construction of the evaluation, for which reason each of the stages are outlined below. The development stages of the evaluation

The First Stage appears in the second century (BCE) when oral examinations were given in China by Chinese officials in the selection of civil service officials. Forrest cited this in Sacristán (2002) as well as Alcaraz (2015), Stufflebeam (1987), Gil, Morales, and Meza (2017). Lemus (2012) goes a little further and places the application of the evaluation questionnaire used by Socrates and other 5th century masters (BCE). On the other hand, Durkheim, cited by González Pérez (2000), says that educational evaluation systems (dogmatic) can be placed between the 5th and 15th centuries (AD), Hernández, Montes, and Delijorge (2013). Durkheim also said that the exam that appears in the educational setting of the medieval university was given in order to show the competence acquired by the student and not as an instrument of certification or promotion.

From the appearance of evaluations in China and Greece to evaluations in medieval times, there were no great advances. However, after the medieval period, Lemus, Hernández, and Guzmán (1991) tell us that in the United States in 1845, they began to give performance tests to students. In Great Britain, the public services created a commission to evaluate education in Ireland. In 1845, in Boston, the use of school achievement tests to evaluate schools began. Between 1887 and 1898, the pedagogue Joseph Rice used comparison groups to measure the effectiveness of programs for the first time and was recognized as the first formal evaluation in America.

Other important data was presented by Stufflebeam and Shinkfield (2005), Guba and Lincoln (1982, 1989), and show agreement in naming "Pre-Tylerian Epoch" (the Pre-Tylerian or technical) to the period of development of the evaluation comprised between 2000 BCE and the year 1930 CE. They expressed particular interest in the year 1916 when performance and intelligence tests were given. Guba and Lincoln (1989) agree to name this period as the first generation, the generation of the measure. However, it should be noted that evaluation and measure had little to do with school programs.

For Escudero (2003), measurement and evaluation were interchangeable terms before the First World War. But then, a special interest in the application of intelligence and personality tests arose. Between 1920 and 1930, standardized tests occupied a privileged space in the education field with the intention of measuring school skills. This gave place for the next stage of the evaluation to arise; however, according to Stufflebeam and Shinkfield (N/D) cited by Alcaraz (2015), evaluations before the 1930s were focused on assessing the outcome of educational programs in students.

The so-called Second Stage, also known as the "Tylerian Period" Alcaraz (2015), went from 1930 to 1957. According to Guba and Lincoln (1982, 1989), it is also known as the second generation of evaluation. It was given this name by the father of the educational evaluation, Ralph Tyler (1969). Its main characteristic was that the evaluation based on the norm began to be abandoned, and what arose is known as criteria-based evaluation.

The Third Stage is recognized by Alcaraz (2015), Guba and Lincoln (1982, 1989), Stufflebeam and Shinkfield (2005) as the "era of realism" or the "third generation of evaluation," that of judgment, which ran from 1957 to 1972. It is in this period that accountability begins, so it was also called the generation of the judgment and valuation by Stobart (2010). At the same time, proposed that the accountability present in the current PISA, PIRLS assessments are direct legacies of this stage. This period has the harshest critics of Tylerian thinking in Cronbach (1963) and Scriven (1967), since they pointed out that it was necessary to overcome the limitations of the evaluation model in what they call subject-oriented evaluation.

According to Guba and Lincoln, cited by Escudero (2003), evaluation in the Tylerian period is characterized by introducing the assessment and the judgment as intrinsic content in the evaluation. Hernández and Guzmán (1991), as well as Cronbach (1963), and Scriven (1967), make special contributions to overcoming Tylerian constraints. For that reason, they are considered the founders of modern curriculum evaluation and of the principles that today are defended in terms of educational evaluation. They introduced the use of questionnaires, interviews, systematic and non-systematic observation as evaluation techniques, to which we owe currently used terms such as formative evaluation, summative evaluation or intrinsic evaluation, and extrinsic evaluation.

The Fourth Stage also called "the fourth generation," the sensitive, "sensitive and constructivist," or "the era of professionalization" by Stake (1976), Guba and Lincoln (1982, 1989), Alcaraz (2015), and Stufflebeam and Shinkfield (2005) is happening from 1973 to the present day. In this regard, Escudero (2003) points out that this period is divided into two sections, the first with marked Tylerian characteristics and the second from the seventies with the appearance of the alternative models of evaluation. Also, Guba and Lincoln (1982) establish two groups of evaluation: "the quantitative and the qualitative." In addition to this, two fundamental elements emerge: "the constructivist methodology and the responsive evaluation" (Alcaraz, 2015; Page 17).

The Fifth Stage is a personal proposal and does not appear as such in any document consulted. However, we are in a period that far exceeds the last century's approaches to evaluation. The so-called fifth stage is due since it has its own characteristics, such as what I call functional illiteracy about evaluation (theoretical knowledge of evaluation techniques and instruments, intermingled with a total lack of practical knowledge of them). On the other hand, in the sources consulted (which do not correspond to work carried out in the last quarter of the 20th century), reference is made to a period of construction and consolidation. So logically, at the beginning of the third decade of the 21st century, with the boom in research in several areas of education and currently even careers related exclusively to evaluation, the current stage may well be called the number five. Yet another reason is that the development of evaluation has not remained static, as expressed by Vélez (2007), cited by Alcaraz (2015), which speaks of the birth of a new paradigm.

This new paradigm opens up new evaluative possibilities that consider relevant the need to promote the exchange of opinions, the values, and experiences of those involved in the assessment of pupils; using not only information on the objectives achieved, the lessons learned, the mistakes made, or the weaknesses identified in the process. It involves going further, using the instruments not only as tools to collect information but as elements for the assessment of the process, products, and evidence. In this model, evaluation is not the end but becomes the means to design, execute, and follow up on the learning process of the students. This is complemented by a different treatment in relation to the techniques and instruments, which become means and no longer ends for monitoring, selection, and recognition of pupils. In this sense, teachers cease being operators to become builders and generators of evaluation strategies. Also, the consideration that evaluation was only the domain of specialists in the field is set aside, thus abandoning the technological vision of evaluation that was present in the Tylerian stage.

1.1.2. Fundamentals and Characteristics of Educational Evaluation

"Educational evaluation in the international context in the midst of the industrialization process of the United States" (SEP, 1998; Page 24), Giroux (1981) comments that in the early years of the twentieth century, schools were conceived as factories, students were the raw material, and educational concepts knowledge, values, and social relations were reduced to terms of neutrality. It is in this context that Fayol (1916) established that the "basic principles of all actions in the administrative, planning, execution, and evaluation fields are a business and evaluation heritage that has evolved in parallel to our times with their respective consequences" (SEP 1998; Page 29). Because of this evolution, scientific evaluation in education arises within the quantitative paradigm with a technocratic approach. Rama (1989), González, and Ayarza (1997) emphasize that "from the 1970s, evaluation began to take hold as a profession that relates evaluation to research and control." (Mora, 2004; Page 7).

For Córdoba, "evaluation is the bridge or main link between teaching and learning that goes beyond quantitative results that determine how much students have learned" (Córdoba, N/D; Page 2). In relation to this, "the polysemy of the term "evaluation" can be derived from the most common meanings that are usually associated with it, among these are: verify, interpret, measure, estimate, understand, know, compare, assess, judge, apprehend, cipher, appreciate, etc." (Córdoba, N/D; Page 3). In this sense, Barlow (1992), cited by Bertoni (1997), states that evaluation is "a very singular term that can express a thing and its opposite: the precise and the approximate, the quantitative and the qualitative" (Córdoba, N/D; Page 3). The evaluation should favor the aspects that account for the observed phenomena or situations.

Along the same lines, Díaz Barriga and Hernández (2000) argue that "from a constructivist perspective, the assessment of learning any kind of content should reveal as much as possible everything that students say and do by constructing valuable meanings from the curricular contents" (Córdoba, N/D; Page 4). In the same vein, León Pereira (1997) describes that through evaluation it is possible to "systematically obtain and analyze the feedback on the processes aimed at cultivating each human dimension, in order to reach even higher levels of understanding and orientation" (Córdoba, N/D; Page 5). The above represent actions that the teacher deliberately uses to investigate. Salinas (2001) says that evaluation must accompany, guide, propose, and offer participation, understanding, and improvement to decide and act on the teaching and learning processes which is the formative function of evaluation.

In the words of Córdoba, the traditional forms of evaluation with a summative approach are closely related to the behavioral theories of learning only interested in the initial and final states, "the reflection on the evaluative results is centered on what the student does, the center is the student's response" (Córdoba, N/D; Page 7).

According to Casanova (1999) and Rosales (2000), formative evaluation should focus on a "permanent and continuous action of assessment and reflection on the development and evolution of students' learning and training" (Córdoba, N/D; Page 8). It implies recognizing what students do and how they do it, which provides valuable elements for didactic orientation and self-evaluation, offering a greater wealth of useful data.

Moreno states that there are three theoretical perspectives of evaluation: evaluation as technology, evaluation as a cultural practice, and evaluation as a socio-political practice. Unanimously, a good part of the 20th century and so far in the 21st, the results of the evaluation have been used mainly to make decisions related to classification, selection, and certification. This is all based on measurements of what individuals know, as well as on the judgments that are made about learning and that are undoubtedly mediated by the design of instruments measurement, as well as by assigning scores and their interpretation. From this epistemological perspective, it is understood that "evaluation as measurement develops functions in which selection, repression, control, and empowerment of the dominant social reproduction are privileged" (Moreno, 2016; Page 104).

According to House (1981), evaluation is a cultural practice, and "it is evaluated with the intention of improving educational processes, and in this, all are actors" (Moreno, 2016; Page 111). That is, evaluation transforms the culture of human relations and involves a constant dialogue with and among students. In this context, the evaluation requires continuous self-evaluation and mutual assessment among peers.

Within the fundamentals of evaluation, we find something that is called socio-evaluation, which is understood as a "political practice used as a mechanism to exercise power, to select and classify individuals according to their merits" (Moreno, 2016; Page 112). In this area, evaluation becomes a tool that verifies individual learning and the acquisition of knowledge. This type of practice emphasizes greater speed and resilience of students when facing evaluation activities. According to Rothblatt (1982), Kemmis (1988), and Moreno (2016), valuation serves as a basis for granting privileges within the framework of the socio-evaluation; technology is used for specific social selection purposes; evaluation is conceived as a democratic, participatory, and liberating process that implies awareness of the student as a learning subject.

The evaluation is not limited to the basic or middle levels; it is also a concern of the higher levels, the latter being the space where the evaluation has its greatest challenges and where it can find more fertile ground. It not only faces the challenge of incompatibility of teacher profiles but must also overcome and respond to the dual role of evaluation in the university as part of the accreditation process and as a mechanism to verify that students have the basic skills for the correct exercise of the profession that Fernández (N/D) aspires to practice. The characteristics that define the university educational evaluation are:

a. Evaluating is to measure and assess.
b. Evaluation is a systematic process.
c. The formulation of a value judgment is based on the result given by the measurement
d. Evaluation is global and comprehensive in nature.
e. Educational evaluation has multiple objects.

For Fernández (N/D), the main characteristics of the evaluation for university learning are characterized by:

1. To be an essential component of the teaching process.
2. Use procedures and instruments to collect information.
3. Be a process centered around the student.
4. Constitute a professional teaching task.
5. To specify, determine, and express the lessons learned.
6. To design an evaluation system.
7. To determine the type of evaluation.
8. Develop instruments to verify the acquisition of these learnings.
9. Specify assessment criteria.
10. To publish the results.
11. Provides data to facilitates educational research.

Currently, in almost all educational systems, references are made to three approaches to evaluation. According to Fernández (N/D), the first is called initial or diagnostic and is used to check if students have the necessary prior knowledge and skills, and to adjust the starting point of the teaching process to the class group. The second is called formative evaluation and is to determine the degree of acquisition of learning, informing students of their successes and errors in order to provide feedback during the educational process by using tools that detect the mistakes and successes. And finally, there is the summative evaluation that is mainly used to assign scores or grades to students and the certification of the acquisition of certain levels, which is identified with the traditional concept of evaluation.

1.1.3. Purposes and Functions of educational evaluation from 1980 to the present

Precise delimitation of the purposes and functions of evaluation represents a major crossroads because the purposes and functions are intermingled with many of the characteristics and fundamentals of the evaluation process. However, it is possible to identify some of the purposes and functions. By the 1960s, the learning objectives model was a powerful technology for assessment, which at that time was synonymous with measurement, test, or examination. This model limited curriculum reform, trivialized the nature of learning, and prevented judging the value of the goals with the aim of determining the students' behaviors, De la Garza (2004).

By 1979, accountability had acquired political importance by overemphasizing administration, program evaluation, and naturalistic evaluation, De la Garza (2004). These evaluation practices were mostly normative focused on selection. In this type of evaluation, the qualifications indicated the success or failure, Moreno (2016), derived from this condition, studies carried out by Stufflebeam in the early '90s of the last century, Gil, Morales, and Meza (2017), promote new theories and evaluation methods as well as new programs to prepare the evaluators themselves. Among the voices that are heard around evaluation, we also find those of Noizet and Caverni (1978), Glaser (1981), Coll, Palacios, and Marchesi (1991), who seek to provide the teacher with reliable and valid reports in terms of usefulness in order to facilitate constructive adaptations. For them, the diagnostic evaluation "must be centered on the student's basic abilities" (Jiménez, 1992; Page 4).

According to the new proposals outlined by Jiménez (1992), evaluation in the 1980s generates a new understanding of the process, highlighting:

1. That the student has sufficient potential.
2. Learning must be optimized.
3. The evaluation should be diversified in terms of methods and instruments.
4. Measurement and evaluation are fundamentally referred to as psychometric and psychodiagnostic techniques.
5. Evaluation should not be considered as an element of prognosis, prediction of success or failure, and the consequent orientation.
6. To assess the dynamic process in its proper dimension.
7. The evaluation should not only give importance to the objectives.
8. The initial evaluation should not be considered only a way to provide information to determine the baseline of the teaching and learning process.
9. The evaluation should consider the continuity of evaluations of the different activities.
10. The evaluation must use the information obtained as feedback.

Since the 1990s, politicians, businessmen, and communicators have demanded greater quality in educational actions. However, evaluation should not be used as a policy instrument to the detriment of evaluation actions but rather as a space to create a culture of evaluation. Regarding the evaluation, Díaz-Barriga (2017) proposes to stop focusing on the quantification of results and detach it from a mechanical relationship with the measurement model. Due to the prevailing condition, "the culture of evaluation has become a kind of halo associated with the simplified use of quality" (Díaz-Barriga, 2017; Page 334).

The individualistic perspective of each program or evaluative action, as well as the dominant evaluation model in the world is individualistic, according to Lecompte and Rutman (1982). Evaluation is elementary, and according to them, the model that has proliferated since the mid-eighties of the last century is the use of the exam to assess performance in order to organize rankings of various forms.

In relation to the above, Ausubel, Novak, and Hanesian (1978); Driver (1981-1982); Messick (1984), and Jiménez (1992) emphasize the importance of appreciating the student's prior knowledge in order to organize and plan instruction.

Stiggins (1995) argue that professor and teacher training models are disconnected from evaluation and that they are centered on learning as a legacy of the evaluation paradigms in force in the last decades of the 20th century and the first decades of the 21st century. There is a marked "evaluative illiteracy that predominates in schools, without a transparent vision about the evaluation process focused on the student and their learning, and without the ability to transform that vision into quality evaluations to help students progress by integrating the evaluations in their usual practice" (Moreno, 2016; Page 101).

The evaluation of student learning aims to assess the changes or results produced as a consequence of the educational process, "the learning evaluation constitutes the final phase of the educational process since it acts permanently on it" (Fernández, N/D; Page 6). Among the evaluation functions that must be currently overcome or expanded, we find:

a. Check if the proposed objectives have been achieved and to what degree.
b. Evaluate and grade the students.
c. Inform the interested people.
d. Orientation, motivation, and learning.
e. Evaluation of the results.
f. Detecting and clarifying problems.
g. Providing data that facilitates educational research.

According to Mora (2004), Posner (1998), Hernández (1998), and Díaz-Barriga (1999), any type of evaluation that is carried out in the educational field must comply with the functions mentioned below:

I. Diagnostic function: orientation and guidance to derive actions to improve the quality of education
II. Instructional function

III. Educational function
IV. Self-training function

1.2. Evaluation in Higher Education

1.2.1. Evaluation in Higher Education Background and Foundations

Since the eighteenth century, the period in which the evaluation related to education and verification of learning was born in Europe, the concern of institutions and governments for the improvement of the quality of education has been promoted worldwide, since good grades of the students are generally associated with the quality of education provided in a school. In our country, there are large cracks in the evaluation of student learning at the higher education level. This is caused by multiple reasons, among which stand out, on the one hand, the great offering that exists related to the diversity of higher education institutions, whether they are government-supported or privately-supported; and on the other hand, the multiple profiles of teachers qualified to teach classes in the different schools of higher education, many of whom do not have any pedagogical training that allows them to properly address aspects related to the teaching-learning processes, among which evaluation stands out.

With regard to the background directly related to the regulation of evaluation practices, there is not much support since there are not many common points that direct what should be done when evaluating students. Additionally, there are higher education schools that have not yet made the transition to competencies, and those that have done so generally have only adapted the approaches to objectives and purposes and have given them the name of competencies. Thus, due to this legal loophole, most higher education schools have their own evaluation criteria and regulations. However, we will try to establish a line of development of evaluation practices in higher education.

Since the publication of agreements 3810 of March 30, 1976 (General Directorate of Education; 1976); 9909 of the General Directorate of Normal Education of June 25, 1959, until the publication of agreement 499 of November 4, 2009, there have been no substantial changes.

1.2.2. Background and Legal Foundations of Evaluation in Higher Education

The systematic, normative antecedent that was established in modern Mexico is represented by AGREEMENT number 3810, by which the learning evaluation procedures formulated by the National Technical Council of Education are authorized for their application throughout the Republic. Among the points that stand out from the said agreement, not because they are the most suitable, but because the following stand out because evaluative practices with marked nuances of their inheritance still subsist.

In section I, it is authorized that said agreement must be applied throughout the Republic in primary, secondary, normal education and of any type or grade, as well as in studies other than those previously mentioned that are taught in educational institutions of the Ministry of Public Education or that have official recognition of validity granted by the same agency.

Regarding procedures, it is stated in subsection “C” that the learning evaluation procedures formulated by the National Technical Education Council shall adhere to the principle whereby evaluation is understood as part of the educational process and as a systematic and permanent activity that allows checking the level at which the proposed objectives are achieved.

Subsection “D” states the following General Evaluation Principles:

a. Be part of the educational process.
b. Be comprehensive, permanent, systematic, and flexible.
c. To be the object of all the elements involved in the educational process.
d. Encourage the participation of the student and all the people who take part in their educational process.
e. It should highlight the successes and deficiencies of the educational process.
f. It should serve as a basis for the planning, mediate and immediate, of the educational activity.
g. It must use appropriate tools and procedures.

Subsection “E” clearly states that the learning assessment is the process that allows the teacher to determine the level at which each student achieves the objectives of a grade-level program.
In the same section, it states that the evaluation includes measurement, interpretation, and value judgment and defines the stated terms as follows:

1. Measurement is the expression of the level of a trait or behavior achieved by the learner; it can be quantitative and qualitative and must be reiterated.
2. Interpretation is the analysis, understanding, and explanation of the data accumulated by the measurement.
3. The value judgment is the result of the interpretation of the costs of the changes that are noticed in the learner’s personality.

The same agreement describes that the Discharge periods refer to the moments in which it is carried out, initial, continuous, and final. The initial evaluation is of an exploratory and diagnostic type that consists of activities through which the teacher will detect what level of knowledge that the students possess, which will allow them to select the necessary resources to achieve the subsequent goals.

Continuous evaluation allows to periodically assess the changes made in the student (attitudes, abilities, skills, habits, skills, and information) and allows planning new activities to reinforce learning at the right time.

The so-called final evaluation is the consideration of all the partial evaluations made during the course in order to elaborate the value judgments that define the level of efficiency achieved by the students in relation to the goals of the program. It is carried out at the end of the course and not to be confused with the traditional final exam.

Section “III” specifies the evaluation techniques, the types of evaluation according to the agents involved, although the development focuses on the instruments, almost leaving aside the techniques, as explained below:

a. The instruments most commonly used to carry out compliance are: “the interview, anecdotal records, checklists, and estimating scales” (Agreement 3810; 1976; S / P).
b. The student’s self-evaluation, due to its formative significance, is an important element that the teacher must have to formulate the evaluative judgment of learning and that all of this information must be captured and processed by the teacher to achieve the comprehensive evaluation of the student.

The evaluation techniques listed in the agreement are:

1. Experimental techniques, which are those that put the subject in a given situation to be evaluated.
2. Pedagogical tests, which can be verbal and non-verbal, according to the degree of psychopedagogical specialization to develop them: informal and formal.

Section “IV” Expression of Progress in Learning

Since the evaluation must be continuous, the student’s progress must be recorded with the same continuity so that the teacher can inform those interested in this process. The scales to be used for such recording are:

1. Interpretive scale. The progress of learning shall be expressed according to a scale that will cover different levels of efficiency.
2. Symbology that facilitates the recording of the previous levels.
3. Periodicity of the information can be monthly, bimonthly, quarterly, semi-annually, and annually.
4. The notation of the final evaluation shall be the symbolic representation of the last evaluative judgment, based on the interpretation of all the monthly, bimonthly, quarterly, semester, or annual evaluations recorded during the school year.
5. The Promotion Criteria will be dictated based on the final evaluation, according to the agreed-upon scale.

In Section "V," the annual recovery refers to the notation of grades that, for purposes of average school grades and educational levels, and establishes "the following numerical equivalence of the letters adopted in Section 2" (Agreement 3810; 1976; S/P):

1. E = 9
2. MB = 8
3. B = 7
4. R = 6

Another of the agreements that guide evaluation practices in most higher education institutions is agreement number 17, which "establishes the standards to which the learning evaluation procedures must be subject in the different types and modalities of education, under the control of the Ministry of Public Education" (SEP, 1978; S/P). The most outstanding aspect identified in this agreement is that "the evaluation of learning is a process inherent to the educational task, essential to verify if the learning objectives have been achieved, to plan the school activity; deciding to promote the student and contribute to raising the quality of teaching" (SEP, 1978; S/P). Thus, it is a practice that cannot be avoided in any educational institution. Furthermore, this agreement is much clearer in the norms that govern the evaluation, within which three articles stand out.

In articles 10, 20, and 30 we find that it is the obligation of schools and organizations that provide educational services to evaluate the learning of students, which must be carried out throughout the educational process through appropriate pedagogical procedures SEP (1978). They also list the official grading scale:

a. 10 Excellent
b. 9 Very good
c. 8 Good
d. 7 Regular
e. 6 Enough
f. 5 Not enough

In articles 10 and 70, it sets forth what is related to the promotion or non-promotion of the student as follows:

I. Article 10: The student shall accredit a cycle, grade, subject, area of study, or subject in accordance with the current study plan when they obtain, as stipulated in the grading scale, a score of 6 or higher.
II. Article 70: Students who obtain a score of 5 in the final evaluation shall be subject to the regularization procedures determined in this regard.

1.2.3. Conceptual Foundations of Evaluation in Higher Education

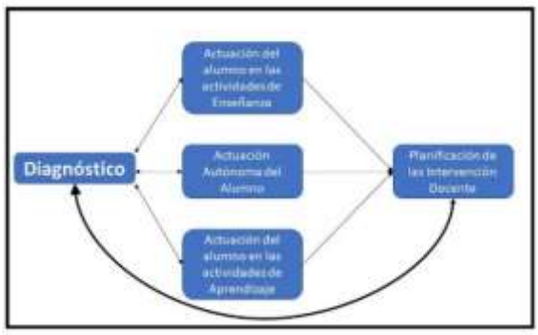
Tyler (1950), from a behaviorist position associated with measurement, states that evaluation is a process whose purpose is to determine the extent to which the established objectives have been achieved. It involves a value judgment that is issued when contrasting the information collected with the previously established objectives. In line with this postulate, Soler (1988) affirms that evaluation is a measurement of learning and does not allow knowing the errors and successes of teaching and, consequently, improving it.

Stocker (1964) proposes a quantitative connotation focused on the evaluation of the amount of knowledge accumulated by a student, expressing that evaluation is a methodological activity that consists of the collection and combination of work data, with a series of goals that result in comparative or numerical scales. On the other hand, Castillejo (1983) says that evaluation can be considered as a rigorous and systematic collection of information to obtain valid and reliable data about a situation in order to form and issue a value judgment about it. Another interesting proposal is that of Casanova (1991), who affirms that evaluation is a systematic and rigorous process of data collection, incorporated into the educational process, which provides access to continuous and meaningful information to know the situation, form value judgments about it, and make the appropriate decisions to continue the educational activity while progressively improving it.

To these ideas, we can add that of Verdugo (1994) in the sense that the evaluation should be considered a systematic compilation of information and articulation of a theoretical personal functioning model, based on the data collected that include experimental and non-experimental procedures. Just like quantitative and non-quantitative procedures, both statements refer to the systematization that requires the use of appropriate tools. In the conceptual references, the multiplicity of terms stated with respect to the evaluation are validated, such as those indicated by Gamboa (2013) and Acevedo (2013), who define it as the systematic determination of the merit, value, and meaning of something or someone based on some criteria, which consists of a comprehensive and systematic process through which information is gathered in a methodical and rigorous way, to know, analyze, and judge an educational object. From this perspective, school evaluation refers to the assessment of students' progress in terms of learning knowledge, abilities, skills, and attitudes, as well as personal and social adaptation.

The previous perspective agrees with the precepts of the Alfa Tuning Latin America project (2007), which presents evaluation as a formative process that considers all the possibilities that are part of the pedagogical process, the results of which will be used for the (re)approach of pedagogical practice; turning evaluation into a cyclical practice (Fig. 5.1). It is a constant back and forth between the analysis of what the student is capable of doing and what they can develop based on the teaching activities in which they have participated. It goes beyond simple memorization and reproduction of content to the real analysis of what the student can do and how they can create new strategies to solve problems in different contexts.

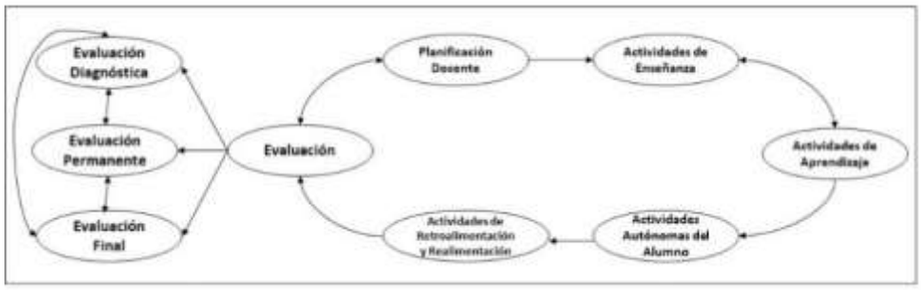
Figure 5.1 Evaluation cycle



Source: Own Authorship

In the same vein, Gamboa (2013) states that it is imperative to reflect on evaluation as a process related to the educational practices of teaching and learning (Fig. 5.2), not as a moment to determine which student passes or fails.

Figure 5.2 Evaluation cycle



Source: Own Authorship

From the etymology, Pimienta (2008) presents how the act of pointing out the value of a thing, such a translation derives from the old French "value" valor, past participle of "valor": to value; coming from "valere": being strong, to have value. Such a concept could seem simplistic and colloquial, since in a good number of our Spanish-speaking countries valuation is synonymous with appraisal and vice versa. This last explanation is adapted in many of the evaluation practices that are developed in most of the higher education institutions.

The translator of Dr. Kennedy's manual (Declan, 2007) defines evaluation exactly the same as the Royal Academy of the Spanish Language Dictionary, which sums it up as estimating the knowledge, aptitudes, and performance of the students. Authors such as Zavala and Arnau (2008) state that evaluation is defined as a process in which student learning is analyzed, and teaching activities are characterized by three variables: teacher intervention, student experiences, and learning content.

Yolanda Edith (2010) and Leyva (2010), citing the Evaluation and Measurement Group (GEM) from the University of Valencia, affirm that evaluation is a systematic process of inquiry to understand the educational reality for the issuance of a value judgment on it. In order to understand the complexity of the evaluation process, four dimensions must be taken into account: a) People, b) Educational organizations, c) The material elements of the educational intervention, d) The normotype, e) The nomothetic, f) The functionality.

On the other hand, Santos Guerra (2003) says that educational evaluation is a phenomenon confined to the classroom, referred to students and limited to the control of the knowledge acquired through different types of tests, which is rarely taken into account as a complex process since it is overlooked that the process involving students contains intermingled elements that cannot be understood in isolation and independently. The teacher acts in a context that conditions his evaluation practice, these conditions can be grouped as follows: a) Evaluating a large number of students, b) Delivering the grades to the Ministry in a specified time determined by the latter, c) Using formats and protocols that are given to them. The above reasons are directly related to the factors that condition the evaluation: a) Legal requirements, b) Institutional oversight, c) Social pressures, d) Organizational conditions.

According to Frola and Velásquez (2011), evaluation is a process of gathering information on the evidence shown by the student to mobilize concepts, procedures, and attitudinal through observable performances, framed in a program or curricular plan that allows casting evaluative judgment on such evidence for making educational decisions.

As far as the Ministry of Public Education is concerned, there is very little official information available that identifies common points on evaluation at the higher education level. which is understood on the basis of the diversity of higher education institutions, both governmental and private, which enjoy a great deal of autonomy with respect to evaluation. However, the evaluation in basic education proposed in the document "The Evaluation During the School Cycle" SEP (2012) can be taken as a reference, which defines evaluation for learning as a process of recording and analyzing information on the student performance, in order to guide decisions regarding learning and teaching processes and which is developed in a formative way. This is the clearest nuance of the formative approach to evaluation, whose essential characteristics include a comprehensive and systematic process for gathering information in a methodical and rigorous manner, which makes it possible to know, analyze and judge the value of an educational object, students' learning, teachers' performance, and the degree of mastery of the curriculum.

According to the Ministry of Public Education (SEP, 2012), in Mexico, the evaluation should not focus on students but on learning as a process of obtaining evidence, making judgments, and providing feedback to students throughout their education. This confirms that the important thing to evaluate in education is performance and not the person, which is why it is considered that appropriate methods, techniques, and procedures should be used that respond to the demands of the Mexican educational system.

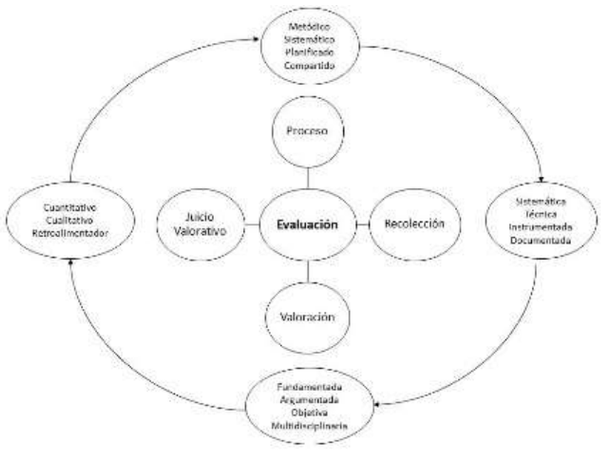
1.2.4 Principles of Evaluation in Higher Education

It is evident that most of the evaluation activities are focused on assessing school performance. However, as Lemus (1974) mentions in his school performance assessment manual, there are some principles (Fig. 5.3) that should be taken into account by teachers and educational authorities when evaluating school work. The following principles stand out:

1. Consider yourself as an integral part of the entire educational process.
2. Be a continuous process of educational activity.
3. Make use of different resources (anecdotal records, observations, interviews, autobiographies, interest inventories, etc.).

4. Be systematic.
5. Dedicate yourself to different aspects of the educational process.
6. Should be completed by different people.
7. Be done in relation to educational goals.
8. Make yourself in relation to the individual differences of the learners.
9. Assess yourself.

Figure 5.3 Evaluation cycle



Source: Own Authorship

For Lemus (1974), evaluation can have several purposes, such as learning motivation, diagnosing student problems, awarding grades, educational guidance, and supervising all school personnel. However, the most important criteria that tests must meet to be considered efficient means of evaluation are: validity, reliability, objectivity, and practicality.

Blanco (1996), citing Cronbach (1963), says that the concept, functions, and methodology of evaluation should not be reduced to the restrictions of a program, since its scope is wider, evaluation is an instrument that provides significant information to make decisions and improve the evaluated object, it also plays a political function, since political motivations influence both the information and the development of the evaluation, which are nuanced by the methodology. Therefore, it is convenient to carry out analytical and controlled studies since they are more useful to compare alternative versions of a program. Since large-scale studies may affect the clarity of the results, the evaluation techniques to be used can be questionnaires, interviews, systematic and unsystematic observation, and test trials.

For Cronbach (1963), the evaluation should be oriented to the improvement of a program that is being used and should seek the maximum social benefit. He agrees with the use of qualitative and quantitative techniques as evaluation instruments, depending on the circumstances. For Scriven (1967), no matter what is evaluated, the objective of the evaluation is always the same. It should be a process that allows estimating the value of something that is evaluated and that can be formative and summative. These latter functions depend on what is to be evaluated, either a program under development to improve it or to check the efficiency of a program when it ends to decide whether to continue it or not. He proposes two issues, first to give the evaluation a single objective, which consists of saying whether something has value or not, and secondly, to introduce formative, summative, comparative, and ethical functions.

On the other hand, Bloom (1975) says that the evaluation should systematically gather evidence to determine whether changes occur and to what degree in each student. The summative evaluation takes place at the end of a period and has two intentions, first to qualify the students in the corresponding unit, chapter, course, or semester. Second to judge the effectiveness of the teacher. On the other hand, the formative evaluation is given during the academic life of the student, in a continuous process that provides the teacher and the student with feedback on the effectiveness of their work, which also reveals in which parts of the unit the student has difficulties. The evaluation can adopt different functions, as it can be diagnostic when the diagnosis is used at the beginning of a course or school year.

However, it should not be forgotten that it is a process that is not limited only to the final exam, but that there may be various indications. In addition, it is a process in which the different functions of the evaluation are presented: diagnostic, formative, and summative.

1.2.5. Evaluation in Higher Education Characteristics and Functions

Without trying to unify the criteria around the characteristics of the evaluation in higher education, since such au undertaking would be a fallacy due to the difficulty represented by the existence of a great diversity of concepts related to the definition of the term, some are listed below from the point of view of Castillo and Cabrerizo (2010):

i. Be integrated into the design and development of the curriculum.
ii. Be formative, which helps to perfect the process and the result of the educational action.
iii. Be continuous, throughout the entire process.
iv. Be recurring.
v. Be criterial.
vi. Be decisive, allowing judgments to be made about the objectives to be evaluated and decisions to be taken.
vii. Be cooperative, which allows the participation of all those involved.

Moreover, as stated by Tindal and Martson (1990):

1. The data must be directly related to the contexts.
2. A general and specific perspective is needed.
3. It is imperative to focus on academic achievement in the classroom.
4. Multiple-reference assessment strategies are needed.
5. Empirical bases for evaluative practices are required.

Casanova (1992) says that: "the functions that in each case we assign to the evaluation, (...) can use the modalities or types of evaluation that are most appropriate for the object of the study, research, or work that is undertaken" (Castillo and Cabrerizo, 2010; Page 31). In this sense, Cardona (1994) assigns the following functions to evaluation:

a. Diagnosis: knowing the starting assumptions facilitates both the adaptation of the training offering to the users and decision making.
b. Regulatory: regulates student learning.
c. Predictive: it facilitates the estimation of possibilities of actions and/or performances, it becomes operative in the initial and formative modalities, oriented to the contextualized design of curricular projects.
d. Feedback: it has a guiding function in the educational process.
e. Control: it is necessary due to the demands of the educational administration, in everything related to obtaining academic degrees and the connotations that these have.

Evaluation, like any school activity, must go through a systematic and focused planning path, stated Moreno and Moreno (2019), citing Flórez (2001), and the evaluation deserves planning, preparation, design, and prior reflection; which agrees with Castillo and Cabrerizo (2003) who affirm that "just as teaching programs are designed, evaluation must be designed so that, with the conjunction of both (teaching and evaluation), the desired learning is achieved" (Moreno and Moreno, 2019; Page 100).

1.2.6. Evaluation Techniques in Higher Education

Evaluation in higher education faces many challenges and challenges, probably one of the main ones is related to the use of adequate techniques and instruments to carry it out, which is closely linked to the profiles of teachers (in most schools, teachers do not have pedagogical training) Cerda (2000), Barriga and Hernández (2002) and Allen (2004) cited by Moreno and Moreno (2019), "assessment methods should stimulate learning more and avoid generating conditions that do not stimulate the student" (Moreno and Moreno, 2019; p. 101). Moreno and Moreno (2019) explain that there are three types of evaluation techniques: informal evaluation techniques, semi-formal techniques, and formal techniques:

1. Informal techniques. They are teaching sessions with a short duration; the teacher does not present them to the students as evaluative acts; there are two types of informal techniques: observation during the activities carried out by the students and the exploration that uses formulated questions.
2. Semi-formal evaluation techniques. They require more time than the informal ones, they demand greater assessment and require more lasting responses from the students; their identified variants are: the work and exercises that the students do in class, the tasks and the work that the students do outside of class, among the tools used, the portfolio evaluation stands out.
3. Formal techniques require sophisticated planning and elaboration processes and are applied in situations that demand a greater degree of control; they are not usually used periodically only to finish a complete teaching cycle; the preferred instruments are: tests or exams, concept maps, scales, rubrics, among others; one of the conditions recognized in formal techniques is that they always provide answers to how and with what to evaluate.

Higher education academics face the dilemma around which are the most relevant instruments to evaluate student learning, especially since almost all higher-level educational centers have turned to competency assessment. However, Moreno and Moreno (2019) consider that before evaluating, the teacher must answer the basic questions such as what do they want to evaluate; that is, if the teacher wants to evaluate concepts, then they can do it through short-answer tests, multiple-choice, exemplification, essay, reasoning, observation techniques, a checklist, ethnographic records, and the portfolio. In case the teacher wishes to evaluate attitudes, she can make use of the techniques and instruments related to "the survey, the participant observation, using the anecdotal record and the estimation scale.

1.2.7. Stages in the Practice of Assessment in Higher Education

Carrying out an evaluative work in a systematic and focused manner that responds to the multiple concerns generated by the evaluation of learning in higher education classrooms forces us to rethink the way in which the process is being developed. Evaluation in the first semesters in higher education serves to select those who are most adaptable to higher education in such a way that it seems that the main objective of the evaluation is to eliminate those who are less able to adapt. This path can be overcome if higher education teachers take ownership of evaluation expertise and develop this practice appropriately. Mendivel (2012), Moreno and Moreno (2019) propose the following procedures or stages for evaluation in higher education:

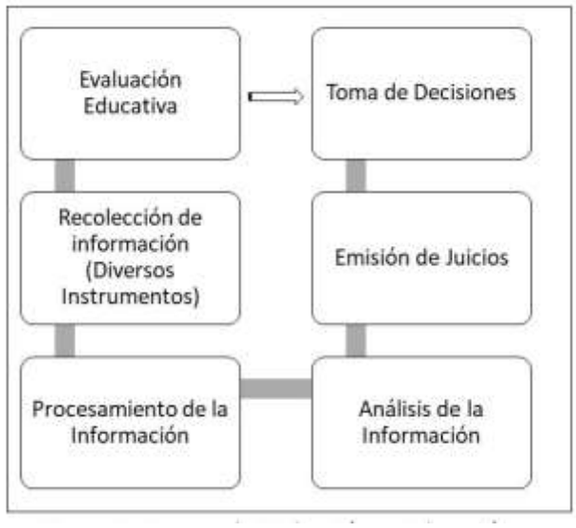
A. Preparation of the evaluation plan.
B. Discussion of the evaluation plan with the student.
C. Development of activities that allow for formative evaluation.
D. Prepare the tests that will allow for the collection of measurable data that give the student the ability to self-evaluate.
E. Discussion between students and teachers of the grades to be given in partial and/or final form.

1.2.8. Evaluation of Students in Higher Education

The modern world is a victim of its own heritage. Over the centuries, human beings have developed the ability to pass judgment, assess, and act accordingly; this ability encouraged the survival of our species. Our daily life is full of moments of evaluation; without this practice, our decisions would be flawed and would depend a lot on random factors. However, when our evaluation processes are focused on other objects or on other people, the situation becomes complex and requires time and effort because a conventional systematization of certain methodological steps to carry out such evaluations, Frola and Velásquez (2011) state that when evaluating, we face a process that begins with obtaining information using multiple and varied ways.

Evaluation in the context of education does not differ much from evaluation in other contexts, nor should there be gaps in evaluation that create restrictions at the educational system level; since it is understood that education, regardless of the level, is focused on the construction, appropriation, and reinforcement of learning. Frola and Velásquez (2011) state that in the educational field, the evaluation process involves obtaining information through instruments (surveys, inventories, questionnaires, tests, among others) to make judgments once the information has been processed and consequently decisions are made to improve processes and services (Fig. 5.4).

Figure 5.4 Evaluation cycle



Source: Own Authorship

The way in which university students are evaluated or should be evaluated has its starting point, in what is understood as learning evaluation. According to Salinas and Cotillas (2007), in the context of higher education, "to evaluate" means estimating, appreciating, calculating the value of something. Therefore, it consists of making a judgment about the value or merit of something, and it is essential to develop two stages before making the judgment: the first consists of collecting the evidence and the second, the application of quality criteria in relation to the evidence, which will allow an estimation of the value or merit of the object being evaluated.

When the term performance evaluation is used in teaching, the object to be judged is the student's learning, and according to Salinas and Cotillas (2007), it can have different purposes, among them:

a. Derive grades.
b. Guide the student to improve performance.
c. Discover the students' difficulties.
d. Discover one's own difficulties in teaching what we want to teach.
e. Assess certain teaching methods.
f. Motivate students to study.

Broadening the scope of the connotations about evaluation, we identify a deeply rooted conflict in higher education that arises when it comes to answering the question: do we evaluate to grade or evaluate to learn? If the assessment is for grading, the problem consists in choosing the best instruments that quickly and easily provide evidence of student learning; and from there to grade, that is it. On the other hand, Salinas and Cotillas (2007) state that if the evaluation aims to offer information to make decisions so that the student learns more and better, the difficulty lies in periodically informing the student about the status of his learning and guiding him for improvement. Such a practice generates another conflict, that of evaluating to grade and evaluating to learn. In this sense:

"Summative evaluation is understood as making judgments at the end of a teaching period, the purpose of which is to grade according to the performance assessed, (...) at the end of that period. Ultimately, the summative evaluation will be represented by a PASS, FAIL, PROFICIENT... (or their corresponding numbers) in the grade report (Salinas and Cotillas, 2007; Page 19).

"On the other hand, we understand formative evaluation as making judgments that are made throughout a teaching period and that are intended to inform the student and the teacher about the student's progressive achievements in order to improve both teaching and learning. The two types of evaluation are not exclusive and, at present, both types of evaluation are considered necessary" (Salinas and Cotillas, 2007; Page 19).

The above lines offer an alternative to the dilemma of the inseparability of formative and summative evaluation, because only in this way is it guaranteed that students are really learning. Since evaluation for training entails, among other things, feedback and replenishment of learning, while summative evaluation is a way of stating that the student has reached the minimum required to be able to migrate from one level or grade to another Furthermore, for the evaluation to serve as an instrument that contributes to training and accreditation, it must meet certain conditions, including those set forth by Frola and Velásquez (2011):

a. Functional: fulfill one or more previously defined functions.
b. Systematic: organized, controlled, regulated, and with evidence of the methodological steps to carry it out; to be inserted or linked with other evaluation systems.
c. Continuous: activity that takes place at different times and with different purposes.
d. Comprehensive: considers cognitive, psychomotor, and affective aspects.
e. Guiding: serves to improve, reorient, remediate educational practice, and guide the students' process instead of eliminating or excluding.
f. Cooperative: socialized from its conception, phases, procedures, definition of purposes, object of measurement, reference profile, selection, and validation of responses.

Improving evaluation proposals in higher education should be a practice that begins with the optimization or adaptation of the elements that are already known and that have probably been used partially or have been operated in inappropriate ways. In recent years there have some trends have emerged that disqualify many of the evaluation procedures using superficial or rhetorical arguments; as stated by Frola and Velásquez (2011), there is a range of concepts related to evaluation that does not need to be eliminated or disqualified since they can serve as complements with a view to enriching evaluation practices, specifically referring to:

1. Measurement: procedure for collecting information and ordering it according to its quantitative or numerical characteristics; in order to assign a numeral based on its comparison with a previously defined or agreed unit, parameter, or scale.
2. Rating: procedure to establish a correspondence between scores obtained on a numerical scale and the qualitative ranges or categories that represent value judgments when crossing them with such scores.

Undoubtedly, there is no formula that guarantees the success of the activities involved in the teaching and learning processes. Moreno (2009) says that evaluation must be an inseparable process and antonomasia linked to learning; that is, it must be evaluated to improve learning, not to fail, eliminate or exclude; when we build on these premises, we show that we see in the evaluation an interactive process of teaching.

Moreno (2009), citing Olivos (2004), states that evaluation in higher education must be understood in its natural development regarding what happens, which uses multiple resources that get to know the student; therefore, requires conscious and reflective attention on the part of the teachers.

Finally, it is necessary to address the matter of the means or instruments that a teacher can use to develop an assessment of learning appropriately. Hamodi, López, and López (2015), citing Castejón et al. (2009) present a series of tools available for teachers to collect the necessary information in the evaluation process, but they clarify that it is difficult to separate the instruments from the evaluation strategies and techniques.

Castejón et al. (2009), cited by Hamodi, López, and López (2015), classify the evaluation instruments based on their oral, written, or observational manifestation, among those that are common we have:

1. Instruments of written expression: exam, written work, essay, poster, report, review, project, field notebook, practical files, diary, folder or dossier, portfolio, and memory.
2. Oral expression instruments: presentation, debate, interview, group interview, discussion group, round table, a panel of experts, presentation, and communication.
3. Practical expression instruments: representation, demonstration or performance, simulation, project development with practical aspect, research, and supervised practices.

In conclusion, the evaluation in education must take into account the teacher-student binomial to improve the realization of the teaching-learning process. In this sense, some conditions cannot be overlooked, among which the fact that the teacher must properly handle the following concepts:

1. The means of evaluation: each and every one of the students' presentations, which can take three different forms: written, oral, and practical.

2. Evaluation techniques: strategies that the teacher uses to collect information.

The new ways of evaluating involve breaking paradigms. In this sense, it is no longer possible to continue using totally unidirectional and vertical ways of evaluating. The new evaluation practices imply an active, reflective, and responsible involvement of the students. As proposed by Hamodi, López, and López (2015), we can develop the following evaluation practices with students:

a) Self-evaluation: evaluation by the student of their own evidence or presentation based on previously negotiated criteria.

b) Peer evaluation or co-evaluation: process in which the student evaluates his peers reciprocally, applies evaluation criteria that have been negotiated; it can be carried out through documentary analysis and/or observation; some authors call it peer evaluation, co-evaluation, or collaborative evaluation.

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Chapter 6 Education based on sustainability: A life in balance

Capítulo 6 Educación basada en la sostenibilidad: Una vida en equilibrio

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Abstract

In this paper, mention is made of the concept of sustainability, its principles, foundations and main objectives; how to implement them in daily life for society, achieving a quality life, because of the large demands on the production of products, the provision of services and new technologies, and its efficient implementation has been reduced. Sustainable development has been developed but not as initially established, as one of its objectives is to maintain a balance between social, economic and environmental factors, without affecting natural resources for future generations, highlighting a factor of great importance for its realization; education, since it allows to introduce the knowledge, skills, values, and principles of sustainability, from the basic level, to the higher school level, facilitating skills and promoting awareness of the value of having a quality life , provided that it meets the requirements of the interrelation with the environment, in addition to those that you have with each of the factors to be able to implement effectively.

Balance, Quality, Sustainability

Resumen

En este trabajo se hace mención al concepto de sustentabilidad, sus principios, fundamentos y principales objetivos; cómo implementarlos en la vida diaria de la sociedad, logrando una calidad de vida, debido a las grandes exigencias en la producción de productos, la provisión de servicios y nuevas tecnologías, y se ha reducido su implementación eficiente. El desarrollo sostenible se ha desarrollado pero no como se estableció inicialmente, ya que uno de sus objetivos es mantener un equilibrio entre los factores sociales, económicos y ambientales, sin afectar los recursos naturales para las generaciones futuras, destacando un factor de gran importancia para su realización; educación, ya que permite introducir los conocimientos, habilidades, valores y principios de la sostenibilidad, desde el nivel básico, hasta el nivel superior, facilitando habilidades y promoviendo la conciencia del valor de tener una vida de calidad, siempre que cumpla con los requisitos. de la interrelación con el medio ambiente, además de los que tienes con cada uno de los factores para poder implementar de manera efectiva.

Calidad, Equilibrio, Sostenibilidad

Introduction

There have been outstanding contributions through scientific and technological advances, which currently help improve living standards, mainly in industrialized countries. This increases the demand for production and acquisition of products, and at the same causes as a result, a minimization of the importance of product development implemented sustainably by current and future generations. It is essential to mention the influence that education has and can have regarding sustainable development. It allows instilling in society from an early age all the knowledge, values, skills, and objectives needed to carry out sustainable development while promoting a better quality of life. It helps establish a balance between all the sectors involved in society, such as the social, economic, environmental factors, to mention some of the main ones.

The main characteristics that allow the development of a sustainable production process are revealed and are precisely the key objectives to reach the goal of a quality life, with the iteration of all factors being in balance. We should mention how this movement arose and which were the main reasons why it was promoted for adoption by society. Also, pointing out which are the advantages of being able to carry it out in an efficient way, either when exercising it individually or in groups, having clear the fulfillment of the objectives in the collaboration of teamwork for better performance and efficiency, promoting the balance in the sustainable product development.

The environmental crisis has reached such an alarming level that it is now necessary, through education, to become aware of the importance of changing the forms of production and social welfare, respect for cultural diversity, and conditions that make possible the existence of life on the planet. In this context, the importance of sustainable education becomes evident as one of the alternatives for the recognition of the value of the conservation of the planet’s natural conditions. In recent years, education has been linked to sustainable development.

Although sustainability is a complex process because it demands the availability of a great variety of resources and conditions to generate collective benefits, it is necessary to rely on the existing means to try to create a system of education that privileges human conscience and rationality before the exploitation and degradation of the environment that threatens humanity itself; that is to say, a system of sustainable education. An education based on environmental knowledge, strengthening actions to contribute to the transformation of the population, and the ecological preservation of the planet attempts to minimize the problems caused by the environmental crisis in the future on a worldwide level.

Background of education for efficient sustainability

The negative impacts resulting from climate change or ocean pollution, to name a few, lead us to speak of an environmental crisis, which also adds to the challenge of societies to seek a balance between product development and environmental protection. It is therefore extremely necessary to contribute to the training of people who in turn can influence good practices towards the surrounding environment. This would result in not only individual actions, not only the realization of the damage caused by the actions of human beings on the planet, but collective actions that generate a social transformation and promote better performance.

Several environmental organizations and activists arose around the world whose goal was the conservation of nature, trying to raise awareness among the population, companies, and governments about the effects that human activities were generating in our natural environment. Likewise, they sought to produce legal and transforming changes that would allow us to live in harmony with the environment. In this way, teaching about ecology constitutes one of the first attempts to link education with the care of nature. This type of teaching should be emphasized since it was centered on the conservation of natural resources. It was also a great contribution to sustainable education since it would allow the expansion of horizons and would begin to incorporate the sociocultural, political, and economic dimensions. In this way, education evolved from a vision based on the knowledge of the natural environment to another that considers the natural and sociocultural built environment, as well as people as a whole with their different traits such as values, emotions, feelings, and reasoning.

The most important characteristics are centered on the fact that it is theoretical-practical since it leads to the resolution of concrete problems based on environmental knowledge, in which people of any group within the population or level at which they are located can perceive the problems that affect individual and collective well-being, making clear the causes and determining the means to solve these problems. In order to move from information to action and to generate social transformation, it is necessary to promote a set of values in individuals and to make these values part of their actions; some of the values involved in education are austerity, respect, solidarity, responsibility, empathy, and coherence. To be able to incorporate these values into our daily lives, it is necessary to know them, understand them, and add them to education-related activities. It is not enough to make campaigns and projects to improve the environment if you do not set your own goals for those actions, as well as and understand the meaning they have in the community and the future of life on the planet.

It is necessary to emphasize the importance of educators as trainers of values since they are the ones who must transmit their principles to their students, thus contributing to the desired transformation of values in society. It is necessary to understand that teachers, at all levels and areas of education, transmit their own principles oriented to the educational model we want, which is why education is fundamental in this aspect. Showing an interest in research, from the conceptual point of view as well as in the change of attitudes and behaviors, to the development of methodologies and didactics of sustainable education (Figure 6.1).

Figure 6.1 Example of the bad habits that society causes in the environment; generating pollution and secondary damages

Source: Cantú, 2016

Principles of sustainable development

The historical process is marked by the expansion of the mode of production, by the technological patterns generated, by economic rationality guided by the purpose of maximizing profits and economic surpluses in the short term, by a division of labor and the unequal exchange of goods between nations. In order to understand environmental problems (Niño-Castillo, et al.; 2020), it is important to have a framework that accounts for their complexity, analyzing the physical characteristics of the environment connected to political, economic, and social conditions (Niño-Gutiérrez, 2008). We face a civilizational crisis; this crisis requires changing the development model and building another one that contributes to restoring the balance between the ecological, economic, and social aspects: sustainable development.
It is important to emphasize that the human species has interacted with the environment and has modified it (Niño-Gutiérrez, 2018). As a result, environmental problems are not simply new problems but have been present for a long time. However, the difference now is that we intend to solve them through education. In this context, education focusing on sustainability has an important role in facing this challenge as it promotes innovative learning. The values of contemporary society are challenged because these values lead to human decisions, thus leading to the root cause of the environmental crisis. The fundamental purpose of education is to ensure that both individuals and societies understand the complex nature of the environment, resulting from the interaction of its different physical, biological, social, cultural, and economic aspects. This will reorient the various disciplines and educational experiences through the acquisition of knowledge, values, skills, and practices that lead them to responsibly and effectively participate in the prevention and solution of environmental problems, but above all in environmental quality management.

Education is key to understanding the existing relationships between natural and social systems and should promote the consideration of values and behaviors that favor the effective participation of the population in the decision-making process (Niño-Gutiérrez, et al.; 2021). Although it is a lifelong process and not only limited to the educational sector, the pedagogical contribution to environmental activities is fundamental because it reforms the duties and rights of the human being. It becomes an element that respects all forms of life and questions the established economic-social model, which perpetuates unsustainability. Education can and should be a strategic factor that is not found in the established development model to reorient it towards sustainability and equity, which should be reflected by the behavior of man improving with respect to his environment and becoming a subject capable of changing the environment with a sustainable vision that lasts from generation to generation (Niño-Gutiérrez, 2017).
In the 1960s, in the United Nations Organization (UNO), the governments of the world questioned the established growth model and the impact it had on the environment. Since then, several programs have been implemented to stop the environmental degradation of the planet.

However, it was not until the 1980s that the World Commission on Environment and Development (WCED) first spoke of sustainable development as an integral process since it demands commitments and responsibilities from the different representatives of society in the application of the economic, political, environmental and social model, as well as the consumption patterns that determine the quality of life. The main objective of sustainable development is to meet present needs without compromising the ability of future generations to meet their own needs, i.e., the development of man and his environment can be sustained indefinitely over time without exhausting the material or energy resources required to function in a balanced way. A concept that assumes that the world is not as vast and limitless as previously thought, so sustainability requires holistic approaches to deal globally with the planetary emergency of pollution, ecosystem degradation, resource depletion, and uncontrolled growth of the world's population.

In 1972, at the conference on the human environment held in Stockholm, the urgency was expressed to adopt an international environmental education program with an interdisciplinary approach and an academic and extracurricular approach. However, it was not until 2002 at the World Summit on Sustainable Development that an international implementation plan was created to promote education for sustainable development, and this plan was launched in January 2005. Likewise, in the United Nations Decade of Education for Sustainable Development, the objective is to encourage governments to contribute to sustainable development by including measures in their educational plans with four fundamental pillars: learning to know, learning to live together, learning to do, and learning to be. In this manner, principles, values, and practices of sustainable development are integrated into all stages of education, encouraging behavioral changes that are necessary to preserve in the future the integrity of the environment and the viability of the economy for the coming years.

It is important to highlight the achievements of sustainable development, which implies the implementation of a continuous adaptation of systems of thought processes and actions that require creativity, flexibility, and critical reflection. This is in addition to changes in the three levels of government that include the fight against poverty, the rationality of production, and consumption patterns for the conservation of biodiversity since sustainability is not only related to ecological policy but also the fight against poverty and social equity.

Sustainability can be defined as a process of improving the living standards of the population of a locality that encompasses four areas: first is the political-administrative, which includes municipal initiatives to promote and coordinate different types of local development programs, this requires a democratic policy of financing and separation of public spending. The second area is the economy, which refers to local initiatives to generate greater productive capacity. The third area is sociocultural, which is the promotion of equal opportunities, and the establishment of links between civil society to enhance the capacity for action and participation in equitable and balanced local development. Lastly, the fourth area is called educational and is responsible for promoting lifelong learning opportunities for all people established in a specific region (Table 6.1)

Table 6.1 Attributes of sustainability for efficient development

Category	Attributes
Sustainability devil	Accepts changes in current production processes to reduce environmental impact; conservation is necessary for economic growth.Technical solutions to environmental problems are emphasized.
Strong sustainability	Accepts the need for radical changes in the economic model and society to facilitate an equitable sharing of environmental costs and benefits (intra- and inter-generational equity). Stresses the need to ensure the survival of species and the protection of critical environments beyond their possible economic use.
Super-strong sustainability	It accepts that the environment is valued in many different ways, in addition to the economic one: there are also cultural, ecological, religious or aesthetic values, which are equally or more important; the concept of "Natural Heritage" is understood as a heritage that is inherited from our ancestors and that must be maintained, bequeathed to future generations, and not necessarily sold or bought in the market.

Source: Flores, 2015

Sustainable education in Mexico

Mexico began to implement sustainable education later than other countries such as the United States, Europe, and Canada. The national development plan was presented, which at the moment called for changes to culture and prevention, sustainable use of resources, and improved quality of life. A pace of growth and inclusion was maintained in the different levels of formal education, in both formal and non-formal education programs; raised as one of the main tasks shared between the government and society, where education is a priority, training, and communication. In 1983, the first environmental education office was created as the Ministry of Urban Development and Ecology. The main objective was to analyze the environmental content of study programs and textbooks for preschool, primary, secondary and normal education. At the beginning of the 1990s, the World Wildlife Fund supported developing the first national strategy for sustainable education with its pedagogical proposals more aligned with national needs and characteristics.

It is worth mentioning that governmental efforts and the interest of academics have improved education in Mexico. It was considered that before creating environmental careers, first, it was necessary to complete several tasks. Those tasks included: modifying traditions, creating education centers at the regional and municipal levels, improving the ecological language to promote and create a new system of values, getting to know the environment, and promoting awareness and respect for interaction with the other elements of nature. Thus, primary school textbooks present a harmonious approach to sustainable education, and the development was started of support materials for teachers in different school environments. To establish better development of the plan, Mexico committed itself through the Ministry of Public Education and the Ministry of Environment and Natural Resources.

Using these resources, they made sustainable development a reality in the country through the school institutions of the different levels and modalities, to achieve the transition towards public and private life, to allow the citizens to participate in the decision-making process, to define the trajectories of national development to which it wants to reach, carrying out the principles of sustainability. Based on the commitment that Mexico managed to establish, the National Association of Universities and Institutions of Higher Education was formed. It sought to strengthen the contribution to sustainable development and to improve the quality of life in society, while creating the vision that the higher education system would contribute to sustainable education for the coming years. This was done along with the premise that none of the areas of knowledge be left out, which meant it was proposed that the creation, transmission, and dissemination of knowledge and its articulation with social and governmental organizations in a working mechanism that allows taking advantage of the strengths of sustainability in the country's development model.

A network of higher education institutions was founded, which promotes extracurricular environmental programs called the Mexican Consortium of Institutions of Higher Education for Sustainable Development. Its purpose is to promote the generation, discussion, and structuring of environmental and educational knowledge and skills that contribute to the development and strengthening of an environmental education that fosters individual and community human development committed to nature, society, and the individual. It is important to strengthen efforts to the maximum, such is the case of the definition of professional profiles, to think about differentiated profiles; to discuss the interdisciplinary approach of the field and its theoretical and methodological implications; to design curricular proposals oriented to the training of researchers and teachers in the field, at the same time that evaluation works are developed on the professionalization processes of sustainable education that allow progress and its redirection if necessary (Table 6.2).

Table 6.2 Example of subjects corresponding to each state of Mexico about sustainable learning; established by the state education authorities of each state

Estado	Programa
Aguascalientes	Educación ambiental para la sustentabilidad en Aguascalientes
Baja California Sur	Jóvenes sudcalifornianos por una cultura de la sustentabilidad ambiental
Campeche	Educación ambiental en el estado de Campeche
Chiapas	Educación ambiental para la sustentabilidad en Chiapas
Distrito Federal	Educación ambiental para el desarrollo sustentable en el Distrito Federal
Durango	Cultura del agua para la sustentabilidad en el estado de Durango
Guerrero	Cultura ambiental: Reto de los Guerrerenses
Hidalgo	Educación ambiental para la sustentabilidad en Hidalgo
Jalisco	Educación ambiental, adolescentes y sustentabilidad en Jalisco
Estado de México	Educación ambiental para la sustentabilidad del Estado de México
Michoacán	Educación ambiental para la sustentabilidad en Michoacán
Morelos	Hacia una cultura ambiental en Morelos
Querétaro	Cultura ambiental en Querétaro
Quintana Roo	Educación y cultura ambiental para la sustentabilidad en Quintana Roo
Tabasco	Educación ambiental para la sustentabilidad en Tabasco
Tamaulipas	Educación ambiental para la sustentabilidad en Tamaulipas
Tlaxcala	Educación ambiental para el desarrollo sustentable en Tlaxcala
Veracruz	Educación para la sustentabilidad en Veracruz
Zacatecas	Educación ambiental para la sustentabilidad en Zacatecas

Source: *Flores, 2015*

Sustainability in the teaching-learning process

Globalization is known as a process of international growth of financial, industrial, and commercial capital, the use of natural, human, and political resources, and any interchangeable activity between countries. This intensifies and changes international economic life when a series of actions that the countries themselves have planned for the achievement of sustainable development are added. When focused on determining the links or relationships of sustainable development, the picture becomes complex. And if the focus is on higher education, establishing a preference for making changes that societies have achieved over time, such as how a country develops in a globalized world and how to achieve sustainability in its development. In this, not only a partial change is proposed, but fundamentally a new lifestyle is sought and a new and better understanding of relations between countries. Higher education institutions assume a social commitment, responsible for promoting the development of science, technology, and activities oriented to cover humanistic aspects that support the integral training of citizens.

The aim is to promote participation, the solution and prevention of environmental problems, and the construction of future scenarios through strategic actions in research, teaching, dissemination, and extension, as established in the action plan for sustainable development in higher education institutions. Buildings and the built environment have an important role, especially because of the impact they have on the natural environment and the quality of human life that is expected. For example, sustainable architecture and design should take into consideration the conservation of natural resources, energy efficiency, the use of non-polluting materials and construction processes, low land use, social and ecological principles; and above all an aesthetic sensibility that as sustainable design significantly reduces the adverse human-generated impacts on the natural environment while improving the quality of life, and social and economic well-being.

All countries in the world have set great challenges, and one of them is to preserve natural resources so that future generations can count on them. All have agreed that education is the fundamental pillar to transform our way of life, making great changes that can lead to a quality life, always maintaining balance. Accordingly, education for sustainable development has been a world priority since 1987 when the concept was defined in the Brundtland Report; by 1992, more than 180 countries committed themselves to sustainable development at the United Nations Conference on Environment and Development in Rio de Janeiro; it was determined that national education systems should be linked to the environment, society, and the economy.

With the priority of establishing principles, values, and practices of sustainable development in all aspects of education and learning, to address social, economic, cultural, and environmental problems, there are four main foundations for effective development: better access to quality basic education, realigning educational programs from preschool to university; this to instill the principles, knowledge, skills and perspectives and values related to sustainable development, always hand in hand with the commitment to fulfill the plans in terms of their objectives.

Education for sustainable development should not only focus on students at the elementary and higher levels but should not have an age limit to obtain knowledge and skills, aimed at the population in general, a community education, where each person can learn from his or her partner and at the same time from the experiences that arise from practice. Since the emergence of implementing skills for sustainable development, there has been criticism from some sectors linked to the field of education in Latin America, who argue that there are no novel contributions of this approach through the exploration of the relationship between education, cultural change, and sustainability. It is discussed as a favorable response to obtain novel aspects that could have a positive impact on conceptual development and practice. Specifically, it is considered that it has addressed aspects of the sociocultural aspects ignored by education focused on sustainability in other regions, how it considers culture is novel and could generate new ways of providing solutions with different alternatives to achieve the objectives and balance between all sectors.

A proposal that aims to contribute to all processes of sociocultural change in order to build a sustainable future, this movement arises at the global level, which means that its conceptual development and its principles have been promoted at conferences and in international forums by multilateral agencies such as the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the International Union for Conservation of Nature (IUCN). In Mexico, since 2001, the 32 states have been promoting the creation of plans, programs, and strategies for environmental education, training, and communication, while simultaneously carrying out a series of inter-institutional actions on the education environment, with the participation of the National Association of Universities and Institutions of Higher Education (Asociación Nacional de Universidades e Instituciones de Educación Superior).

In the different global discourses that have been presented to make known important data on how to carry out sustainable development, the possibility of rethinking the relationship between the cultural dimension and the sustainability of societies is mentioned. Such a situation could generate new ways of interpreting the problems, of looking for solutions, and alternatives to improve the desired results.
Specifically, the approach of sustainable education in Latin America has tried to incorporate the sociocultural dimension in its work, but this does not mean that it diminishes all the contributions that have been generated, which is why it is important to reflect on its proposals and promote progress in different areas and on different topics, since it is a critical exercise for any discipline that intends to contribute to change towards a more sustainable future.

In education for sustainability, different areas must be considered to make it known that it is being carried out correctly and efficiently. It is characterized to describe seven areas which are the following ones:

Political dimension Its objective is to promote the development of qualifying subjects, expansion of social management spaces, dialogue, respect, and individual participation and citizen participation.

Ecological dimension Promotes the sustainable use of natural resources; establishes a social commitment to build appropriate controls of emissions and waste generation derived from production; and generates human resources capable of generating scientific and technical knowledge about ecosystems.

Epistemological and scientific dimension One of its goals is to reform the methods of knowledge production, interdisciplinarity, the internalization of the environmental dimension to the object of knowledge of each discipline, the transformation of educational profiles, programs, and the recognition of traditional knowledge.

Pedagogical dimension This refers to innovative proposals that guarantee quality education for all, the planning of processes focused on learning, facilitating the understanding of reality and its transformation at the personal and community levels, creatively addressing learning needs, the development of workplace competencies and attitudes for life, work, organization, and the construction of learning communities.

Ethical dimension It reveals the rethinking of the role of human beings in the world, analyzing the value building that lies behind knowledge. It is the renewal of values, an ethics based on cooperation and respect for nature, dialogue, and democratic and equitable coexistence among the members of society.

Economic dimension Promote that individuals and social groups reflect on the ecological impact of the current economic model, generating awareness and engaging with social trends concerned with sustainable construction.

Cultural dimension Party to recognize the cultural set of traditions and community values of the different communities, recognition of plurality and respect for different worldviews, and the recovery of traditional systems of community organization for the use of natural resources.

It is intended to have an orientation towards the basic principles of education, achieving the formation of individuals aware of their environment and respectful of all living beings. For this, an educational process based on a broad and integral concept of education is required. That is to say that its purpose is to develop a person who can learn to know, to learn to live collaboratively, to learn to do, to learn to be.

The concept should be understood broadly, as it encompasses various issues that are of great relevance for the planet, such as climate change, biological diversity, disaster risk reduction, cultural diversity, poverty reduction, gender equality, health promotion, peace, and human security, among others.

Education-based on sustainability

Nowadays, with all the scientific and technological contributions that are available, better and efficient results have been achieved in the educational sector, as well as in different sectors for greater growth and development. However, sometimes there is a sensitization that has a certain influence on the production systems, to reach the new lifestyles that we want to implement, mainly in industrialized countries, which are the main ones that have introduced new unsustainable models. A clear example is the burden of consumption by increasing in an unattainable way. For this reason, some social, economic, and environmental problems, which in turn are related to each other, are commonly found and constitute development problems that could later generate different problems for the life of mankind.

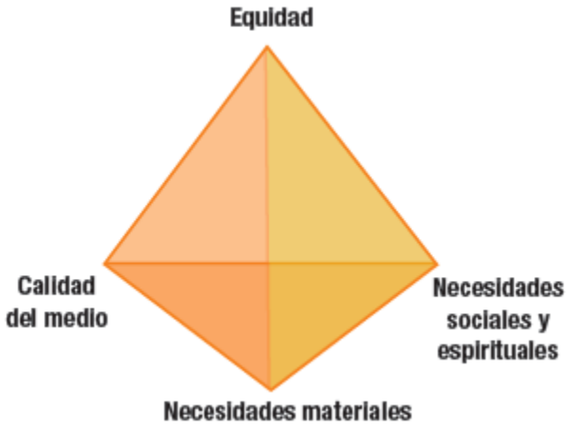
Sustainable development is fundamentally about the relationships between people, the way of leading daily life, according to the environment where they live, and to be able to maintain a balance between both, as well as the social and economic development models are present. The main one is the human element, making it a priority to establish the relationships between the social and economic elements of the population in addition to the natural resources they have, in order to achieve positive results or in the worst case, the process is totally negative, and the objective of maintaining a balance between each of the elements is not achieved. It is very common that it proves difficult on most occasions to carry out the idea of sustainable development, for all the actions that must be considered to be able to execute it efficiently. However, there are feasible and simple options to start or emphasize, a way to achieve it, starting with the identification of the needs that justify a particular project, analyzing which would be the benefits or positive responses that would be had to achieve them. The needs are classified in the following way:

Materials

They are classified in everything related to the welfare of the person, such as food, physical security, housing, everything that ensures a quality life.

Social and spiritual The individual aspirations that one has as a person; education, freedom, recognition. Environmental quality To be able to have access to a clean and healthy environment, a sustainable ecosystem. Equality To be able to enjoy the diversity that is presented, taking into account future generations, providing them an opportunity to share in the well-being of the environment and society (Figure 6.2).

Figure 6.2 Quality of life parameters



Source: Aznar, 2010

Sustainable development is intended to be a goal, but to reach it, it should start not only as a goal but also to establish a process to facilitate actions and not only through the application of techniques and programs as it is usually done for other methods. As any social process mainly involves values, beliefs, and behavior of the person or society, to be able to develop in an efficient and effective way, education, specifically sustainable education, should be more deeply involved in a strategic way, and this will allow establishing from the beginning a development model with a focus on sustainability and equality. Education facilitates the ability to understand how everything is related and to achieve a balance between natural and social environments without affecting any of them while obtaining great benefits such as achieving an international movement of thought and action promoting respect for the care of people as well as the environment and the planet's resources. This will provide an excellent basis to contribute to the values that support respect, care, and responsibility. Consistency within education for sustainability allows us to have better training to develop and acquire behaviors, practices, and/or skills that allow all human beings to meet the basic needs to live a full life.

The educational process promotes innovative learning and is characterized by anticipation and participation. This gives the capability to understand and get involved in everything one wants to do. A clear example that can be seen from the elementary school level, whose main objective is to provide students with the skills and abilities, as well as fundamental knowledge so that they can develop and implement innovative projects. In the future, that will allow them to have more opportunities to grow in everyday life; instilling leadership in their values to achieve great goals, establish their businesses if they wish, creating and promoting the creation of jobs in regions or sectors where it is necessary to have greater development, as well as growth in the economic sector, reflecting a balance to have more growth at a personal level and as a society.

However, the search for sustainability not only depends on education; there are a variety of factors that influence the development of processes and values that promote sustainability. Some of which are: economic organization, participation in decision making, social interrelationships, among others; it should be considered important that each one is needed to achieve sustainability because if any aspect fails, it would be difficult to develop it correctly. That is why it is necessary to inculcate the principles and foundations of sustainability, from the basic level of education, to achieve it correctly in the coming years. Education is a social instrument of transformation for society itself. If one of the other elements or most of them do not take into account the participation to make the necessary changes, it would be impossible for the education sector alone to achieve the desired transformation, production choices, consumption patterns, and the established development makes it improbable to promote sustainable development without establishing changes in these structures.

Education with a focus on sustainability is aimed at all types of people, regardless of their age, and develops mainly from the perspective of lifelong learning, implements all types of learning modalities; non-formal and informal forms. It tries to reflect the concern for life and education of excellent quality, to provide people with the knowledge to be able to understand what is happening (knowing), to complement within society, to feel part of it (knowing how to be), in addition, to achieve participation in the processes of development, creating the ability to establish skills and develop new ones over time (knowing how to do Figure 6.3).

Figure 6.3 The relationship and execution on how to implement knowing, knowing how to do, and knowing how to be

Source: *Aznar, 2010*

The practices and knowledge that are initially learned will be applied to individual and collective habits through small decisions or activities that are carried out in daily life. Therefore, when establishing plans or strategies mainly in education, it is important to emphasize that this allows learning for sustainability. But above all, it is obtained through practice and models to follow that are carried out in daily life.

It should not be limited to only exercise it individually, but to be able to develop the ability to collaborate with others through teamwork, thereby achieving a change in social structures, personal and group participation is achieved in the search for efforts to find better mechanisms and frameworks to move towards sustainability.

To provide knowledge about sustainable development through theories that facilitate obtaining skills and abilities, with the objective of implementing them in a correct manner. In the first place is theoretical rationality, which allows the application of scientific knowledge to improve educational practice. It is found in the rise of a renewed conceptual apparatus of science that transcends the fragmentary objectivity of the reductionist analyses of the analytical and mechanistic approach. It allows, through multidimensional and comprehensive explanations, to offer cognitive and methodological proposals more in line with the human-social sciences and with the need to connect the natural, socio-economic and cultural phenomena of the environment and development in an interdisciplinary manner. Concerning this perspective, education could focus on reviewing and offering methodological proposals for the understanding of the socio-environmental problems of development, the understanding of the interaction between human beings and the natural and sociocultural environment, as well as the relationship between thought and action in the development of the competencies required for sustainable human development. As a second point, practical rationality is established, since it facilitates the recreation and new construction of knowledge from experience, provided by the application of scientific knowledge in the different fields of action; it implies a way of reintegrating educational theory and practice that requires the exercise of a reflexive knowledge to do, but also a reflexive doing to know. With regard to education, it is specified in reflecting critically on the aims and objectives of education for sustainable human development, specifying the concepts that relate to the environment, education, science, and sustainability, as well as being able to analyze and assess the world reports on development published annually by international organizations, such as human development.

The reports represent important documents for the analysis and understanding of the reality of human development, to be able to establish response options and sustainable proposals, to build, contribute models and systems that allow to indicate and evaluate the process of education for sustainable development.

Finally, there is ethical rationality, which allows us to change our representations of reality from an ethical system, such as the reintegration of educational theory-practice. To the extent that we act guided by different motives, which have to do with collective value systems, it also calls for a type of information on values, of an ethical nature, to commitments that guide education.

This rationality involves in the very definition of sustainable development the moral conception and the ethical attitude from fostering the values of sustainability; the ethics of sustainability; it is also economic, social, and political ethics, which can encompass different areas of interaction, for example, the social, ecological, political, economic, between society and its institutions.

The set of these interactions makes up the triple dimension of ethics for sustainability, the first is defined by the values that define the individual rights that pertain to the relationships between human beings; these are the rights of the first generation, the second is defined by the values that define the social rights that correspond to the relationships between human beings and social organizations; and the third is defined by the values that specify the rights related to the environment, peace and the development of society.

These three types of rationality serve as a reference to specify in a coherent manner. The basic competencies for sustainability to be developed in the curricula and the different study paths, from theoretical rationality, the cognitive competencies can be specified (field of knowing), referred to the critical understanding of the problematic of global sustainability from the practical rationality, procedural competencies can be specified (field of expertise knowledge), referring to the acquisition of skills, strategies, and procedures for decision making and the implementation of sustainable actions; from the ethical rationality, attitudinal competencies can be specified (field of experiential knowledge), referring to the clarification and development of attitudes and values related to sustainability.

Fundamentals of a sustainable education

Education for sustainability must share all the features of a quality educational experience, incorporating the values of sustainable development in the teaching-learning process; highlighting mainly the values on which it is based, those that allow to carry out development in a more efficient way, to be able to make a selection in which the most convenient ones can be chosen to be able to exercise them during the process, similarly with critical thinking that allows facing the problems that may arise in different circumstances, giving a favorable response to correct the problems or seek ways of a solution with the interaction of different people applying teamwork, focusing on reaching the goal and showing the commitment to achieve sustainability.

In order to make decisions, it is necessary to integrate all the people who work together to reach the end results. This helps to have a greater contribution of ideas when a problem arises, as well as to establish some improvement in the development process, including those related to the environment and the way of learning. Different means can be used to achieve the necessary skills in the sustainability approach, such as didactic resources, the experiences of people who may have more time in practice, the realization of debates; this will allow building a joint form of knowledge either on a local or global scale with a focus on development problems.

It establishes the spirit that should preside over the design and implementation of education programs for sustainability, developing participation in planning and management for sustainable development, achieving in educational practice the knowledge of the reaction between the problems and uses of resources of each region is linked to local development.

The participation of the different social stakeholders in the decisions and actions to be taken is important since it affects the type of development to carry out an effective and sustainable model.

The goal is to involve the population in the planning and management of development, to assume the role of social dynamization, seeking complicity in good practices.

The field of sustainable education is undergoing a continuous transformation, a permanent construction, and reconstruction where a wide range of theoretical and methodological approaches, postures, and languages converge, making it a complex field of knowledge and practices. The challenge of education in this globalized world is to contribute to reorient our patterns of action towards the new paradigm, to favor the progressive transformation of patterns of resource utilization and personal interrelationships based on criteria of ecological sustainability and social equity. The transformations required by educational systems are important not only to solve the problems of coverage and quality but also to incorporate this new ethic, without which it is very difficult to think that new paths to social development and sustainability can be opened (Table 6.3).

Table 6.3 Continuing education courses

Curso	Institución responsable	Dirigido a profesores de niveles y modalidades
Cambio climático: ciencia, evidencia y acción	Centro de capacitación y educación para el desarrollo sustentable, SEMARNAT-SEP	Inicial, preescolar, primaria (regular e indígena), secundaria, telesecundaria, educación física, especial, extraescolar y artística CAPEP
Prácticas educativas para el desarrollo sustentable	Universidad Tecnológica Emiliano Zapata del Estado de Morelos	Inicial, preescolar, primaria (regular e indígena), secundaria, telesecundaria, educación física, especial, extraescolar y artística
Que cambia con el cambio climático	Dirección General de Formación Continua de Maestros en Servicio	Inicial, preescolar, primaria (regular e indígena), secundaria, telesecundaria, educación física, especial, extraescolar y artística CAPEP
Economía, Ambiente y Sociedad, ejes de la Sustentabilidad: un enfoque para la enseñanza básica	Universidad Tecnológica de Tula-Tepeji	Secundaria

Source: Flores, 2015

The strategies are aimed at moving from quantitative growth to product development based on efficiency, innovation, clean production, and the practice of the 3Rs: recovery, recycling, reuse. It also implies making qualitative changes in the investment pattern, both public, private, and social, redirecting it towards sustainable projects with high social profitability; consumption must be coherent with the regenerative and assimilative capacities of the global systems that sustain life.

Environmental strategies focus on conserving genetic, species, and ecosystem biodiversity, halting the extinction and destruction of habitats, recovering degraded ecosystems, using farmland more efficiently, preventing global warming and the destruction of the ozone layer.

Implement strategies to reduce the use of fossil fuels and replace them with other sources and properly manage domestic and industrial waste; human strategies focus on reducing the population explosion and reducing migration to cities by promoting sustainable rural development, adopting measures to minimize the consequences of urbanization, generating policies for equal access to basic resources with health and education programs, protecting cultural diversity, stimulating citizen participation and combating absolute poverty. It is necessary to change the population's consumption patterns to avoid excesses that produce over-pollution, reduce the growing disparity in salaries, generate more sources of employment for consumption and local and regional markets.

In the case of technological strategies, the aim is to adopt more efficient and cleaner technologies, less intensive in the use of natural resources and energy consumption; to preserve traditional low-pollution technologies for support.

The key point is to create a proposal of dematerialization that allows the dominant paradigm to defend the idea of a planet with inexhaustible resources, largely on technology. It is possible to achieve a significant dematerialization if the most efficient technologies that exist in the market are intensively applied, and in parallel, the most impacting consumption patterns are changed.

Conclusions

Sustainability has been present in human life for decades. However, in recent years it has had a greater impact due to the great demand that has been generated for the acquisition of products, services, technology, among other things; as well as the way of life that developed countries have been living, the excessive exploitation of natural resources, not taking into account the consequences that could be generated if they do not have the necessary considerations to establish sustainable development, trying to bring a balance in the social, economic, and environmental spheres.

However, it should be noted that the education sector has great importance regarding implementing sustainable development since education instills in students the basic principles, knowledge, skills, values, and above all, creates awareness about the importance of sustainability, in addition to the great advantages that can be obtained by carrying it out. In this way, we can enjoy a quality life hand in hand with sustainability; also, it is easier to acquire everything mentioned since it begins to provide such knowledge from an elementary level to the higher levels of study.

If sustainable development is established and carried out, great benefits could be obtained. In addition to promoting the culture that is part of life, this will allow more efficient implementation on a daily basis. A great advantage is that by introducing the principles of sustainability to the present and future generations, we have the teaching of how to implement it in society, with all the skills and abilities that they can acquire to achieve a change; creating and promoting employment, the creation of innovative projects that lead to greater development, either in the regions where they are presented with greater requirements as well as in large cities and countries. Remember that to function in an efficient manner, we must work individually, also work together as a team where all people can get involved for better results, fulfilling the principles and values that sustainability contains.

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Chapter 7 Parasitism management in animal production system: Sustainable approaches for their control

Capítulo 7 Manejo de las parasitosis en unidades de producción animal: Métodos sustentables para su control

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Abstract

Despite the use of modern anthelmintics to treat and control parasitism in animal production systems, these illnesses continue affecting both animals' health and diminish production parameters. One of the most important is gastrointestinal nematodiasis which is present in temperate and tropical conditions and represents larges economic losses. The concern increases with the new nematode isolates resistant to different broad-spectrum anthelmintic families (multi-resistant isolates). In addition to social pressure to have food that is safe and that does not harm the environment. The above, leading to the development of alternative gastrointestinal nematode control methods and allows to decrease the excessive use of commercial anthelmintics, extend the useful life of these products and help to have sustainable animal production systems. However, first, this valuable information is encountered in specialized periodic journals in the English language, second due to its high cost, it is difficult to access in general for students and producers who need to know about this information for its application in production systems. A literature review was carried out about the alternative control strategies of nematodes in ruminants that have been developed worldwide with a simple explanation of their potential use, the results obtained so far, and that their dissemination free of charge to make it available to the public. The above using the access granted by the Autonomous University of Campeche to databases such as Elsevier, Springer, and Ebsco Host.

Production system, Alternative control methods, Gastrointestinal nematodes

Resumen

A pesar del uso de los modernos antihelmínticos para tratar y controlar las parasitosis en los sistemas de producción animal estas enfermedades siguen afectando a los animales y disminuyendo los indicadores productivos. Entre estas parasitosis resaltan las nematodosis gastrointestinales que se presentan en climas templados y tropicales y que año con año reportan pérdidas millonarias. Esta preocupación se ha incrementado con la aparición de cepas de nematodos resistentes a las diferentes familias de antihelmínticos de amplio espectro (multirresistentes), además de la presión social por tener alimentos inocuos y que no dañen al medio ambiente. Ante este panorama se ha desarrollado un área de métodos de control alternativo de las nematodosis que permitan disminuir el uso excesivo de antihelmínticos, prolongar su vida útil y convertir estos sistemas productivos en sustentables. Sin embargo, esta información se halla en revistas especializadas en idioma inglés y por su alto costo es de difícil acceso para estudiantes y productores que necesitan conocer esta información para su aplicación en los sistemas productivos. Se realizó una revisión de literatura sobre las estrategias de control alternativo de nematodos en rumiantes que se han desarrollado a nivel mundial, con una explicación sencilla de su uso potencial, los resultados obtenidos hasta el momento y que se logre su difusión de manera gratuita para asegurar que esté disponible para el público en general. Lo anterior usando el acceso otorgado por la Universidad Autónoma de Campeche a bases de datos como Elsevier, Springer y Ebsco Host.

Sistemas de producción, Métodos control alternativos, Nematodos gastrointestinales

Introduction

Despite the use of modern anthelmintics, some authors agreeing that parasitism, especially gastrointestinal nematodes are the most prevalent parasites in the world, these parasites are responsible for huge losses animal production system especially those based on grazing management and their control have great importance due to the growing human need for the protein of animal origin and the pressure of developed countries leading to limit the use of chemical substances that pollute the environment.

Similarly, it is recognized that in the last decades the control of these nematodes relied on the use of commercial anthelmintics. However, the inappropriate and indiscriminate use of these substances has led to the appearance of new resistant strains of these nematodes to one, two, or three of the commercial anthelmintics families existent in the market, and this resistance was rapidly extended, in such a way, their use on animal production systems is endangers.

On the other hand, there are a social concern and economical pressure which demands not only higher production they also demand efficiency, considering, animal welfare and overall, this production must be according with the environment, namely sustainable. The latter implies an adequate use of modern commercial anthelmintic and overall, the seek for non-conventional alternative methods which help to control this parasitosis

However, the chosen solution must be adapting to the regional epidemiological features and the farm conditions. In this sense, it must use a combination of management and alternative control methods to avoid economic losses and to create control schemes based on an integral parasite control management. Nevertheless, there are few pieces of literature about this topic, regularly attend to principles of parasite control by separate, regularly are of scientific cut and highest const for veterinary students and farm owners who are the persons that fight every day with this illness.

Therefore, the chapter aims to integrate the different strategies developed worldwide in one document, provide a simple explanation of its potential use at the farm level, and finally ensure the free diffusion of this information to students, farmers, and interested people.

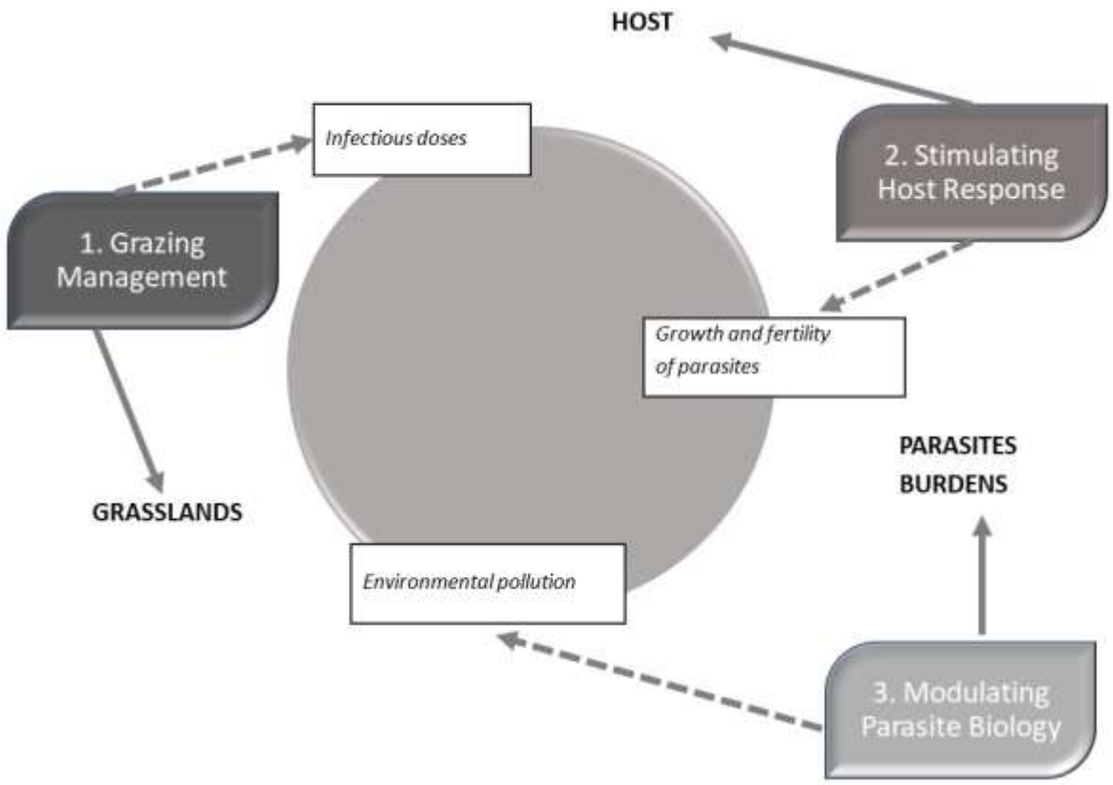
Principles of action to interrupt the life cycle of parasites

There are three principles of action used to interrupt the life cycle of parasites presented in figure 7.1 (Hoste & Torres-Acosta, 2011):

1. Reduce contact between the host and the infectious stage of the parasite
2. Stimulating the host response
3. Eliminate the parasite of the host

Similarly, there are different parasite control methods for each principle of action, it is important to use a combination of these methods to ensure animal health, low parasite burdens, and maintain the production parameters.

Figure 7.1 Three main principles of action to control gastrointestinal nematodes: bold arrows, target for action; dotted arrows, consequences on the life cycle of parasites



Reference Source: (Hoste & Torres-Acosta, 2011)

1. Reduce contact between the host and infectious stage of parasite

Grazing Management

These alternative methods of parasite control use grazing practices to diminish animal exposition to infectious stages of gastrointestinal nematodes (Sharma, Singh, & Shyma, 2015). To practice this type of control strategy, it is important to know and apply the knowledge about the epidemiological conditioning factors affecting local parasite, since different features could modulate the parasite's biology i.e. growth and survival of infective larvae in the paddock, which can affect the results obtained from this strategy (Reynecke *et al*., 2011).

This method can be divided into two strategies: in) Defense sanitary measures, ii) Offense sanitary measures (Hoste & Torres-Acosta, 2011).

i. Defense sanitary measures

Reduce animal load. Considered the most efficient way to reduce parasite problems, the less animal load allows the complete grasses recovery, reducing the impact of animal contamination of paddocks, and finally occurs fewer dose infection to the animals, this strategy generates a balance between components in the animal's production system and is the basis of organic farms in the United States of America (Hoste & Torres-Acosta, 2011; Torres-Acosta & Hoste, 2008). For the organic farms in the United States of America, a maximum of two animals units per hectare is required while in humid tropical conditions is established just one animal unit per hectare; in subhumid climate, like Campeche and Yucatan the value is around half-animal unit per hectare, this information was calculated by Comisión Técnico Consultiva de Coeficientes de Agostadero (Fernández-Reynoso, Martínez-Menes, Ramírez-Cruz, & López-Velasco, 2012; Hoste & Torres-Acosta, 2011).

Grassland rotation. This strategy is based on the knowledge of larval development from l1 to infective stage or L3, which is known as the viability of larvae in paddocks. Because L3 cannot feed these larvae have a period time of life, after this time larvae death by inanition, if this time knows it will be possible to use as the rest period for grasslands and in this way obtain grasslands clean and safe of parasites; It is important to consider the survival time of the larvae: in a temperate climate, it is known that larvae can survive form six to 12 months, however, in tropical conditions only survive four o fewer weeks this time is modulated by the season whether it's dry or rainy. Although good results are reported in temperate conditions at the moment remain as a good alternative for tropical conditions (Barger, *et al*., 1994; Burke *et al*., 2009). For humid tropical conditions three of four days of grazing and 27 to 28 days of grasslands rest is suggested (Vásquez-Hernández, *et al*., 2006).

ii. Ofense sanitary measures

With this principle, it is known the clean of grasslands from larvae nematode through chemical, physical and biological agents.

Sun and ultraviolet rays. The practice of intensive grazing generates that level of grass is cut close to the soil in this way the rays of the sun can penetrate, and the ultraviolet rays can reach the nematode larvae in the paddock, the latter is corroborated in zones with an intense dry season, in this scenario, there are no nematode larvae in the paddocks as a product of the sun rays intensity (Hoste & Torres-Acosta, 2011). This knowledge is in use in European countries with organic production systems since in this type of farms it is not possible to use commercial anthelmintics; in these farms are used grazing management taking into account dry and wet season to establish the rest period for the grasslands and in this way clean the pastures and return the animals when is considered that infective larvae decreased and the risk of infection is low for the animals (Napoléone *et al*., 2011).

Other organisms proved for the control of gastrointestinal nematodes. Some living organisms have been studied and classified as susceptible to use in the gastrointestinal nematodes control, the most studied are:

a) The fungi *Duddingtonia flagrans*, the fungus is marketed as a BioWorma the product, has a recommended dosage of 3x104 chlamydospores of a *D. flagrans* strains IAH 1297/kg of body

weight/day. This product has proved in horses, bovine, goats, and the authors report a decrease in the fecal egg count of nematode larvae of these three species. The decreased in counts was recorded as follows: For the case of equine a large variability was reported, however, the number of larvae reduce by 84% at six weeks post-treatment; in the case of bovine was similar founding high variability for the first eight weeks of treatment and a decrease of 81% at the eight weeks of treatment; for the case of goats was similarly high variability and a reduction of the 86% at the eight weeks post-treatment (Healey *et al*., 2018).

b) Mix or alternate grazing system. The mix or alternate grazing system is an offensive method which use the parasites specificity, when using others hots species these have a vacuum effect and thus clean the grasslands and the consumed larvae cannot complete their life cycle and damage the host. Some authors published information about the use of this alternative control strategy i.e. in animal production system with mix grazing of bovine and sheep a decontamination of infective nematode larvae occur in grasslands with time this strategy help to improve the productive parameters (Rocha *et al*., 2008).

c) On the other hand, in farms with alternate grazing with horses and bovine has recorded a decrease in nematode egg excretion in horses by 50% compared with a horse grazing system (Forteau, *et al*., 2020).

d) Other evaluated methods are, i.e. sodium hypochlorite and citric extracts, these alternatives were evaluated on laboratory conditions and showing good control results after this step methods were in field conditions, but it is necessary to assess their effect on the environment (González-Garduño, *et al*., 2010). Besides were evaluate on laboratory conditions sawdust of different trees species like pochote (*Bombacopsis quinata*), melina (*Gmelina arborea*), ciprés (*Cupressus lusitanica*) y teca (*Tectona grandis*), recording effects from 65.38% of reduction of larvae in the culture for teca; 87.57% of reduction for pochote; 91.46% for Melina and finally 97.94% of reduction for ciprés; sawdust were collected in sawmills and are promising; although they are not proved yet at field conditions (Álvarez *et al*., 2007).

2. Stimulate the host response to withstand or set up an immune response

Different methods help hosts to resist the parasites or to set up an immune response against them. The latter is mediated by the coevolutive history of the species as well as epidemiological factors. Among these strategies exists ones to help the host to repair the damage induced by parasites and them that stimulate the immune response (Torres-Acosta & Hoste, 2008).

a) Vaccines againts nematodes

Vaccines are a way to protect animals through the stimulation of immunity in this manner the host can deal with the field parasites infection due to the defense system recognize the etiological agent and can develop an immune response to oppose and eliminate from the body the etiological agent. There is a huge market in this field due to a large number of animals (18 billion) and an enormous interest of researchers to find the best way to immunize animals; regrettably, there are few effective vaccines to protect productive animals from helminths (Morrison & Tomley, 2016).

The latter could be due to the complexity and diversity of parasites involves and due to the complexity of the immune response such as macrophages antibody-dependent, granulocytes natural killers dependent of antibodies and non-lymphoid action of particular way at the intestinal level (Hewitson & Maizels, 2014). Despite these factors nowadays, has been developed vaccines against the *Dictyocaulus viviparus* nematode in bovine, *Haemonchus contortus* in sheep and the cestode *Echinococcus granulosus* in sheep (Claerebout & Geldhof, 2020).

– *Vaccine against Dictyocaulus viviparus in bovine.* Vaccines are composed of X-ray irradiated larvae, these vaccines stimulate a strong immune response and they have been effective to reduce the dictyocaulosis outbreaks (McKeand, 2000). Strube *et al*. (2015) in their study found that a dosage of a suspension of 1000 to 2000 irradiated larvae (Bovilis, Huskvac, MSD animal health, Ireland) had an impact on the number of adult parasites which was reduced by 93.3%; in this context, the low number of adults parasites affected the larvae excretion on feces which decreased by 93.5%; these results show that the vaccine have a good effectivity to reduce the grasslands larval contamination and therefore to avoid new reinfections during the grazing.

– *Vaccine against Haemonchus contortus of sheep.* The intestinal antigen was discover 20 years ago and, it was reported these specific antigens could neutralize enzymes related to the digestive process of the adult parasites (Smith & Smith, 1993). Two different studies prove the vaccine and have obtained the following results:

i. In their study, Bassetto *et al*. (2014) using doses of 50 mg, 5 mg in groups of males and females and their related control groups; found that females, despite to show titles of antibodies against *H. contortus* these antibodies were not high enough to show an effect over the variables of fecal egg count and hematocrit and some females had to be dewormed due to low hematocrit; on the other hand, males developed a strong immunity, until ten folds compared with females, and the 5 mg dose had the best results by significantly reducing the egg counts per gram of feces without affecting the hematocrit, finding a reduction in eggs per gram of up to 72% during the experiment. The physiological demand of pregnancy affects the immunity development (Valderrábano *et al*., 2006), however, females immunized when they were lambs were better protected during their adult life (Bassetto *et al*., 2014).

ii. Teixeira et al. (2019) report that vaccines show good protection in tropical conditions, where the rainy and dry seasons are well established. The application of the first dose at the beginning of the wet season decreased the eggs per gram count by 90%, and four more applications were enough to protect the sheep until the end of the trial when the risk of exposition decreased. In addition, they report that lambs of vaccinated females receive this immunity through colostrum and can be vaccinated until the next wet season.

The main effect of the vaccines is to decrease the *H. contortus* female parasites oviposition which in turn reduces the pasture contamination (Barnes *et al*., 1995). However, the trial was executed to prevent the oviposition of the parasite females during the wet season; these authors recommend this model of control and argue is not expensive and do not has a withdrawal time (Teixeira *et al*., 2019).

b) Genetic selection

Even though the exact mechanism is not yet known, naturally exist some animals which are capable to withstand the detrimental effects of parasites infections, these type of animals present reduce parasites implantation, reduced parasites burden, and low quantity of excreted eggs to the grasslands which bring with it a reduction in the infectivity of the pasture (Hoste & Torres-Acosta, 2011). In countries like Australia and New Zeland, some enterprises which produce sheep have been reduce the use of commercial anthelmintics by using genetic selection based on the test of reduction of fecal egg count this test is used to select animals naturally resistant to nematodes (Hunt *et al*., 2008). Some reports show that the use of progeny test under standardized conditions is an appropriate alternative to evaluate genetically for resistance to gastrointestinal nematodes (Heckendorn *et al*., 2017).

In this sense, it has been shown that livestock associations of producers can select their studs and establish programs directed to prove the futures studs, consistent of artificially infecting them with some specific parasite strain, evaluate the challenge, and using it as a phenotypical resistance test. This methodology allowed select the parents of future generations and, at the same time, this selection enable improving the resistance of the descendant females of this program even under high natural levels of infection (Aguerre *et al*., 2018). Recently have been published works that propose the genetic markers as a quick way to select naturally resistant animals to nematodes, the DIS3L2 gene is suggested for Katahdin sheep (Becker *et al*., 2020). As well as the role of simple nucleotide polymorphism of genes of immune response located on OAR3 and other sections of the genome of Corriedale and Pampinta sheep (Raschia *et al*., 2021).

c) Use of nutrition

The pathological effects caused by nematodes in animals result in more nutritional needs and a decrease in animals productive indicators and is considered an important factor to tolerate the parasitosis caused by nematodiasis (Burke & Miller, 2020). It mentions that the level of protein is necessary for this context, however, recent literature has identified that the balance between protein and energy of the diet is essential to maintain adequate health status and tolerate the presence of the parasites (Méndez-Ortíz et al., 2019)

And it is reported that in humid tropics environment where leguminous are an essential part of the diet of small ruminants, supplementation with an energy source like sorghum, maize, or molasses of sugar cane, by itself improve the resilience of the animals to parasites (Gárate-Gallardo *et al*., 2015; Hoste & Torres-Acosta, 2011). There are reports of the supplementation use to control nematodiasis, i.e. in one experiment, the authors administrated 200g/d of pelletized food of cotton seed (384g/kg/ DM; 12 MJ/kg DM; approx. 45% of dietetic protein non-degradable in the rumen) three times a week, Monday, Wednesday and Friday to merino sheep during prepartum and found that protein supplementation was effective to increase the body weight, fat, and muscle of the carcass of female sheep and this effect moved to the lamb's weight (Macarthur *et al*., 2014). Similar results were reported by Houdijk *et al*. (2012)

They used merino sheep and a supplement (400 g/d) with this level of supplementation achievement decrease the fecal egg count (fewer grasslands contamination) and positively affected the sheep body weight. In addition, reduce the use of anthelmintics by 33% and improve lambs weight gain by 20% (Houdijk *et al*., 2012).

In other experiment Crawford *et al*. (2020) studied changes in the source of protein in a series of trials, using pellets of alfalfa with 15% of protein, maize and soybean flour with 19% of protein, and maize, soybean flour, and fish mixed flour with 19%; the flours were administered at 1.28% for alfalfa and 1% for the others supplements to equally the administered protein and using Suffolk sheep; these authors found that fish mixed flour as a non-degradable rumen protein source increase the body weight, hematocrit, reduce the FAMACHA and the fecal egg count and these changes occurs when the addition of flour reach the 2% of the animal's bodyweight.

In humid tropical conditions where exists an abundance of tropical leguminous, which are a source of natural protein, it has been tested supplement strategies only with energy, since protein requirements are acquired from grazing. As an example, exist the work of Gárate-Gallardo *et al*. (2015) in this trial one group of animals was fed with 108g fresh basis of ground maize, and two more groups were fed with ground maize at 1% and 1.5% daily, and the control group remain without supplementation; it is found animals supplemented with 1.5% of body weight increased their daily weight gain in24% compared to animals infected a no supplemented, besides, there was a decrease in the fecal egg count by 55% and the partial budget shows better total gains and a net gain of 5.8 dollars per animal (Gárate-Gallardo *et al*., 2015). Similarly, it is reported that the use blocks of urea-molasses decrease the fecal egg count and help animals to withstand the detrimental effects of the parasite and getting gains plus 45% in treated animals (Waruiru *et al*., 2004).

3. Eliminate parasites from the host

a) Use of cooper oxide wire particles.

Copper oxide wire particles are commercial products used to treat deficiencies of this mineral in livestock in deficient areas, the wire particles lodge in the abomasum of the animals from where they degrade and give off copper ions, however, when producers use this product they observe that gastrointestinal nematodes loads, were also reduced; the use of 5 grams of this mineral supplement reduced the parasite loads in sheep by 96% for the case of Haemonchus contortus; by 56% in the case of Ostertagia circumcincta and did not affect Tricostrongylus colubriformis because it is intestinal and not an abomasal parasites (Bang *et al*., 1990). Recently, in a semi-arid region of Kenia, Africa, a trial using 45 indigenous goats in a free-grazing system was conducted, authors reported that the use of copper oxide particles in a dose of 1.7 g of copper (Copinox®, Animax Ltd, UK) did not significantly reduce the fecal egg count, however, after animals were humanely slaughtered, it was observed a reduction in the number of adult parasites by 58.8% for the abomasal nematode Haemonchus contortus; by 9.1% for the intestinal nematode Trichostrongylus colubriformis; and by 16.7% for the nematode Oesophagostomum venulosum (Waruiru *et al*., 2017).

In another study, carried out in North Carolina, USA, using Dorset Katahdin, and Barbados sheep with ages of 3 months and with one or two applications of two-gram capsules (Copasure®, Animax) on days 0 and 42, reductions were reported; for the double application of the copper oxide wire particles by 78.4% at the end of the experiment; while in sheep treated on one occasion there were reductions by 53.7%; on the other hand, slight improvements in weight gains and hematocrit were reported (Schweizer *et al*., 2016).

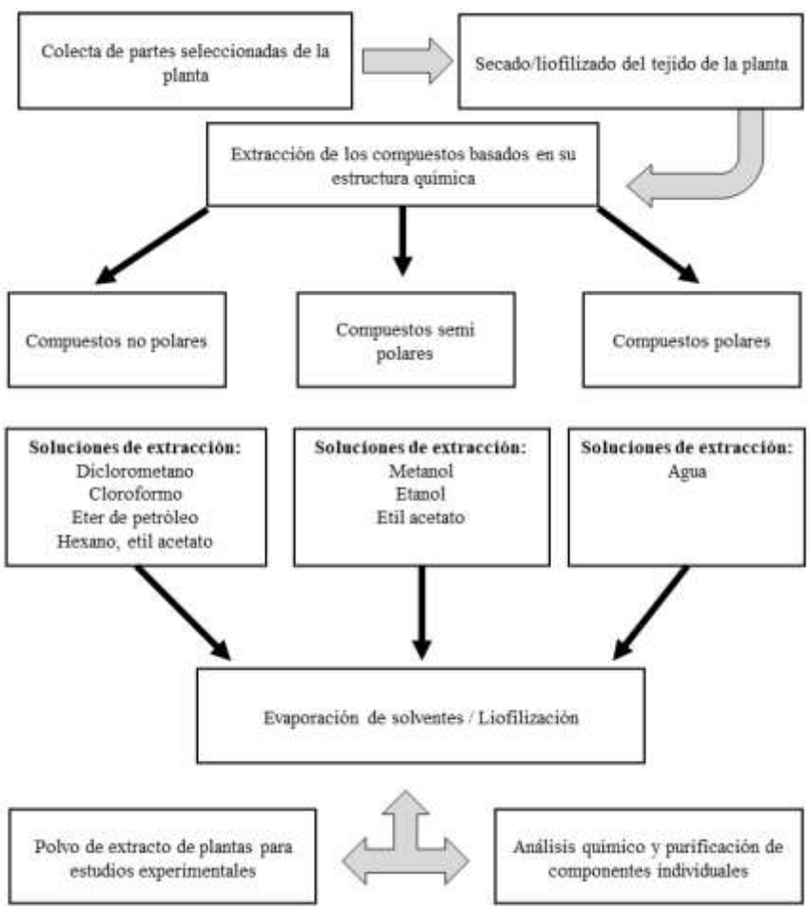
In another study, Campigotto *et al*. (2019) in a trial carried out on a farm in Brazil with multiparous lactating females of the Lacaune breed and with the use of two 1.74 g copper capsules (Copasure®, Animax, UK) in a humid subtropical climate the treated groups had significantly lower fecal egg counts from day 15 post-application.

b) Use of biactive products of plants and herbs

With the development of anthelmintic resistance to broad-spectrum families of antiparasitics currently used, one of the alternatives that have developed the most is the search for plants and herbs as a part of the local pharmacopeia. Plants play a critical role in maintaining human and animal life in harmony; they have interactions with herbivores parasites, and establish interactions and affect them in various ways (Mendoza-de-Gives *et al*., 2012). Before creating modern anthelmintics, humans used plants to control parasites of both humans and those that affect livestock in empirical way (Mendoza-de-Gives et al., 2012). Different studies confirm the effectiveness of these plants; and some commercialized products contain mixtures of plant extracts and use as supplements in diet (Castagna *et al*., 2019).

On the other hand, some effects of these plants contribute by reducing the dynamics of parasite infections, reducing the contamination of grasslands. In addition, it has a positive effect on the resilience of animals (Hoste & Torres-Acosta, 2011). Different plants and plant parts have been studied; however, different results have been obtained, the latter since plants produce different metabolites that in turn are influenced by the time of year, temperature and amount of rainfall recorded, plan growth periods, parts composing the plant, predation degree (herbivory) (Garcia-Bustos *et al*., 2019). There are different methodologies to test and use these plants, they have been proved in vitro and in vivo employing extracts made with different groups of solvents with different polarity grades that can extract the different secondary compounds from the plants, followed by a lyophilization process for their conservation and subsequent use (Fig. 7.2) this has also been tested with plant materials dried in stoves and with plants offered as food on a fresh basis (Hrckova & Velebny, 2013).

Figure 7.2 schematic representation of steps to obtain the groups of phytochemical compounds of plants



Reference Source: (Hrckova & Velebny, 2013).

Different substances with anthelmintic potential have been reported in this list it can find:

Fenoles

These substances are the most widely distributed in nature, are components of natural products which include: monophenols or terpenoids (thymol, cresol, and carvacrol); benzenediols (catechols and resorcinols); flavonoids (quercetin); substitutes of benzoic acid (gallic acid and vanillic acid), and cinnamic acid; their antiparasitic potential comes from its antioxidant properties (Garcia-Bustos *et al*., 2019). Different studies report the efficacy of these substances. In in vitro study, is reported that carvacrol and thymol at doses of 0.33 mM (0.05 mg/ml) cause the death of the Ascaris suum parasite more than 80% (Lei, Leser, & Enan, 2010). While the hatching of Haemonchus contortus eggs at a dose of 0.781 mg/mL decreased by 90%, finally larval motility reduced by 97% with a dose of 3.125 mg/mL (Ferreira *et al*., 2016).

Another promising substance belonging to the polyphenols group (tannins, flavonoids, and isoflavonoids) is the cinnamic acid and its derivatives which are obtained from the Acacia cochliacantha plant leaves; this substance is extracted with less polar solvents which collect fractions with the best anthelmintic effect. These extracts decrease the hatching of H. contortus eggs using doses of 1 mg/mL more than 98% (Castillo-Mitre *et al*., 2017). While extracts of the A. cochliacantha plant foliage on a dry basis and inclusions of 10% fecal egg count decrease more than 50% in Creole kids (León-Castro *et al*., 2015).

Tannins

These chemical compounds are a highly studied group of polyphenols, and several studies have been developed to prove their efficacy both live and in vitro. In this regard, a study using sheep fed with Sulla (Hedysarum coronarium) with a percentage of inclusion in the diet of between 10 and 12% of dry matter and with artificial infections with Trichsotrongylus colubriformis and Teladorsagia, it is reported a reduction in fecal egg counts and the load of Teladorsagia (abomasal parasite) was reduced by 48%, but there was no effect on T. colubriformis which is an intestinal parasite (Niezen *et al*., 2002). On the other hand, it is reported that the acetone/water extract of the sainfoin plant (Onobrychis viciifolia) alters the anatomy of the larvae of H. contortus and T. colubriformis at the hypodermis sections since separations were observed between the cuticle and the hypodermis; on the other hand, muscle degradation, and lysis of the non-striated region with disruption of the organelles and swollen cytoplasm were observed (Brunet *et al*., 2011). In live studies, it is observed, after the recovery of adult nematodes from goats fed a plant rich in tannins Lysiloma latisiliquum supplied to the animals at a rate of 800 g fresh base that parasites suffer pathological damage such as vacuolization of their muscle cells, and hypodermic, which damages motility, nutrition and could eventually damage your reproductive processes (Martínez-Ortiz-De-Montellano *et al*., 2019).

The use of another tropical plant, Havardia Albicans, administered to sheep at a rate of 14 g / kg of live weight and with artificial infections, found that the use of this plant decreased the excretion of fecal eggs by 58.8% (Francisco Alejandro Méndez-Ortíz, Sandoval-Castro, & Torres-Acosta, 2012). The use of this plant also showed a reduction in parasitic female's size by 7% and a significant decrease in the parasite female's fertility (Galicia-Aguilar *et al*., 2012). In the same way, the use of Sericea lespedeza pellets, either from leaves or the whole plants (stems and leaves) include at 50% of the diet of goats for 42 days, had significant reductions in the nematode fecal egg count, and even had an effect on coccidia oocyst count from day 7 to 42; an antiparasitic effect was observed when including at 25% of the diet, however, it was more effective for the leaf pellet diet group (Dykes *et al*., 2019).

Terpenos

Terpenes also have been tested, and their nematicidal effect reported. The essential oils of Melaleuca alternifolia at a dose of 1.7 mg/mL reduce the hatching of H. contortus eggs by 98%, and at doses of 56 mg/mL reduce larval motility until 88% (Grando et al., 2016). (Grando *et al*., 2016).

Saponins

Saponins are a group of triterpenoids reported with an inhibitory effect against parasites of animals. These substances are obtained from oats and edible mushrooms. In one study, extracts of Calotropis procera were tested with the techniques of egg hatching and larval development tests using different concentrations; at a dose of 4 mg/mL, the hatching of H. contortus eggs was reduced by 91.8%, and at 2 mg/mL, it was reduced by 48.2%; while at 1 mg/mL, larval development decreased by 99.8% (Cavalcante *et al*., 2016). On the other hand, the use of Zizyphus joazeiro bark showed an antiparasitic activity over the egg hatch with a mean lethal concentration value of 90% at 1.79 mg/mL; the extracts did not affect the larval stages and motility on H. contortus (Gomes *et al*., 2016). In the same manner, the ethanol-water extract of the basidiocarp of the edible fungus Pleurotus djamor was studie to know the ovicidal and larval motility inhibition effects on H. contortus parasite; the extract was fractionated by phases using silica gel column chromatography; and a fraction with 100% inhibition of hatching was found at a dose of 10 mg/mL, after 72 hours of exposure, the latter fraction contained free fatty acids ≤ 1% of the triterpenoid β-sitosterol (Pineda-Alegría *et al*., 2017).

There are compounds or mixtures of herbs or plants, that are on sale to the public for the control of nematodes, some extracts of plants of the *Lauraceae* family, in addition to some Australian species of *Hylandia* and *Fontainea* (Garcia-Bustos *et al*., 2019). In this context, it is relevant to test these commercial products, to know their anthelmintic activity. A product with a mixture of plants from the *Compositae, Cesalpinacae, Liliacae, Bromeliaceae,* and Labiatae families, which provide anthelmintic ingredients such like essential oils, resins, tannins, organic acids, and mucilages, was tested; the product was given at a dose of 10g and 20g per lamb which are the highest doses; these mixtures reduced parasite loads until 33%, according to the formula used to calculate the efficacy of commercial drugs, in this sense, the authors recommended that the use of these substances should be accompanied by other control strategies such as those outlined above to complement the control and reduce dependence on commercial antiparasitic (Castagna *et al*., 2019).

Use of by-products to control gastrointestinal nematodes

The agro-industrial and livestock sector by-products represent sources of environmental pollution, and their management is a key element to reduce this pollution; around 16 million tons of agro-industrial by-products are produced just in Europe. Therefore, use these kinds of waste as ingredients back in the food chain is crucial to prevent contamination (Correddu *et al*., 2020). In this sense, they have tried agro-industrial by-products such as those generated by the cocoa industry (Cocoa), coffee waste (coffee percolation), peanut waste, hazelnut waste, and Yucca. For the case of Theobroma cacao, it has proved extracts of the leaves of the annual pruning, and the peel of the fruit of three cacao species (AZT, CAL, and CEY). The result showed good nutritional values since leaves and peel are rich in protein, the latter assessed throughout a proximate analysis: parasitological in vitro tests showed that both extracts can stop larvae unsheathing, although leaves extract is better and when exposing the larvae to extract of the variety CAL damage to the sheath and muscles were observed (Mancilla-Montelongo *et al*., 2021).

On the other hand, it has been reported that cocoa husk and pulp extract produce an ovicidal effect, that kills nematode eggs at doses of 1200 µg/mL for pulp and 2400 µg/mL for shell (Vargas-Magaña *et al*., 2014). In the case of the coffee percolate residue, a water acetone extract was made and its effect in vitro and in vivo was evaluated, two varieties of coffee (Clean and Smooth (CS) and Shade Grown (SG) Starbucksĭ) were used with the inclusion of 100 g of coffee percolating in a comprehensive diet, for the in vivo test, growing sheep were used, and is reported that the CS strain showed anthelmintic effect from 150 µg/mL, while the SG strain reached 1200 µg/mL, for the in vivo effect 100 g of inclusion in the diet did not decrease the number of eggs found a reduction of only 10% (Ortiz-Ocampo *et al*., 2016). For the case of the inhibition of hatching, is reported that the acetone extract water from the percolate of Coffea arabica; Garat®, Mexico does not produce a significant effect (Vargas-Magaña *et al*., 2014). For peanut (Arachis hipogaea) and its methanolic and lichen extracts, anthelmintic activity was reached at concentrations of 10 to 15 mg/mL for the methanol extract, achieving inhibitions of 66% and 79% respectively, while for the lichen extract the inhibition was reached at 62% and 71% respectively and at doses of 20 mg/mL is reported 87% and 80% of efficacy respectively (Tahir *et al*., 2020).

Its effect in vivo as a supplement in meat-producing goats has also been studied and it was found that using 15% and 30% inclusions animals improve their daily weight gain, finding a better yield with the inclusion of 15%, on the other hand, the fecal accounts of eggs of nematodes were reduced 36% and 71% respectively for the percentages of inclusion (Min *et al*., 2019). Another important product is banana bracts, which were dried and ground lately hydroalcoholic extracts were made and tested within vitro tests for egg hatching and larval migration assay; the best inhibition of hatching was achieved with a concentration of 2.5 mg/mL, achieving 88% inhibition, while the best inhibition of motility was achieved with the concentration of 5 mg/mL (Kakimori *et al*., 2019). For the case of Yucca (Manihot esculenta), the use of the methanolic extract of the leaves of Yucca at a dose of 2400 µg/ml was effective to inhibit larval development (of L1 L3), on the other hand, when included in the diet, yucca foliage in an amount of 450 g/lamb/day the average excretion of fecal egg count is decreased by 41%, and the development of eggs to larvae reduced by 60% (Marie-Magdeleine *et al*., 2010; Marie-Magdeleine *et al*., 2010).

Combined use of alternative methods

The resistance of living organisms to different substances used for their control is a natural process of defense, therefore, the sustainability of the control strategies used against gastrointestinal nematodes of ruminant must be based on the use of several alternative methods together (Hoste & Torres-Acosta, 2011). In addition, this group of strategies must be suitable to the production system, which is why is difficult to carry out this kind of evaluation, however, some works evaluate the combination of methods. In this regard, the use of copper oxide particles and the nematophagous fungus *Dudingtonia flagrans* has been combined, and it was found that the use of copper oxide particles did not affect the ability of the fungus to trap nematode larvae and found a beneficial effect of treating the animals with copper and fungus as they excreted fewer eggs and the larvae are trapped by the fungus which means less contamination of the meadow resulting in a lower dose infection for the animals (Burke *et al*., 2005). The use of copper oxide particles and food supplementation in goats has been evaluated with good results (Martínez-Ortiz-de-Montellano *et al*., 2007).

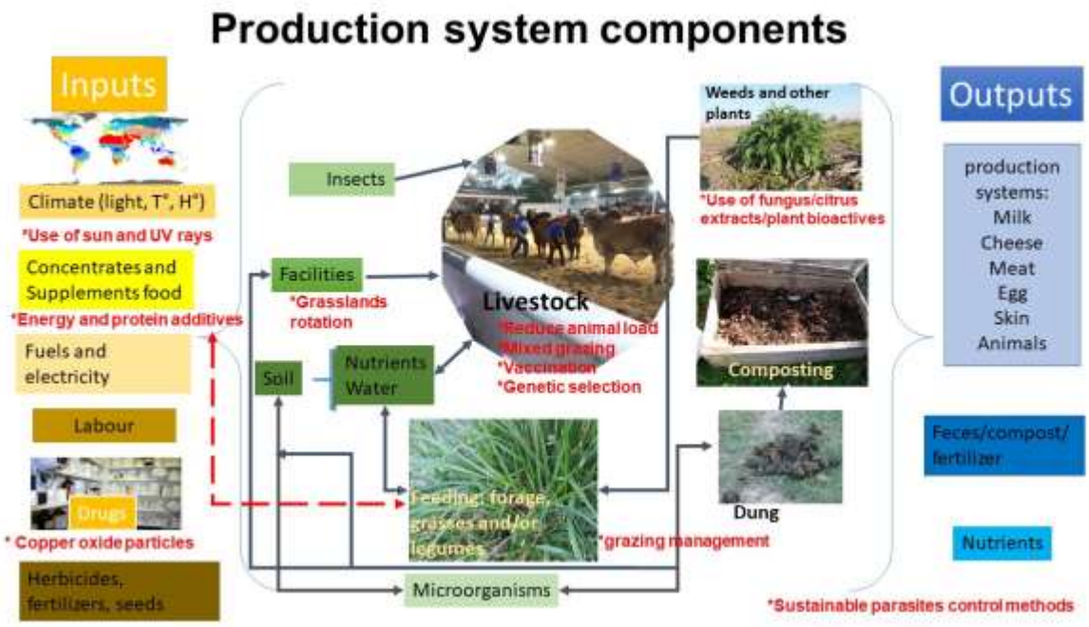
The use of nutritious materials with secondary plant metabolites improves nutrition and affects parasites was also evaluated, and a decrease in periparturient relaxation of immunity is reported (Kidane *et al*., 2010). Fruit flour of native tropical species (*Caesalpinia coriaria*) with anthelmintic potential and a percentage of inclusion of 10% and the use of overpass soybean protein to improve animal nutrition has been tested, in this context, there is an effect on parasites attributed to tannins and the combination of fruit flour with soybean paste shows a protective effect on the protein reaching its greatest effect at the ratio 80:20 (Palma-García *et al*., 2019). Alternative control methods are not potentiated between them, they have additive effects if they are alternatives that affect in a different way parasite, that is to say, they are focused on different biological stages of the parasite (Hoste & Torres-Acosta, 2011).

Conclusion

It must be recognized that the control of parasites in a sustainable way is not an absolute concept given the different regions and productive systems of the world and, therefore, could have different levels of adoption and impact on farmers (Henrioud, 2011). Therefore, for control programs of parasites in productive systems to be sustainable, a type of management of parasite behavior is required, this management seeks to minimize the damage caused by parasites, not control them excessively (selection pressure), and carry out a preventive approach that pays close attention to changes at the ecosystem level caused by human activities and that are suited to the productive system in a particular way. The challenge is to use good animal husbandry practices and the principles of integrated parasite management (IPM) in a pragmatic way that allows sustainability in production; For this reason, the aspects proposed by Horwitz & Wilcox, (2005) must be considered, which among their recommendations include:

- Put Attention to the host's ability to resist infection through its well-being, nutritional status, and/or immune system.
- Ensuring the strategic application of chemical controls; only in combination with other practices.
- Habitat management to maximize the effects that other organisms might have on the parasite.
- Continuous analysis of each component of the production system (Figure 7.3) to know when and where to implement or modify the parasite control approach and even identify those factors that are influencing the presentation of parasites at a certain moment

Figure 7.3 Relationship of parasite control methods and the components of the production system to reach sustainability



Reference Source: author´s own elaboration

Several authors agree that the management of alternative methods of parasite control should take into account the different stages of the life cycle of parasites to find strategies that affect parasites at different sites of action: i) modulating its biology, ii) increasing the resistance and resilience of the host, iii) decreasing its amount in the pastures Table 7.1 (Burke & Miller, 2020); for example, the use of copper oxide particles either in combination with secondary plant metabolites affecting the larval establishment, grazing systems that minimize infection and improve the nutritional status of animals that increase their resilience and resistance to gastrointestinal nematodes, in this sense the selective use of anthelmintics is not ruled in production systems (Burke & Miller, 2020).

Tabla 7.1 Alternative control methods for gastrointestinal nematodes in ruminant livestock

Método	Objetivo
Copper oxide particles	Adults *Haemocnhus contortus* parasite
Plant secondary compounds	*Haemocnhus contortus* adults and other gastrointestinal nematodes depending on plant species; possible involvement of larval development
Nematophagous fungi	Free-living stages of the nematode larva
Genetic resistance	All parasitic stages of nematodes

Reference Source: (Joan M. Burke & Miller, 2020)

Similarly, owners of animal production systems should use the alternative control method available to them, considering the epidemiological characteristics of the production area, and do not forget the importance of anthelmintic selective treatments. As examples include some systems in use in northern and southern regions of the United States of America Tables 7.2 and 7.3 (Hildreth & McKenzie, 2020; Navarre, 2020). On the other hand, some techniques make a progressive adaptation in the management of the herd, coherent with practices used by farmers in terms of time and space, in such a way an analysis of the possible combinations of the management of the resources of grazing, the management of production, the epidemiology of gastrointestinal nematodes are used as models of parasitic infections to find the management that minimizes risks and increases production (Napoléone *et al*., 2011).

Table 7.2 Determinants of the prevalence and degree of cattle nematodosis

Nature of challenge
Overriding determinants
Climate
Weather
Season
Region
Pasture and management determinants
Pasture quality and productivity
Pasture type
Pasture topography and drainage
Grazing management: age group separation, alternate species, stocking rates, rotation, supplemental feeding
Production type: dairy (confined vs pastured), beef (stocker vs cow/calf vs feedlot, etc)
Animal-based determinants
Immunologic status
Physiologic status
Health
Nature of parasiticidal effort
Effectiveness of parasiticide usage
Effectiveness of product: spectrum of activity, larvicidal versus adulticidal, degree of resistance
Persistence of product Diminished efficacy: formulation considerations (topicals vs injectables, etc), dietary considerations (gut flow, ingredients, closures, etc), generics
Coordination of epidemiology with treatment
Time and extent of posttreatment challenge

Reference Source: (Navarre, 2020)

Table 7.3 Principles of control of gastrointestinal nematodes in cattle in the Southern United States

Increase overall herd immunity
Proper nutrition
Decrease stressors
Decrease other disease pressures
Graze cows after calves
Maintain biosecurity practices to prevent introduction of resistant GIN with herd additions
Incorporate resistance to GIN in genetic selection programs
Keep refugia
Avoid deworming all animals before turnout onto clean pastures
- Especially critical with macrocyclic lactones and other long-acting products
In cow/calf operations consider only deworming cattle younger than 5 years and allow older cows to serve as refugia
- Be aware of special circumstances that may alter this recommendation such as nutritional stress, treatment of liver flukes
Use and store products properly
Always use at least 2 classes of anthelmintics at the same time
Dose based on actual weights if possible
Do not store products at the processing area unless it is climate controlled
- Follow label directions for storage

Reference Source: (Navarre, 2020)

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Chapter 8 Geography of the COVID-19 pandemic and learnings for environmental sustainability

Capítulo 8 Geografía de la pandemia Covid-19 y aprendizajes para la sustentabilidad ambiental

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Abstract

This review article was prepared under the Geography approach and promotes discussions about the contents it studies, which are based on comparative data between the group of publications that addressed aspects of the advent of the Covid-19 pandemic and the group of publications that he related it to environmental sustainability as a prevention of the emergence of other pandemics. When the objective, at the same time, refers to the presentation of the result of the comparison of the approaches used in the publications on the subject, which can serve to formulate deeper reflections of other authors, with the production of new studies and publication of academic articles on the topic addressed. To facilitate understanding of the text, the meanings of terms and concepts used were defined, such as Agenda 2030, sustainable development, Covid-19, Public Health Emergency of International Importance (ESPII), metaphor, mode of production and consumption, new coronavirus (SARS CoV-2), pandemic, public policy, resilience, environmental sustainability and zoonoses. The sample of publications used to compare the aspects derived from the pandemic with the adoption of measures proposed in the objectives and goals of the 2030 Agenda, of sustainable development, was also defined as a guiding tool for the society-nature relationship, for, between other outcomes to prevent recurrence of pandemics.

Pandemic, SARS-CoV-2 virus, Covid-19, Schedule 2030, Environmental sustainability

Resumen

Este artículo de revisión fue elaborado bajo el enfoque de Geografía y promueve discusiones sobre los contenidos que estudia, las cuales se basan en datos comparativos entre el grupo de publicaciones que abordaron aspectos del advenimiento de la pandemia por Covid-19 y el grupo de publicaciones que lo relacionaba con la sustentabilidad ambiental como prevención del surgimiento de otras pandemias. Cuanto el objetivo, por la vez, se refiere a la exposición del resultado de la comparación de los enfoques utilizados en las publicaciones sobre el tema, lo que puede servir para formular reflexiones más profundas de otros autores, con la producción de nuevos estudios y publicación de artículos académicos sobre el tema abordado. Para facilitar la comprensión del texto, se definieron los significados de términos y conceptos utilizados, tales como Agenda 2030, desarrollo sustentable, Covid-19, Emergencia de Salud Pública de Importancia Internacional (ESPII), metáfora, modo de producción y consumo, nuevo coronavirus (SARS CoV-2), pandemia, política pública, resiliencia, sustentabilidad ambiental y zoonosis. También se definió la muestra de publicaciones utilizadas para comparar los aspectos derivados de la pandemia con la adopción de medidas propuestas en los objetivos y metas de la Agenda 2030, del desarrollo sustentable, como una herramienta orientadora para la relación sociedad-naturaleza, para, entre otros resultados a fin de prevenir la repetición de pandemias. Y, finalmente, se incluyó una propuesta de política pública para mitigar el riesgo país a las pandemias.

Pandemia, Virus SARS-CoV-2, Covid-19, Agenda 2030, Sustentabilidad ambiental

Introducción

This article takes into account that among the lines of study of Geography in the field of environmental sustainability, in its relationship with health and communication, is the analysis of the occurrence of diseases in time and space, their presence and territorial mobility, as well as the conflicts that they can cause between flows and fixed and mobile populations[7], as is the case of the pandemic disease Covid-19 characterized below in a simplified form. In these terms, this approach proposes to present a position on the relationship between the aforementioned pandemic and environmental (in) sustainability (Niño-Gutiérrez, 2021), as well as to call the attention of local, regional and global governance.

That is to say, the growing process of globalization of socio-spatial activities, considering the effects on different forms and technical means of interrelation between society and nature, through its mode of production and consumption, explained in another paragraph below, not only offers an advantage to the prevailing interests of the actors that participate in its protagonism.

[7]For the scope of this article, the flows are the spatial circulations of people and goods and the fixed ones are the means of communication that generate the flows (transport vehicles), travel centers and hospitals for follow-up and medical care to patients affected by Covid-19, as well as, cemeteries and crematoria for those who died from this disease (AGUIAR, 2021).

But, it also presents a disadvantage for society as a whole, as is the case of the emergence and spread of diseases in the spatial aspect (Aguiar, 2021; Rabello; Oliveira, 2021), whose process has as one of the facilitators the exploitation, many times, unsustainable of natural resources by some segments of the activities of the mode of production and consumption, in different geographical scales between cities, regions and countries.

In this line of thought, Rabello and Oliveira (2021), proposing the multidisciplinary debate on environmental issues that they list, consider the advent of the pandemic by Covid-19 as "a warning for our society to reconsider its modes of production, consumption and exploitation of natural resources", as well as, states that zoonoses ( )" Ebola, swine flu, avian influenza, Zika virus, HIV, among others, were intermittent alerts of the emergence and situation of the current pandemic [...] ". However, it must be considered that these diseases have not been totally eradicated in the geographies of the world.

The main objective was to present the results of the interpretation of the approaches used in the four publications that served as a comparative basis, which may serve to formulate deeper reflections of other authors, with the production of new studies and publication of academic articles on the subject addressed. The study is justified by the fact that the Covid-19 pandemic, in the form in which it was disseminated, has the potential to stimulate the reformulation of governance and public policies on environmental sustainability at the global level. What are the contributions of the approaches used in the summaries and/or conclusions of the publications studied in this work, in which Covid-19 is related to its environmental setting, to promote discussion on the subject?

Methodology

Given this context, for the preparation of this article we consulted publications that addressed different focuses of the pandemic[8] caused by Covid-19, which allowed us to constitute two groups for analysis purposes. In the first group, diagnostic in nature since the beginning of this worldwide disease, a simplified knowledge of the characteristics of the virus was obtained, as well as the dynamics, socioeconomic impacts, management and effects of the disease on human behavior.

And the second group of publications, had a characteristic of prognosis of the relationship between society, natural resources, environment and sustainable development, to identify possible and simplified proposals for preventing the recurrence of pandemics by applying the objectives and goals of the Agenda 2030[9], of sustainable development[10], instituted by the United Nations, as will be detailed below. Thus, this article contributes in the way of approaching the subject, since the results presented here add to the formation of knowledge the contents that highlight the need to comply with the Agenda 2030, of sustainable development, and proceeding in this way, contribute to the reconstruction of the society-nature relationship, including the respect for Science and the compliance with the global agreements that address this issue.

In this sense, an approach to the Covid-19 pandemic is presented, under the approach of the necessary environmental sustainability advocated in the 2030 Agenda for sustainable development, which should focus on the society-nature relationship. It is noteworthy that the relevance of this study for the field of Geography lies in the fact that its approaches are able to demonstrate the spatial interrelationship between social factors and health phenomena, including the Covid-19 pandemic, in geographic space. In this case, the methodological approaches used in Geography allow to establish, for example, the cause and effect relationship between the mobility of the population, the performance of its mode of production and consumption, changes in the original geo-environmental conditions of the territories, i.e. the imbalance in the interrelationship between man and the environment (Barcellos et al, 2021), i.e. nature.

[8] Pandemic is the worldwide spread of a new disease and the term is used when an epidemic, an outbreak affecting one region, spreads across different continents with sustained person-to-person transmission (FIOCRUZ, 2021).
[9] The 2030 Agenda, which consists of a Declaration, 17 Sustainable Development Goals (SDGs) and 169 targets, seeks to ensure that all nations and all people around the world are included and benefit from the achievement of the SDGs. (UNHCR, 2021).
[10] Sustainable development is a development capable of meeting the needs of the current generation, without compromising the ability to meet the needs of future generations. (WWF, 2021).

Development

When approaching the sources of consultation that supported this study, the approach method was used, related to the reasoning adopted in the approach to the topic, and the procedural method, which refers to the way in which the stages of the work were developed. In the first, inductive reasoning was used, from the particular to the general, that is, from the analysis of data on the socio-spatial problems of the pandemic by Covid-19, for environmental sustainability as a whole. In the second, the historical method was used to verify the geographic facts resulting from Covid-19 in their relationship with environmental sustainability.

It should be noted that the management of the methodology of approaching the subject discussed here, the reflection of Souza (2009) was considered, in which the words "environment" and "sustainability", guiding the construction of the term "environmental sustainability", would be metaphors formulated in international institutions, which, full of political meaning, and without support in geography, would constitute contradictory elements to the socio-spatial reproduction of the aforementioned mode of production and consumption.

It should be clarified, therefore, that the term "environmental sustainability", catalogued as a metaphor, due to the lack of a conceptual theoretical basis in Geography, is used here in the context of the society-nature relationship, whose theoretical basis is well developed in this discipline. The use of this term is justified by the meaning of the word metaphor, i.e., it means "a figure of speech in which there is a transfer of meaning from one word to another, through an explicit non-comparison [...]" (Dicio, 2021). Therefore, he assumes that the term environmental sustainability would have been coined for didactic purposes, since it expresses a meaning more in line with the need of capitalism to consider the limitations of nature in its development process than the very concept society-nature methodologically validated by Geography.

As for the procedure, we used the consultation of indirect documentation through a search service of contents available on Internet sites, between 25/07 and 16/08/21, to form two groups of publications, the first with content focus on the emergence and initial effects of the pandemic and the second with focus on preventive measures that can be adopted in the face of the recurrence of pandemics. Therefore, the contents of the analysis of the first group of publications are presented as follows:

Preliminary reflections on the characteristics of the virus and the origin of Covid-19 in the Chinese metropolis of Wuhan and the association between wild animals and man, destruction of natural habitats (Carvalho, 2021); 2. Proposals regarding containment of virus spread, positive changes in the environment resulting from the imposition of quarantine as one of the determinants of low socioeconomic activity and temporary restrictions on spatial mobility, especially of motor vehicles and, indeed, reduction of environmental pollution, in addition to conjectures about new formats of interrelationships, including those at a distance due to reduced flows of professional and personal activities (A3 Magazine, 2021); 3. Impact of Covid-19 on small businesses, pointing out the strategies used to avoid paralyzing the economic activities represented by this segment, such as: online service and home delivery, reduced business hours, employee turnover (Sebrae, 2021); and 4. Effects of the Covid-19 pandemic on people's behavior in relation to the consumption of goods (Innocente, 2021).

In the second group of publications, in turn, the contents were obtained using the same information technology tool mentioned above, however, using the keyword "Pandemic and Environmental Sustainability" in which the publications inserted on the first page were selected, which, after being numbered, from 1 to 10, had each of their numbers written on a sheet of paper that was then folded so as not to allow them to be seen. The papers containing the numbering of the publications were then shuffled so that four of them were randomly selected, forming the sample by the publications numbered 2, 5, 9 and 10, which were marked in bold and underlined in the respective excerpt of the note sheet as follows:

How Covid-19 represents a challenge for sustainability; 2. The list of natural resources facing the Covid-19 pandemic in Latin America and the Caribbean; 3. Environment and pandemic; 4. Sustainability during times of pandemic (Covid-19); 5. Environment and pandemic; 6. Sustainable development after the pandemic (video); 7.

Coronavirus and the environment, a closer relationship than we think; 9. The coronavirus pandemic is more necessary than ever to act in favor of sustainable development; and 10. Likewise, as for the procedure, at the stage of the results of this study, it is set out below, where the relevant facts listed in the summary and/or in the conclusions and recommendations of each selected publication that addressed the relationship between Covid-19 and the public policy of environmental sustainability are highlighted.

Mode of production and consumption, one of the possible definitions of this concept is the socioeconomic system, of spatial and environmental character predominant in human relations with nature, which can be subdivided into several interdependent stages, whose current version moves, above all, by the intensive use of financial capital, information technologies, and permanent creation of consumption needs for the population. Such steps, in turn, do not always originate and conclude in the same spatial cut, since, in recent years, this system, in reproducing itself globally, was conditioned to the availability and adequacy of natural resources and labor, to the means of production and its technologies, and the particularities of the consumer society.

In short, the environmental consumption of the natural space by this system is configured from the stage of extraction of raw materials and/or products of cultivation and breeding of animals and birds, and their respective processing; manufacture of products, durable or not, for various purposes, trade often conditioned by numerous innovation and marketing strategies, in which the continuous and growing consumption becomes part of human nature, even when it is limited by the purchasing power of people (Bauman, Baudrillar, Drucher, Harvey; Padilha, Rodrigues apud Marchesini Júnior, 2021*).*

Public policy, among the numerous definitions of this concept, the following is used here: "are State actions for the social demands of societies" (HOFLING, 2001). While, *environmental sustainability*, refers to a characteristic of a process or state that can maintain the properties of the environment through space-time (López, 2021) and r*esilience*; one of the possible meanings of the word resilience used in this study is "the ability of groups and communities to cope with external stresses and shocks due to social, political and environmental changes" (Adger, *apud* Gonçalves, 2021). It should be added that it is not uncommon for the term resilience to be used in association with sustainable development (Pastorelli Júnior, 2018; Sebrae, 2019, Lemos, 2021).

In a retrospective analysis, it was found that the virus causing the Covid-19 pandemic received the name SARS-Cov-2, in February 2020, and was identified from an alert to the World Health Organization (WHO), due to the finding of pneumonia cases, at the end of 2019, in the metropolis of Wuhan. This urban agglomeration is located at the geographical coordinates: 30° 29' 54" North Latitude and 114° 15' 58" East Longitude (DB City, 2021), in the territory of the People's Republic of China, with a population of more than ten million people in 2015 and dense geographical connections with various parts of the world.

The strain of the new coronavirus is one of seven already identified (HCoV-229E, HCoV-OC43, HCoV-NL63, HCoV-HKU1, SARS-COV, MERS-COV, SARS-CoV-2), according to the Pan American Health Organization (PAHO) (2021b). Possible symptoms of this disease include fatigue, nasal congestion, conjunctivitis, headache and sore throat, fever, loss of taste or smell, and dry cough (PAHO, 2021; 2021a). Covid-19 disease, can cause "renal, cardiac and nervous problems, as well as changes in blood coagulation," according to an article published by Santos (2021). For Carvalho (2021), the disease in question is "transmitted by personal contact, from person to person" and "can progress to severe pneumonia, obstruction of the lungs and death from respiratory failure." As for the mutations of the virus, its occurrence and spread, they are associated with non-vaccination, as well as, with infected people, it can undergo variations and be transmitted (Aguiar *apud* Arantes, 2021).

The argument that local, regional and global governance has difficulties in dealing with the pandemic efficiently and effectively, is justified, at least, for the following reasons. In fact, on 12/04/2020, more than one million eight hundred thousand people were infected and 111 000 died (Vieira, 2020), by this relentless disease, which, in its trajectory of several waves of contamination of the human population, by different variants of the virus, exceeded in just over a year, that is, to date 08/13/2021, more than 205 million infected and four million three hundred thousand dead in the world geography (Table 8.1), whose figures can be considered catastrophic to humanity.

Table 8.1 Situation of the Covid-19 pandemic in the world (confirmed cases, deaths, vaccine doses)

Statistical data on the world as of 08/13/2021	
Confirmed cases of the disease in the population	205.338.159
Deaths from disease in the population by geographic region	
America	2.043.623
Europe	1.238.433
Southeast Asia	605.221
Eastern Mediterranean	247.045
Africa	125.145
Western Pacific	73.614
Total	4.333.081[1]
Vaccine doses administered to the population	4.428.168.759

Source: WHO, 2021

[1] = it should be noted that the total of 4,333,094, presented in the WHO coronavirus panel, differs from the sum of the quantitative by region presented by the institution.

In addition, an article published on 04/20/2020 entitled "Covid-19: end of the geography of hypermobility?" (Dumont, 2021), analyzed here, reveals antecedents of the pandemic, for example, in the cut of the Chinese socio-economic space and later in others, described below: A) the hygienic and sanitary conditions of a significant part of the Chinese urban population cannot be considered satisfactory; B) correlation between its spread; C) the geography of mobilities (rural emigration to urban territories, more developed as Wuhan), initially in the interior of China and then in South Korea, Taiwan, Japan, Hong Kong and Singapore, due to multiple geo-economic relations with China. Notably, as reported in the press, the disease subsequently reached Italy and other European countries, since then, its spread across Europe was relentless. "At the end of March, the United States became the most affected country in the world. By the end of May, America becomes the global epicenter of the pandemic [...]" (RTVE, 2021); D) WHO only recognized the existence of person-to-person transmission of the virus on January 23, 2020 and E) on January 30, 2020, WHO declared that the outbreak of the new coronavirus constituted a Public Health Emergency of International Concern (PHEIC), the highest alert level of the Organization, as provided for in the International Health Regulations. The declaration of the pandemic, in turn, took place on March 11 of that year, during which time the virus continued to infect people at all geographical scales. On the other hand, in the public policy of many countries, to combat the pandemic, it was noted, among others, some specific measures of restrictions on the interrelation of the population with the space, especially urban, and operation of production and consumption activities, such as "curfews, mandatory quarantines, restriction of freedom of movement and grouping [...]". Due to these governmental procedures, there are conjectures that these measures "test the foundations of democracy" (France 24, 2021), the focus of which will not be discussed here because it escapes the object of this study.

Moreover, despite the agile development and approval of preventive vaccines against Covid-19, by the end of 2020, especially in countries considered developed under a geo-economic perspective, the distribution and administration of vaccines in the world population as a whole did not take into account the principle of human equity, i.e. the need for timely universal access in all countries and, in these, throughout their age pyramid simultaneously. In addition to the difficulty of global governance to ensure the implementation of the aforementioned principle of equity, it should be noted that at least three reasons are observed for the fact that this pandemic disease has remained active, with greater or lesser extent and intensity, the geographical regions of Terra, until this time (16/08/2021) and yet it is not clear when it will be extinguished.

The first reason is attributed to the lack of equitable access to safe and effective vaccines, for various reasons, including production concentrated in a few countries that hold their patents and, in some countries, the logistical complexity of distribution and application in the population. The second reason is non-compliance with the sanitary protocol by population groups, whose reasons vary according to age, health education, socioeconomic background, cultural and ideological concepts, among others, and finally, the third reason refers to anti-vaccine and immunization behavior, or the denial of vaccine efficacy by segments of the population in different countries, including the adherence of some social and political leaders.

From this point of view, one of the possible inferences about governance deficiencies is the failure to ensure that the redefinition of global protocols inherent to the interaction between society and nature is actually practiced by the entire mode of production and consumption, as it is a collective and participatory assignment of governance and society as a whole.

However, the exhaustive analysis of the public policy of coping of Covid-19, is not part of the scope of this study, so there was no in-depth approach to the content available in the literature dealing with this aspect of the performance of local actors, regional and global governance. Notwithstanding this methodological reservation in this study, the exercise of citizenship and the vindication of fundamental human rights in the field of health and sustainable environment require suggesting reflections for the recreation of local, regional and global governance on other bases. And among the motivations that justify it is the hypothesis that there was no establishment of effective public policies on the relationship of society with natural resources in order to prevent the spread of contagions and impacts of the Covid-19 disease virus, and its variants, as reported in the following excerpts:

Covid-19 is a zoonotic disease (transmitted from animals to humans) but has spread from humans to humans very easily because of the high overcrowding and connectivity of our social structure. Part of the problem of zoonotic diseases, which has not been given much attention so far, lies in continuing to shift natural boundaries, as well as fragmenting, destroying and degrading ecosystems that have the capacity to "control" the spread of diseases (ECLAC, 2020).

And also:

The relationship of natural resources with the COVID-19 pandemic is very diverse [...]. On the one hand, they are essential factors for the control of the crisis (food, drinking water, biodiversity and electricity), and on the other hand, they are impacted by its consequences (use of fuels, minerals, etc.). Access to drinking water is fundamental because hand washing is one of the main measures to prevent the growth of contagions; energy and electricity are essential to guarantee water supply and living conditions in homes, as well as to ensure the functioning of hospitals; agricultural activity is the basis for maintaining food security; and finally, non-renewable natural resources are of great macroeconomic importance in most of the economies of Latin America and the Caribbean (ECLAC, 2020).

It is emphasized that, in the first fragment above, it is possible to infer that the lack of respect - by some parts of society and, sometimes, by those who have leadership and decision-making power, specifically, in the mode of production and consumption - to natural boundaries and ecosystems that, among others, have the function of preventing the spread of diseases, especially in the form of pandemics, is a behavior that should be reviewed as soon as possible.

The content data of the two groups of publications, mentioned in the methodology and procedures step, are presented below, with literal transcription, or with adaptations, following the order of the drawing.

Publication 2: The Role of Natural Resources in the Face of the Covid-19 Pandemic in Latin America and the Caribbean (ECLAC, 2021)

The 2030 Agenda and the biodiversity, water, energy and food targets are even more relevant. The pandemic increases the need to protect biodiversity, the urgency to respect and protect natural spaces, as well as to ensure their services to the population in a sustainable manner. It is possible that economic recovery can be built in coherence with the recovery of ecosystem health, but structural changes are required. [...] It is also recommended to promote the transition towards new, more sustainable, inclusive and climate change-adapted production models. A fundamental element [...] is to join efforts to preserve the diversity and integrity of ecosystems, respecting their natural boundaries and avoiding the fragmentation, degradation and destruction of habitats. This is a key task to protect human health, as it regulates dispersal and reduces the risk of contagion of zoonotic diseases.

The analysis in this publication reveals the importance of governments and populations meeting the goals of the 2030 Agenda for sustainable development as a fundamental measure to protect human health from the risk of disease transmission, as there is the possibility of a recurrence of pandemics.

Publication 5: Environment and Pandemics (Carabias, 2021)

In this publication, the author presents eight themes for reflection on the environment and pandemic as follows:

1. Reconstructing the relationship with nature and respecting natural ecosystems.
2. Reorganize the economy with environmental sustainability.
3. Radically change consumption and production patterns.
4. Transform cities in sustainability and resilience.
5. Promote diversified, resilient and sustainable rural development.
6. Science-based decisions about the future.
7. Regain confidence in multilateral institutions, comply with global agreements and turn them into actions on the national agenda.
8. Promote a change of attitude towards a culture of sustainability and respect for nature.

The analysis of these topics allows inferring that, although the author does not directly mention the source, almost all of their contents are related to the procedures contemplated in the Sustainable Development Goals (SDGs) of the 2030 Agenda.
Publication 9: The coronavirus pandemic is more necessary than ever to act in favor of sustainable development (United Nations, 2021).

This publication, in addition to emphasizing the role of the United Nations in addressing the effects of the pandemic, including assisting governments, recommends the 2030 Agenda for sustainable development and global agreements as the compass for navigating the world, as shown in the following summary.

Under-Secretary-General Amina J. Mohammed said lives and livelihoods around the world depend on the ability of the United Nations to support governments in combating this "unprecedented health, humanitarian and socioeconomic" crisis.

Calling the Sustainable Development Goals, which fall under the 2030 Agenda for Sustainable Development, "the compass" needed to guide us, he also cited the Paris Agreement on Climate Change and the Addis Ababa Action Agenda on Financing for Development among the compacts that should mark the world's navigation chart.

"We will have to keep in mind a dual mandate: to respond urgently to curb the effects of the pandemic, while at the same time assisting in the performance of governments and the population so that they can regain a better and more resilient future," Mohammed said. Similarly, he said that when the time comes to allocate resources, special attention will be given to the needs of countries affected by conflicts and disasters, least developed countries, landlocked developing countries and small island developing states.

As mentioned in the previous issue, this publication highlighted the need to use the 2030 Agenda, for sustainable development, as well as, the Paris Agreement on Climate Change and the Addis Ababa Action Agenda on Financing for Development, among the compacts that should signal action by governments and people in navigating the world.

Publication 10: The pandemic and the challenges of sustainability - learning on World Environment Day (Hernandez, 2020).

In summary, this publication defends the idea of rethinking the requirements of the so-called sustainable urbanism in which there are cities resilient to pandemics, whose parameters are contained in the 2030 Agenda for sustainable development, as shown below:

In summary, urban planning, architecture and urbanism in general, must rethink the components of the matrix of sustainable urbanism from making cities more resilient to the new threat: pandemics. This does not imply forgetting that the main challenges of cities remain, among others, the following: the reduction of inequalities and urban segregation; the curbing of environmental degradation and the management of uncertainties associated with climate change and with the change of the model.

Thus, the relevant results obtained through the comparative analysis between the contents on the emergence and initial effects of the pandemic and the second with a focus on preventive measures that can be adopted in the face of the recurrence of pandemics, as mentioned above, are described below:

1. Protection of biodiversity, the urgent need to respect and protect natural spaces, as well as to ensure their services to the population in a sustainable manner, highlighting compliance with Agenda 2030.
2. Reconstruction of the society-nature relationship, respecting natural ecosystems, adopting a means for sustainability and resilience of urban and rural areas, decisions based on respect for Science and compliance with global agreements.
2. Role of the United Nations not to support governments in the fight against this health, humanitarian and socio-economic crisis, and the 2030 Agenda for Sustainable Development, the Paris Agreement on Climate Change and the Addis Ababa Action Agenda on Financing for Development, among the pacts that should mark the world's navigation chart.
3. Rethinking the components of the sustainable urbanism matrix has as main challenges in cities: the reduction of inequalities and urban segregation; the curbing of environmental degradation and the management of uncertainties associated with climate change and with the change of the model.

Discussion

In this topic, comparisons are made between the results previously mentioned in publications No. 2, 5, 9 and 10, and the works that mostly addressed facts related to the characteristics and origin of the virus in the metropolis Wuhan, China, its association between wild species, animals and man, the destruction of natural habitats, etc., the containment of the spread, the impact of Covid-19 on small businesses, indicating the strategies used to not paralyze the economic activities that this segment represents, as well as the effects of this pandemic on human behavior.

As a result of this analytical comparison of contents, the answer to the proposed problem was obtained, as well as the objective established for the development of this work, as shown below. Both the problem and the objective proposed in this work are solved with the contributions of the approaches used in the summaries and/or conclusions of the publications studied, relating Covid-19 to environmental sustainability. That is, they refer to measures to prevent the recurrence of the spread of diseases through compliance with the Agenda 2030, sustainable development, and global agreements, which, in short, proclaims the need to rebuild the relationship between society, and its mode of production and consumption, with nature. This process includes respect for natural ecosystems, decisions based on the guidelines of Science (Niño-Gutiérrez, 2020), the adoption of sustainability measures and urban and rural resilience (Niño-Castillo, et al, 2020), which encompasses the reduction of inequalities and the solution to segregation among people.

Likewise, these approaches may serve to formulate deeper reflections by other authors on the topic addressed, resulting in an open path for other research to follow in the study, promotion and development of new articles that disseminate the content of the 2030 Agenda on sustainable development and global agreements, whose implementation is attributable both to local, regional and global governance, as well as to the populations and their institutions as a whole.

Conclusions

As can be appreciated in the previous theme originating from the interpretation of the approaches used in the four publications that served as a basis, this work defends, as a solution for the prevention of the recurrence of pandemics, the measures included in the 2030 Agenda, of sustainable development in the form of environmental sustainability goals and targets, and in the global agreements, to which, at the same time, local, regional and global governance, the respective populations and their institutions are obliged.

Therefore, the problem and objective posed in this study was duly resolved, since the contributions of the indirect research sources, and mainly of the summaries and/or conclusions of the publications studied, fundamentally addressed the need to promote reflections and discussions for the adoption of measures to prevent the recurrence of pandemics, including the publication of new academic articles in order to disseminate the subject to society as a whole.

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Chapter 9 State of the art on the "El Veladero" National Park of Acapulco, Guerrero, Mexico

Chapter 9 Estado del arte sobre el parque nacional "El Veladero" de Acapulco, Guerrero, México

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Abstract

The “El Veladero” National Park is a natural reservoir in Acapulco de Juarez, Guerrero, so the general objective is to present in a synthesized way the elements that gave rise to the National Park and a specific objective; contribute to the state of the art in said natural area and its conservation. The guiding question, Is the objective that gave rise to the protection of said National Park currently being met? The methodology used was qualitative in nature, the documentary technique was used, which implied consulting the databases of *Latindex*, *Redalyc*, *SciELO*, among others. The work was based on a historical-geographical approach on the concepts of National Park and Sustainable Development. Results, based on the historical periods of Mexico, it was obtained that in pre-Columbian times the original cultures lived in harmony with nature thanks to a holistic worldview, but from the arrival of the Spaniards this relationship was altered by an exploitation excess of natural resources water, soil and vegetation, in such a way that, to date, there are several categories of management at the federal level to preserve the still pristine natural spaces such as the National Park. Conclusion, the “El Veladero” National Park was decreed so that the Port of Acapulco had a green lung where regulated ecotourism could be practiced with low impact on the surrounding environment.

Acapulco, National Park, Sustainability, Territory, Tourism

Resumen

El Parque Nacional “El Veladero”, es un reservorio natural en Acapulco de Juárez, Guerrero, por lo que, el objetivo general es, exponer de manera sintetizada los elementos que dieron origen al Parque Nacional y como objetivo específico; contribuir al estado del arte en dicha área natural y su conservación. La pregunta rectora, es ¿Se cumple actualmente con el objetivo que dio origen a la protección de dicho Parque Nacional? La metodología empleada fue de índole cualitativa, se recurrió a la técnica de documental, lo cual implicó consultar las bases de datos de *Latindex*, *Redalyc*, *SciELO*, entre otras. El trabajo, se sustentó en un enfoque histórico-geográfico sobre los conceptos de Parque Nacional y Desarrollo sustentable. Resultados, con base en los periodos históricos de México, se obtuvo que en la época precolombina las culturas originarias vivían en armonía con la naturaleza gracias a una cosmovisión holística, pero a partir de la llegada de los españoles dicha relación se vio alterada por un aprovechamiento excesivo de los recursos naturales agua, suelo y vegetación, de tal manera que, a la fecha existen varias categorías de manejo a nivel federal para preservar los aún espacios naturales prístinos como por ejemplo, el Parque Nacional. Conclusión, el Parque Nacional “El Veladero” fue decretado para que el Puerto de Acapulco contara con un pulmón verde donde podría practicarse el ecoturismo regulado y con bajo impacto en el medio circundante.

Acapulco, Parque Nacional, Sustentabilidad, Territorio, Turismo

Introduction

This article takes up again the lines of study of Geography in the field of environmental sustainability, in its relation with the human activities that are developed on the diverse elements of nature. Thus, this approach proposes to present a position on the relationship between the aforementioned pandemic and environmental (in) sustainability (Niño-Gutiérrez, 2021). In other Latin American countries such as Brazil, this approach is developed in parallel and even goes further when a multidisciplinary debate on environmental issues is proposed (Rabello & Oliveira, 2021). Hence, the objective of the paper is to synthesize the central ideas of the creation of the National Park "El Veladero" of Acapulco in 1980 and its prospective. The justification for the document is to synthesize the past, present and future of El Veladero National Park. The guiding question was how to rethink the sustainable future of the National Park under study.

In Mexico, a natural area was named a National Park for the first time in 1917. SEMARNAT mentions that the National Park called "Desierto de los Leones" was the first natural area that was authorized to be protected for the exploitation of its resources. El Veladero National Park has been one of the most recently categorized national parks in the state of Guerrero. It was decreed as a PNA on July 17, 1980 and covers 3,159 hectares (Vargas, 1997).

To be named as such, it had to meet a series of requirements stipulated by the Secretariat of the Environment and Natural Resources, which took into account its cultural and biological aspects, its capacity to carry out scientific research, and its capacity to practice ecotourism in order to categorize this natural space as a protected natural area (Semarnat, 2020).

Problem statement

At the international level, conceptual mapping is useful to characterize and define academic constructs, as in this case the term National Park and the variable Sustainable Tourism. In the municipality of Acapulco, there is a lack of knowledge about the existence of diverse international bibliography on the use of this methodological technique that clarifies the concepts, ideas or theories reviewed in a documentary way. In Latin America there is evidence of the use of concept mapping in countries such as Colombia, Ecuador, Mexico and Peru. This has brought about notable achievements such as the elaboration of documentary, empirical and systematic review articles. These studies are becoming more numerous and/or complete in accordance with the complexity and high degree of precision required to present a proposal of such magnitude, since concept mapping is a valuable qualitative methodological technique that, if well focused, contributes to the dynamism of the concepts in the current state of the art.

The holistic character of the conceptual mapping is evidenced through the understanding, characterization, analysis and interpretation of the concepts of National Park and Sustainable Tourism in order to help systematize the most accepted characteristics of both terms under study through a pragmatic vision. Conceptual mapping in this work addresses the two concepts as academic constructs linked to the Sustainable Development Goals (SDGs) through an environmental dimension supported by the criteria of sustainable development, which through conceptual mapping is feasible to implement in Mexico thanks to its scientific and educational value. There is scarce literature on the two constructs studied in this research. This study fills the documentary gap and systematizes the concepts of Sustainable Tourism and National Park.

In the state of Guerrero there are few studies that integrate conceptual mapping, one of those studies is by the author Niño (2018), who exposes the fundamental features that integrate any study developed in function of conceptual mapping. Within his analysis, he mentions that conceptual mapping aims to "achieve continuous improvement where new scientific models and theories that seek to transmit and generate knowledge are tested" (p. 3).

Referring to the municipality of Acapulco, the Mexican Government categorized "El Veladero" as a national park in 1980 (Semarnat 2016). The main problem surrounding this National Park has been the constant demographic pressure. This has caused the constant invasion of settlers to build unauthorized settlements and the destruction of vegetation in order to use the soil for clandestine crops (Vargas, 1997). This causes the loss of endemic flora and fauna. Therefore, it is vitally important to work on the basis of the problem, which is represented by the local population's misinformation about the ecological importance of "El Veladero". The general objective is to summarize the elements that gave rise to "El Veladero" National Park and the specific objective is to contribute to the state of the art in this natural area and its conservation. The guiding question is: Is the objective that gave rise to the protection of "El Veladero" National Park currently being met?

Justification

The present proposal is innovative and original. It will identify, through a temporal perspective, the evolution of the concepts of National Park and Sustainable Tourism. Both concepts have an importance in sustainable tourism development. This research has a practical-applied character because it assumes the challenge of contributing to systematize the advances achieved between 1971 and 2021. It provides a synthesis focused on the two categories mentioned above. This contribution of genuine historical-cartographic research is innovative because it is inserted in the framework of sustainable development in order to strengthen the correct use and management of the concepts of National Park and Sustainable Tourism. In Mexico, there is no in-depth research study that addresses the concepts of National Park and Sustainable Tourism based on the conceptual mapping tool.

The importance of the study of these two constructs lies in the fact that national parks are a special group of protected natural areas, since within them plans can be developed for sustainable tourism use and thus achieve local development (CONANP, 2020). Therefore, national parks and sustainable tourism are closely related. In the case of Acapulco, "El Veladero" National Park is a place with high value within its category of Natural Protected Area (NPA), which is an area of great biological, historical and cultural wealth. However, despite being designated as a protected natural area, there have been conflicts between the local population and the environmental authorities. If the national park is not maintained, Acapulco Bay could be at ecological risk, which could lead to drought, landslides, soil erosion, and other consequences (Vargas, 1997). At present, the area is in a state of abandonment and the problem of contamination and population encroachment is growing. The main cause of the population's lack of interest and the lack of support from municipal authorities has been the lack of information about the national park.

Development

Conceptual framework, the basic concepts on which the study will be based are: 1) Sustainable Tourism, 2) National Park, 3) Sustainable Development. Sustainable Tourism will be understood as: "Tourism that takes full account of current and future economic, social and environmental impacts to meet the needs of visitors, the industry, the environment and host communities" (UNWTO, 2005).

National Park, are biogeographic representations, at national level, of one or more ecosystems that are significant for their scenic beauty, their scientific, educational, recreational, historical value, for the existence of flora and fauna, for their suitability for the development of tourism, or for other similar reasons of general interest (SEMARNAT, 2020).

Sustainable Development, the evaluable process by means of criteria and indicators of environmental, economic and social character, that tend to improve the capacity of life and the productivity of the people, based on own measures of preservation of the ecological balance, protection to the environment and use of the natural resources, so that the satisfaction of the necessities of the future generations is not compromised (SEMARNAP, 1996).

Methodological framework, the technique that will be used in this research will be the conceptual mapping technique, its antecedents go back to what Novak (1990) called for the first time as "concept maps and diagrams", later Tobón (1996) developed the conceptual mapping technique, he is considered as the father of this technique. The method will be analytical and documentary in nature. This requires the consultation of printed and digital documentary materials, such as: journal articles, book chapters and books where a systematic, conceptual and methodological approach of the works consulted is followed in order to respect the concepts, definitions, characteristics and opinions of the selected theoretical referents. The documentary method is enriched with cabinet work. It will include the consultation and selection of relevant information regarding the variables National Park and Sustainable Tourism. For this purpose, search engines, academic databases, virtual libraries and institutional repositories of universities and non-governmental organizations will be used. The methodology used will be qualitative, which includes the review of documentary material from 1971 to 2021 and will include a technique of consulting information from different web pages. Therefore, a historical and inductive methodology will be followed and a longitudinal and exploratory analysis will be carried out.

Documentary technique, first of all, we will resort to the reading, selection and analysis of books, book chapters and articles published in print or digital form on the two variables under study: National Park and Sustainable Tourism. The methodology will be qualitative in nature. Documentary techniques will be used, which will involve resorting to Latindex, Redalyc, SciELO database, among others. The research work will be based on a historical/geographical approach, which allows a semi-detailed analysis of the evolution in time and space over 50 years in the world. Its priority is centered on the contributions published by various theoretical referents of the Mexican, Latin American and Spanish schools. The qualitative techniques include the consultation of printed and digital conceptual cartography, which supports the state of the art of the two constructs under study: National Park and Sustainable Tourism.

Theoretical framework, the theory of complexity attached to sustainability, described by Luna (2020), describes the three pillars, economic, social and environmental, of sustainable development, in subsystems and these in turn form the complex system of sustainability. Sustainability, in some countries is synonymous with "sustainable" and is a term coined since the 1987 Brundtland report, drafted by the UN, by Dr. Gro Harlem Brundtland, and originally called "Our Common Future". The phrase that summarizes Sustainable Development in the report is the following: "Meeting the needs of present generations without compromising the ability of future generations to meet their own needs" (Larrouyet, 2015).

The most important precedent for the Bruntdland report was the Stockholm conference held in 1972, where the exponential growth of development was limited to protect the environment (Domínguez & Aledo, 2005). The theory of sustainable development is based on principles that are focused on caring for the planet's natural resources while achieving economic development for the entire population. These principles can be represented in three pillars, which are: the environment, society and the economy. Also, this theory arises from the need to change the paradigm of indiscriminate consumption of natural resources and the concern to ensure the availability of natural resources to new generations.

Prior to the postulation of this theory, there was the theory of development. This theory was used to manage existing social economic structures in the medium and long term. It grouped countries into categories, depending on their socioeconomic development, into developed and underdeveloped countries (Gutiérrez, 2007). It also provided the basis for building the theory of sustainable development. More closely linked to economics, it can be said that development is born and becomes known as a tool to protect and manage natural resources, human beings and future generations and, at the same time, preserve the capitalist production model through the balanced and efficient management of resources to achieve their preservation (Ibañez et al, 2020).

It can be observed how sustainable development is constituted by several bases causes that involve its origin, this has also emerged as a paradigm of spatial development policies since the nineties, which is recognized for seeking an integral approach that allows the harmonious evolution of the economic, social and environmental subsystems that coexist in the territory to maintain and increase the collective welfare in the long term (Cervantes & Gómez, 2007). The relationships involving sustainable development in productive and social contexts are broad and multidisciplinary. The economic activity to which it is related can range from the primary sector to the service sector. For example, in tourism, the main objective of sustainable development is not only about environmental conservation, it has to be balanced in order to satisfy the needs of visitors, social and economic needs (Vera, 2001).

As mentioned above, the main objectives of development are to contemplate the survival of human beings and their way of life, and to this end, the aim is to conserve natural resources in a sustainable manner. However, the way of life of human beings implies an ever-increasing consumption of resources; therefore, if human beings continue to exploit resources indiscriminately, there will be no point in trying to conserve these resources in the future. From an international perspective, there are various points of view that differ from the primary objectives of sustainable development and call them into question. Considering that sustainable development is based on group support between communities and the general population and future generations, it is not possible to talk about sustainable development if there is a socioeconomic imbalance among the population. Some having a higher purchasing power than others, obtaining greater benefits at the expense of the work of others. Above all, sustainable development cannot be addressed if there is a consumerist market that is in charge of offering all natural resources as raw material and that is becoming larger and larger (Segrelles, 2013).

The history of the paradigm of sustainable development is based on ideas and models that seem to solve the problems of the environment and society, which humanity is going through, however, it often remains a utopian vision that is far from reality. This term has been losing its basis, where previously the goal was to achieve social development while conserving natural resources, today it has been corrupted to be seen as something "exclusive" or "elitist". Derived from the above, in the case of sustainable tourism, for example, it has become a synonym of a product that becomes exclusive for individuals with high purchasing power, leaving aside egalitarian social development. The "natural" or "ecological" aspect becomes the raw material of tourism to be available to tourists, leaving aside the conservation of natural resources (Domínguez & Aledo, 2005).

In the case of Mexico, because it is a country categorized as underdeveloped, the government has always sought to achieve egalitarian socioeconomic development based on sustainability. The approach to definitions of sustainable development depends on the area being addressed. In political-environmental matters, the concept is more closely linked to the protection of natural resources; however, economic and social criteria are also integrated, but emphasis is placed on the protection of the ecological balance in order to satisfy the needs of future generations (SEMARNAP 1996).

From an economic-political perspective, sustainable development is seen as a tool that promotes economically viable activities, taking into account society and natural resources. Regarding the latter two, it seeks to improve the living conditions of society and at the same time materialize productive processes that lead to decrease environmental impacts (Secretaría de Energía, 2015).

In scientific matters, Mexico has been a hotbed of sustainable research. For example, Niño (2013) mentions that "sustainability implies an analysis of ethical, social, political, economic and ecological factors, in discussion with different spheres of the governments of Mexico and the world" (p. 79). Also, he mentions that sustainable tourism, integrated to a national park, is defined as a process that aims to favor the quality of life of local communities and at the same time, maintains a standardized quality to favor tourists' experiences and conserve natural and cultural resources at the same time (Niño, 2013).

In the case of national parks, various researchers integrate multidisciplinary methodologies, taking into account various factors at the same time and integrating methodologies focused on regional development and a geographically guided point of view to plan and manage NPAs of this nature (Niño et al, 2007). The history of national parks and recreation are linked to the impact of human beings; human interest in using natural spaces is what drives the creation of alternatives to maintain sustainable tourism use. Therefore, the scientific community is currently seeking to integrate a multidisciplinary and trans-disciplinary methodology to work with national parks.

Results

Entering into the subject of protection of natural spaces in Mexico, is to get involved in a very broad subject historically speaking, since the time of the Mesoamerican cultures there was a conscience towards the care of nature. This can be seen through the most important cultures that were part of pre-Hispanic Mexico, cultures such as the Maya and Mexica, worshiped nature and paid tribute to elements such as rain, the sun, plants and animals, many of these elements had a deity that the population associated with each one and were represented in various ways such as sculptures made of different materials, of which there are many vestiges today (Gonzalez, 2001).

In pre-Hispanic Mexico, society was very involved with nature, so much was their respect that they worshipped it, they felt part of it and not superior. From this period it is also known that the indigenous people took recreational walks in areas of natural spaces, even one of the rulers, King Netzahualcoyotl of Texcoco, ordered to make several Ahuehuetes plantations in order to carry out activities of landscape appreciation (*Op. Cit*., 2006). Therefore, as it happened in the United States, the conservation of natural areas occurred through the search for recreational activities, at least in Mexico's pre-Hispanic era.

According to the 1996 law, Mexico's Natural Protected Areas seek to conserve the country's endemic species while conserving its ecosystems, promote environmental education and environmental awareness, encourage government and private sector participation in protection, and ensure that NPAs can be managed based on specific and effective management programs and plans (Melo, 2002). With this, it is possible to observe the notable difference in the basis for the creation of NPAs, which initially sought only to conserve resources for their later exploitation and use for recreation, and then moved on to something more complex, such as environmental education.

Table 9.1 Historical summary of the protection of National Parks in Mexico

Epoch or historical period of Mexico	Event related to the History of the conservation of natural areas in Mexico.
Pre-Columbian Period	Botanical gardens and public parks created under the order of King Netzahualcoyotl of Texcoco (1402-1472).
Colonial Period	The Spanish Crown decreed laws in favor of the conservation of timber resources (1679).
Period after the Independence of Mexico	Benito Juarez established the first laws for the protection of Mexican flora and fauna, among them the Forestry Law (1870). The first natural area for conservation and public recreation, El Desierto de los Leones was decreed under the order of Lerdo de Tejada (1876).
Porfiriato	Porfirio Díaz decreed the Monte Vedado del Mineral del Chico as a National Forest (1898).
Mexican Revolution and post-revolutionary period	Department of Forests was created (1910). Venustiano Carranza decreed Desierto de Los Leones as a National Park (1917). Guadalupe Island was decreed as a Reserved Zone for Hunting and Fishing of animal and plant species by Plutarco Elías Calles (1928).
Government of General Lázaro Cárdenas del Río	Miguel Ángel de Quevedo sponsored the creation of 39 National Parks (1935).
Government of Miguel de la Madrid Hurtado (1982-1988)	The Secretariat of Urban Development and Ecology (SEDUE) and the National System of Natural Protected Areas (SINANP) were created. More than three million hectares of ecosystems were protected and the General Law for Ecological Balance and Environmental Protection (Ley General del Equilibrio Ecológico y la Protección del Ambiente, LGEEPA) was enacted (1988).
Government of Carlos Salinas de Gortari (1988-1994)	The National Commission for the Knowledge and Use of Biodiversity (CONABIO) was created. Ten Biosphere Reserves, two National Marine Parks and eleven other reserves were opened (1992).

Source: Castañeda, 2006

In the state of Guerrero, "El Veladero" National Park has been one of the most recently categorized national parks. It was decreed as a PNA on July 17, 1980 and covers an area of 3,159 hectares (Vargas, 1997). To be designated as such, it had to meet a series of requirements stipulated by the Secretaría del Medio Ambiente y Recursos Naturales, which took into account its cultural and biological aspects, its ability to conduct scientific research, and its capacity for ecotourism in order to categorize it as a protected natural area (Semarnat, 2020).

El Veladero is located in a high area in the bay of Acapulco and the area is characterized by being quite irregular because it is mountainous, within the PNA there is a characteristic oak forest, in addition to vegetation characteristic of the low deciduous forest: ceiba (*Ceiba pentandra*), amate (*Ficus insipida*) and fruit trees such as tamarind (*Tamarindus indica*), mango (Mangifera indica), huamúchil (*Pithecellobium dulce*); it also has endemic fauna: Black iguana (*Stenosaura pectinata*), green iguana (Iguana iguana), raccoon (*Procyon lotor*), chachalaca (*Ortalis vetula*), quail (*Coturnix coturnix*), tlacuache (*Didelphis marsupialis*) among others. During the rainy season, bodies of water are formed, which form small streams and riverbeds that cause runoff (Vargas, 1984). After Acapulco's tourism boom, many families migrated to the port in search of a better quality of life by working in tourism. These families did not have enough resources to build houses, so they had to settle in El Veladero, which had been set aside for wildlife protection.

A SWOT analysis of the Veladero ecosystem as a Natural Protected Area mentions anthropogenic practices as the main problem facing the National Park, which indicates poor management by the government of the surrounding communities. Something similar within the weaknesses where the lack of dissemination by the government stands out (Aviléz, 2014 cited in Niño and Saldaña, 2014). The first natural space to be declared a National Park in the state of Guerrero was the Grutas de Cacahuamilpa National Park, decreed on April 23, 1936, most of the park is located in the State of Guerrero and another small portion in the State of Morelos, it is located north of the state capital, in Chilpancingo.

The second natural space to be decreed as a National Park in Guerrero was General Juan N. Álvarez National Park, located in the municipality of Chilapa de Álvarez and was decreed as a National Park on May 30, 1964 (Vargas, 1997).

Discussion

In the Spanish School, National Parks or other protected natural areas serve as a kind of territorial and tourist promotion, where the aim is to attract visitors through landscapes of natural beauty; however, this promotion can lead to the deterioration or even the disappearance of the natural area in question (Serrano, 2001). Therefore, it is necessary to manage these natural areas through responsible use that integrates an environmental conservation policy.

Sustainable tourism is a tool for managing tourism activity through the correct use of the natural environment, combining objectives of equitable social and ecological development; it is not only an environmental requirement for society. This means that it is not only an obligation, but that an establishment, in this case a tourist establishment, has to have an internal policy where a sustainable conscience is integrated in all the work strata, with this not only the satisfaction of the tourists is maintained, but also the local inhabitants can take advantage of the benefit (Ivars, 2001).

The objective of sustainable development is to incorporate the principle of solidarity within a community, which means that population concentrations mutually support each other from the local level with a global vision. An example in Spain where sustainable development is sought at the local level is the figure known as a Natural Park, which is a unit where there is preferably a retrospective balance between the agricultural sector, environmental conservation and biodiversity. The Agricultural Natural Parks are a modern tool where nature is preserved and the use of the geographical space is achieved through agricultural activities (Segrelles, 2015). This means that their function, in addition to being an ecological support, is to generate resources for the local population, so it is a sustainable management, since they are directly related to society, the environment and the economy.

Sustainable development is an alternative that arises to change the current model of tourism development, in a way that achieves a balance between the processes carried out in tourism activity and the resources it uses, most of which are natural resources (Rodriguez, 2010). The balance between economic benefit and the care of natural resources can be achieved through responsible and sustainable tourism development. Sustainable tourism consists of the active participation of society, the government and a suitable distribution of the natural territory (Vázquez et al, 2010). Among the contributions of Spanish referents, what stands out the most is a fair territorial distribution and this can only be achieved through a methodology with a geographical approach to the use of natural areas, which is what has led to the success of Spain in the management of its Natural Parks.

"Sustainable tourism is tourism that takes full account of current and future economic, social and environmental impacts to meet the needs of visitors, the industry, the environment and host communities" (UNWTO, 2005). The definition proposed by the UNWTO alludes to a strategy that each tourism destination must follow to move forward in a positive way, not only as a measure to mitigate damage to the environment, but also as a tool for social progress.

Over time, the term "sustainability" has lost its original essence and has been corrupted to favor the interests of the capitalist system. Ecotourism" has become an elitist activity, where only the wealthiest sector enjoys at the expense of the natural resources offered by the different tourist destinations (Domínguez & Aledo, 2005). Therefore, it is important to seek strategies where the term "sustainable" is not manipulated for false advertising purposes, but can be integrated into the policies of tourist destinations, so that local communities can also be included.

Natural parks are important because they have two functions: through them, conservation of the natural heritage is demanded and at the same time they function as a tool to achieve local socioeconomic development (Prats, 2001). Sustainable development is carried out when the needs of present generations are met without compromising the resources that can be used by future generations through ethical, social, environmental and economic objectives to ensure equal living conditions among the entire population with a vision towards the future (Provencio, 2019). In this sense, sustainable tourism has the laborious task of seeking to keep a tourist destination attractive, without forgetting to maintain the natural environment, so that its resources are not degraded. The paradigm of sustainable development is the result of the evolution of different ideas derived from the theories of development with respect to tourism; it seeks to maintain tourism activity by posing problems that can be solved with a focus on sustainability (Vera, 2004).

Within the sphere that represents the contributions of referents provided through the work of experts in the field of National Parks in Mexico, sustainable development is observed from different points of view, derived from the focus on the discipline in which it is being approached regarding the concepts of National Park, Sustainable Development and Sustainable Tourism. Sustainable development is a paradigm which integrates development policies and seeks to equitably integrate the economic, social and environmental subsystems or pillars, so that they feed back and generate a totalitarian development (Cervantes, 2007). This perspective of sustainable development is an idea derived from the equitable integration of the components of sustainable development, and stands out for the naming of sustainable development as a paradigm.

Sustainable tourism is an integral planning of a tourist destination where a sustainable approach is used, so that a space develops a tourist model through the exercise of using, but not overexploiting its natural and cultural resources, based on which the needs of the population can be met through the economic resources obtained through tourism. Within the strategy to integrate a sustainable approach to tourism, the aim is to maintain the satisfaction of tourists, that is, to integrate an equitable local development without affecting the tourist activity (*Op. Cit*., 2007).

Sustainable development is a strategy to safeguard natural resources and human life while preserving the capitalist system that has prevailed throughout human history. Sustainable development is not a paradigm that destroys a system that has prevailed for a long time, on the contrary, it seeks to contribute and evolve this system through the Sustainable Development Goals (SDGs), so that the existing natural heritage can be valued and appreciated by the current and future population (Ibáñez et al, 2020).

Sustainable development cannot solve all social and environmental problems globally, such as pollution, overexploitation of resources, climate change, among others. For this, it is necessary to work with the root of the problems and integrate a multidisciplinary perspective. Sustainable development emerges as a tool to work based on it, specifically it does not work as a solid solution to end all the problems that afflict humanity, it works more as a means to avoid or curb as much as possible the problems mentioned above, through an appropriate methodology (Gutiérrez, 2007).

Sustainable development has to integrate an analysis on different important factors, such as ethics, society, political, economic and ecological factors, through the different layers of government. Sustainable development takes into account the social system as the main factor, since human activities and their influences are found within this system, therefore, all human relations, behavior and activities have to be contemplated in a sustainable strategy, this means integrating values and ethics to the SDGs to achieve a sustainable conscience.

National Parks are characterized by being of scientific interest at the geomorphological level, thus enabling them to be integrated with an ecological-environmental policy (Niño, 2013). The scientific interest that national parks possess is complemented by the capacity to carry out recreational activities, in this way it can be said that there is a social approach, since it seeks to integrate educational aspects with the practice of responsible tourism.

Sustainable tourism is defined as a process divided into two parts, on the one hand, it seeks to reach a socioeconomic development and on the other hand it seeks to maintain quality in the tourist experience and the most important thing is to integrate the above while maintaining the conservation of cultural and natural heritage (ibidem, 2013). From a social perspective, the objective of sustainable tourism is not only to seek to improve the living conditions of the host communities, it is also important to work on the satisfaction of tourists, since they are the main factor for local economic development. National Parks are of great importance to achieve the sustainability of the natural environment; therefore, they must be managed through a regional planning and development policy, which represents the basis for a new model that will achieve sustainability and prosperity for the local population (Niño, 2003). Most of the poor communities in Mexico develop within a rural environment, therefore, this disadvantage can be turned into an advantage through a strategy for ecotourism. The same can be applied to National Parks, through a strategy to develop community-based tourism.
SEMARNAT has recently defined National Parks as:

"Biogeographic representations, at the national level, of one or more ecosystems that are significant for their scenic beauty, their scientific, educational, recreational, historical value, the existence of flora and fauna, their suitability for tourism development, or for other similar reasons of general interest" (Semarnat, 2020).

The National Parks are the support in a geographical area because they contribute to avoid important problems, such as natural disasters, floods and landslides. These have to be analyzed in a way that includes not only physical aspects, but also geographical, population, economic and environmental aspects in order to improve their management and solve in a timely manner the problems that the parks of the national territory are going through. In some places, the national parks serve as environmental regulators and even help boost productivity, as in the case of tourism, by helping to improve the landscape (Vargas, 1997).

Good planning for a national park is achieved through land-use planning, and planning is dictated to establish sustainable development, commanded by community action (Niño & Melo, 2006). Ecotourism planning considers the geoecological characteristics of the landscape in order to avoid possible impacts and problems with a vision for the future. National parks are characterized by the recreational use of wildlife, distinctive natural landscapes, special uses for nature restoration, agricultural uses and human settlements (Niño, 2003).

Natural Parks should be managed based on a methodology with a geographical approach (Niño & Segrelles, 2014). Natural Parks in Spain are characterized by being managed through the Autonomous Communities that make up that country and within that management a management that helps to distribute an area in a correct way so that there is no conflict between natural and urban elements has to be taken into account, therefore, a geographical approach that at the same time is multidisciplinary is the best option for the management of these parks.

National parks are developed through territorial organization and function for regional development for the population (Fortunato, 2005). If you want to analyze the concept of sustainable development, you have to inquire about the different points of view of the referents in economic growth, conservation and preservation of biodiversity, of those who try to change the consumerist system of natural resources through protest (Garcia, 2015).

Good management of a National Park is achieved through a model where tourism can be the main promoter, not only for the dissemination of the park, but also for the development of the communities near the parks. In the case of Costa Rica, this methodology is widely used because there are several national parks (Aguirre, 2008). Costa Rica has a large volcanic area with abundant flora and fauna, as well as very valuable landscapes, which is why it has been used for years to establish volcanoes as National Parks so that they can be used for tourism and at the same time conserve their natural resources (Alvarado *et al*, 2021).

Conclusion

The problem and objective posed in this study was duly resolved, since the contributions of the indirect research sources, and mainly from the contributions of the analyzed publications, fundamentally addressed the need to promote reflections and discussions for the adoption of measures to prevent the elements of nature through the declaration of natural protected areas, which at the federal level, an example of this, are the national parks, among other categories of nature management. In summary, "El Veladero" National Park was decreed so that the Port of Acapulco would have a green lung where ecotourism could be practiced in a regulated manner and with low impact on the surrounding environment. However, this objective has been marginalized in each of the past state and municipal administrations.

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Variable	Descripción	Valor
V_V	Volumen de Venta	20000
P_V	Postura de venta	490.61
V_C	Volumen de Compra	20000
P_c	Postura de Compra	485.39
P^{Uh}	Precio último Hecho	491.61
V_o	Volumen Operado	1241979
P_u	Precio/Utilidad	0
P^{VL}	Precio/Valor Libro	0
U_a	Utilidad p/Acción	0
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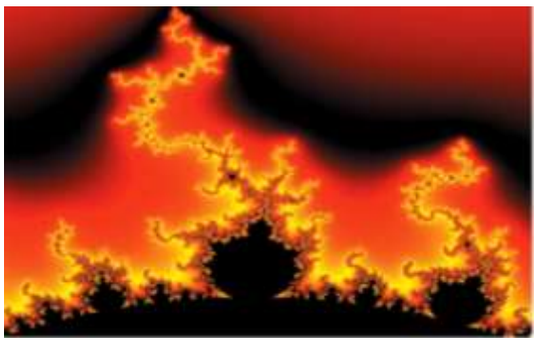

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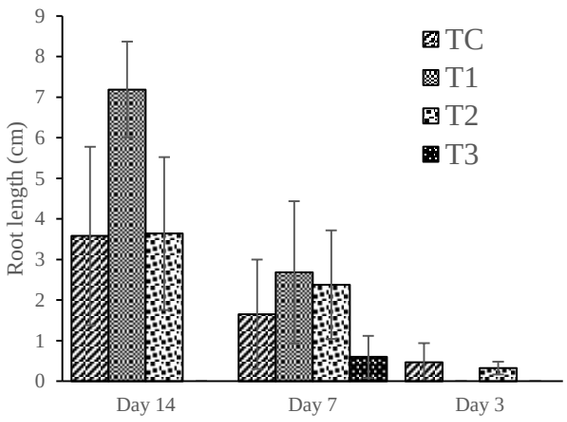

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