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Rural housing in the municipalities of Pacho - Cundinamarca (Colombia) and Tlatlaya - State of Mexico (Mexico)

Vivienda rural en los municipios de Pacho - Cundinamarca (Colombia) y Tlatlaya - Estado de México (México)

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Abstract

This article presents the results of the theoretical-descriptive research of documentary type, whose objective was to make a diagnosis of housing in the municipality of Pacho - Cundinamarca (Colombia) and Tlatlaya - State of Mexico (Mexico), from the analysis of the results of the housing deficit in Colombia (DANE) and social backwardness in Mexico (INEGI), in addition to deepen concepts of housing, construction systems and sustainability in different documents consulted in databases such as Google Scholar, Scielo, Redalyc. The municipality of Pacho has approximately 8,856 homes of which 44.1% are in housing deficit and in the case of Tlatlaya there are approximately 8,561 inhabited homes, of which 62% are estimated to be in social backwardness; for these two municipalities there are similarities in the materials and construction systems of the housing within which predominates the floor in earth or cement, adobe or brick walls and roofs in sheet or asbestos-cement. From the analysis, it is possible to recognize the design and construction processes, seeking that the houses are decent, safe, sustainable and respond to the needs of the population, respecting the cultural and traditional aspects of each context, seeking an equitable development in the communities of the two countries.

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Key words: Human Settlement, Community**,** Decent Housing, Sustainable Development.

Resumen

Este articulo presenta los resultados sobre la investigación teórico-descriptiva de tipo documental, cuyo objetivo fue realizar un diagnóstico de la vivienda en el municipio de Pacho – Cundinamarca (Colombia) y Tlatlaya - Estado de México (México), a partir del análisis de los resultados del déficit habitacional en Colombia (DANE) y rezago social en México (INEGI), además profundizar conceptos de vivienda, sistemas constructivos y sostenibilidad en diferentes documentos consultados en bases de datos como Google Scholar, Scielo, Redalyc. El municipio de Pacho cuenta con aproximadamente 8.856 hogares de los cuales el 44,1% se encuentran en déficit habitacional y en el caso de Tlatlaya hay aproximadamente 8.561 viviendas habitadas, de las cuales se estiman se encuentran en rezago social el 62%; para estos dos municipios se encuentran similitudes en los materiales y sistemas constructivos de la vivienda dentro de los cuales predomina el piso en tierra o cemento, muros en adobe o ladrillo y techos en lamina o asbesto-cemento. A partir del análisis se logra reconocer los procesos de diseño y construcción, buscando que las viviendas sean dignas, seguras, sostenibles y respondan a las necesidades de la población, respetando los aspectos culturales y tradicionales de cada contexto, en procura de un desarrollo equitativo en las comunidades de los dos países.

Palabras clave: Asentamiento humano, Comunidad**,** Vivienda digna, Desarrollo Sostenible.

Introduction

Professor Jesús Velázquez Lozano (2007) defines housing as an enclosed and covered space that provides protection and security to its inhabitants from climatic agents, as well as privacy and development of their identity, constitutes the basis of the family patrimony and must be functional to the needs of the inhabitants. In the case of rural housing, it is defined by García and Aristizábal (2020) as a construction that mainly provides protection for its inhabitants, especially from climatic conditions, and also includes anthropological and psychosocial aspects, thus relating to the natural, cultural and social context of the particular region where it is located; its distribution and conformation of spaces depends on the needs of its inhabitants. Therefore, apart from being a physical element that provides protection and shelter, the house is also a scenario where the social fabric is developed and strengthened, represents the culture and tradition of the farmers and is an agribusiness scenario.

It should be noted that the right to adequate housing is recognized in international human rights law as an integral element of the right to an adequate standard of living. Therefore, the habitability of housing must be guaranteed by identifying the physical, sociocultural and environmental aspects of the areas to be built or intervened, in order to determine their architectural, installation and structural characteristics, and ensure that they are decent, sustainable and safe. Unfortunately, the concentration of the population in Latin America is in the cities, which influences the adequate administrative development of the countries, since

these efforts are concentrated in the cities and the rural sector is somehow left behind; it is essential to establish strategies that reduce the gaps between these two sectors, to promote equitable development among the population and especially access to decent housing (Garcia-Puentes and Bernal-López, 2022; Sánchez, De La Cruz-De La Cruz, López-Becerril, Arana-Ovalle, 2021; and Garcia-Palacios and Moyano-Estrada, 2020).

On the one hand, in Colombia, according to projections of the National Administrative Department of Statistics (DANE), there is an approximate population of 50,372,424 inhabitants by 2020, with a territorial extension of 1,141,748,000 inhabitants, composed of 32 departments, one of which is the department of Cundinamarca, located in the center of Colombia on a high plateau of the eastern mountain range and covering eastern and western flanks. km^2One of them is the department of Cundinamarca, located in the center of Colombia in a high plateau of the eastern mountain range and covers the eastern and western flanks of the same, has a population of 2,792,877 inhabitants (DANE, 2020), being the fourth most populated department of the country, it has a land area of 240.06 $km^2$240.06 of which 15415.94 km^2It is composed of 116 municipalities, among which the municipality of Pacho is highlighted in this research, which is located in the north-west of the department of Cundinamarca and has a rugged topography, with various branches of the Eastern Cordillera that run through its territory of 403.04 hectares, i.e., 40,304 hectares of land with a population of 2,792,892,877 inhabitants (DANE, 2020). km^2The administrative distribution of the area is 72 territorial spaces with characteristics typical of the mountainous zone of the eastern cordillera defined by its altitude in four thermal floors: Paramo, cold, temperate and warm. According to the DANE projection (2020), it has a total population of 25,803 inhabitants, of which 14,127 live in the town and 11,676 in the town and rural areas.

On the other hand, according to the National Institute of Statistics and Geography (INEGI), Mexico has a population of approximately 126,014,024 inhabitants and a territorial extension of 1,964,375,000 inhabitants. km^2 1,964,375, and when adding the Exclusive Economic Zone of the territorial sea, which covers 3,149,920 $km^2$3,149,920, the country's total surface area is 5,114,295,000 square meters. km^2Its political division is composed of 32 federal entities, of which the State of Mexico is located in the central zone and is divided into 125 municipalities, with a population of 16,992,418 people (INEGI, 2020); of this population, 87% lives in urban localities and 13% in rural localities, with a territorial extension of 22,499,953,920. km^2Of the total area, 38.1% is agricultural, 34.9% forestry, 16.7% livestock, 10.3% industrial and urban; in terms of land tenure, 40.32% is ejido. In the southwest zone of the State of Mexico is located the municipality of Tlatlaya, which stands out in the present investigation, it is divided by the municipal seat, 25 towns and 183 rancherías, in addition its territory amounts to 788.6 km^2The climate in Tlatlaya is cold, temperate and warm and according to INEGI (2020) it has a total population of 31,762 inhabitants.

The National Population and Housing Census 2018 revealed that in Colombia of the 14,060,645 households in total, 5,144,445 million households have housing deficit or social

lag, structural and non-structural, representing 36.59% of Colombian households. In Mexico, according to INEGI, there are 34,892,977 homes, of which 8,504,424 have a housing deficit or social backwardness, whether structural or non-structural, which represents 24.4% of the homes in that country. For the department of Cundinamarca the census of households is 945,601, of which 280,849 should improve their housing conditions, which would represent a percentage of 29.71% and for the State of Mexico with information from INEGI (2020), it was known that there are 4,481,007 total homes, of which 639,104 should improve their housing conditions representing 14.3% of homes in the state. It should be taken into account that, in the municipality of Pacho there are 8,856 total households, of which 3,906 have deficiencies, in the rural sector there are approximately 3,562 families of which 2,833 have their own housing and 729 do not, (Alcadia municipio de Pacho, 2020). As for the municipality of Tlatlaya it was found that there are a total of 8,561 dwellings, the average number of occupants of the dwelling is 3.7%.

According to research, there are risk factors that affect human health in housing, such as inadequate construction materials, inadequate water storage and consequent contamination, among others. This is why it is important to analyze and compare the housing deficit or social backwardness, construction systems and housing design criteria in communities, taking into account the principles of sustainability to meet current needs and safeguard future generations.

It is worth highlighting that, the countries of Colombia and Mexico have proposed public housing policies with the objective of adequately solving the housing deficiencies of rural households, to ensure access to decent housing, as stated by Olvera De La Cruz Miriam Monserrat (2018), that is, housing that allows its inhabitants to lead a healthy, safe and sustainable life to develop a life project in the countryside; although these efforts have not been sufficient for the population of the rural sector in the two countries to enjoy adequate minimum conditions of habitability in their homes.

Likewise, the Sustainable Development Goals (SDGs) are tools to eradicate poverty and deal with climate change that go hand in hand with the preservation of resources for future generations, in this case goal 11.- sustainable cities and communities, specifically in goal 11.1, which seeks to ensure that all housing is safe and affordable, as well as sustainable for a better comfort of those who live in them, which should be included in the national public policy to achieve better settlements and thus obtain a better quality of life and conserve natural resources.

In this sense, this study was aimed at carrying out a theoretical characterization of the physical, sociocultural and environmental aspects of regions in Colombia (Cundinamarca) and Mexico (State of Mexico) related to housing, which allows identifying in the literature the architectural, installation, and structural characteristics of rural housing, analyzing the climatic, social and cultural conditions in Pacho- Cundinamarca (Colombia), Tlatlaya-State of Mexico (Mexico), from the principles of sustainability, and structural characteristics of rural housing analyzing the climatic, social and cultural conditions in Pacho- Cundinamarca (Colombia), Tlatlaya-State of Mexico (Mexico), from the principles of sustainability, thus allowing to classify the data

obtained from national, departmental or state and municipal surveys to qualify and quantify the deficiencies of housing in the chosen municipalities.

Materials and methods

This is a theoretical-descriptive research of documentary type for which it was carried out tracking, organization, systematization and analysis of electronic documents on housing, housing deficit in Colombia and social backwardness in Mexico covering the period of time between 2011 and 2021. For this purpose, the search was carried out through search channels such as Google Scholar, Scielo, DANE, INEGI, CONAVI, CONPES, Redalyc, Gobernación de Cundinamarca, municipality of Pacho, municipality of Tlatlaya, UAEM institutional repository. It was possible to find important documents such as the National Population and Housing Census in Colombia 2018, Social Gap and National Census of Mexico 2021, Departmental or State and Municipal development plan, articles in specialized databases, National Policy on Sustainable Buildings, undergraduate and graduate theses and previous research that allowed to go deeper into the topics of interest. The organization consisted of making matrices in Excel, where the information collected was recorded, in order to make a comparative analysis of the information obtained from the two municipalities under study. For the systematization of the search criteria, the following terms were included: Human Settlement, Community**,** Decent Housing, Sustainable Development.

The sample for this study corresponded to homes located in the municipalities of Pacho-Cundinamarca (Colombia) and Tlatlaya-State of Mexico (Mexico), where according to national, departmental or state and municipal censuses, households with housing shortages were identified, which allowed the classification of housing characteristics, such as wall and floor materials, overcrowding, basic services, and other variables that were analyzed through 3 methods incorporating Excel tables, such as: Registration of documents found in the different databases with information of interest of the topics to be addressed in the research to perform a theoretical characterization on the physical, socio-cultural and environmental aspects of regions in Colombia (Cundinamarca) and Mexico (State of Mexico) related to housing, classification of qualitative and quantitative variables found for housing as architectural, facilities, and structural characteristics of rural dwellings analyzing the characteristics of rural dwellings, and structural characteristics of rural housing analyzing the climatic, social and cultural conditions in Pacho-Cundinamarca (Colombia), Tlatlaya-State of Mexico (Mexico), from the principles of sustainability, diagnosis of similarities and differences of housing in Pacho-Cundinamarca and Tlatlaya-State of Mexico classifying the data obtained from national, departmental or state and municipal surveys to qualify and quantify the deficiencies of housing in these municipalities.

Result

Housing in Tlatlaya-State of Mexico

Rural housing in Mexico has different typologies and presents an urban morphology that is immersed in different contexts and social realities, while most of the urban area was once rural towns dedicated to agriculture and livestock (Torres Veytia, E., Vega Díaz, L., & Higuera Meneses, C., 2011). Currently, rural areas are increasingly affected by not having decent housing, from the lack of security due to houses built of wood or adobe and sheet metal that would not withstand a natural disaster, to not having the necessary services such as electricity, drinking water and drainage, so that the inhabitants are more prone to disease and their quality of life is affected by these factors.

According to INEGI, a population is considered rural when it has less than 2,500 inhabitants, while urban is that where more than 2,500 people live, in this case the National Autonomous University of Mexico (UNAM) has addressed the analysis and prospects of sustainable rural housing in Mexico. In this regard Vázquez (2013), points out that the states with the highest number of people living in communities with less than 2,500 inhabitants are Veracruz, Oaxaca, Chiapas, State of Mexico, Puebla and Guanajuato; According to CONAPO (National Population Council), some criteria taken into account for differentiating between urban and rural Mexico are that rural areas are identified with a population distributed in small scattered settlements, with a low ratio between the number of inhabitants and the area they occupy, as well as a predominance of primary activities, rural areas are characterized by small, close-knit communities and because, unlike cities, the space available for green areas is not small. rural areas tend to be more dependent on natural resources and organic materials, where the environment does not suffer great damage and life tends to be more peaceful and relaxed; It should be noted that earth is considered as a basic and ecological construction material, a resource that has a great impact on cultural roots, because it is the traditional materialization means of housing that suffers a technological and cultural discredit due to a gradual loss of knowledge of its properties and the empirical practice in its use requires social management processes and technological innovation to project it as the most important material resource of the rural habitat. (Calla García, A. 2007)

Mexico covers a territorial extension of 1,964,375 $km^2$1,964,375, of which 1,959,248 $km^2$1,959,248 are continental and 5,127 km^2 5,127 are insular surface. To this territory must be added the Exclusive Economic Zone of the territorial sea, which covers 3,149,920,000 sq. km. $km^2$3,149,920, bringing the country's total surface area to 5,114,295,000 square meters. km^2. The capital of Mexico is the Federal District (Mexico City), the political division of Mexico is composed of 32 states and has a population of 126,014,024 people and its population density is 64.3 inhabitants/km2 , so that there are 34,892,977 homes, of which 24.4% or 8,504,424 were identified as being in conditions of Housing Backlog.

The state of Mexico is located in the central zone of the Mexican Republic at an altitude of 2,683 meters above sea level, in its highest plain which is the Toluca valley, its territorial extension of the state is 22,351.8 km^2 of the total area, 38.1% is agricultural, 34.9% forestry, 16.7% livestock, 10.3% industrial and urban; in terms of land tenure, 40.32% is ejido. The average annual temperature is 14.7°C, 73% of the state has a temperate sub-humid climate, located in the high valleys of the north, center and east; 21% is warm sub-humid and is located towards the southwest, 6% is dry and semi-dry, present in the northeast, and 0.16% has a cold climate, located in the high parts of the volcanoes.

The State of Mexico has 125 municipalities, with information from INEGI 2020 it was obtained that the State of Mexico ranks 1st nationally for its number of inhabitants 16,992,418, of which 8,741,123 are women and 8,251,295 are men. The population of the State of Mexico lives in: 87 % urban localities and 13 % rural localities, in the state of Mexico the total number of dwellings is 4,481,007 and the social backwardness is 14.3%, i.e. 639.104 and the materials with which the houses are built are: 63.3% of firm or cement floor, 96.8% walls of brick, brick, block, stone, quarry, cement or concrete and 89.6% concrete roofs or joists with vaults and the services they have are: 75.1% have piped water inside the house, 99.6% have electricity and 86.5% have drainage connected to the public network.

The municipality of Tlatlaya is located in the southwestern part of the State of Mexico, and according to information from the Constitutional City Council of Tlatlaya (2022-2024), it is made up of the municipal seat, 25 towns and 183 rancherías; its territorial division is made up of 117 delegations. Its municipal seat is located within the geographic coordinates 18°37'01" north latitude and between the meridians 100º12'27" west longitude of the Greenwich meridian. Its territory amounts to 788.6 $km^2$788.6 hectares, which represents 3.5% of the state. The predominant climate in Tlatlaya is classified as sub-humid tropical climate, of course with summer rains. It also depends on the seasons of the year and according to the altitude where we are located, for these reasons we have cold, temperate and warm climates. Summer is the season that is bountiful for the farmer, plants and trees are renewed, especially agriculture is promoted by planting corn, beans and pumpkins. In autumn the farmer harvests corn, sesame, beans, pumpkin and some are dedicated to the sugar cane harvest or piloncillo.

In relation to the surface area occupied for rural production, Tlatlaya is the second municipality with the second highest proportion destined for the use of agricultural production units, pastureland, pastures, forests and areas lacking vegetation; there are 3,047 agricultural production units, 1,680 refer to agriculture and self-consumption among the population, with a population of approximately 31,762 inhabitants and a population density of 40.3 inhabitants/ha.km^2. It should be noted that the total number of particularly inhabited dwellings is 8,561, of which 7.3% are dwellings with dirt floors. The availability of services and equipment in the houses is 34.3% of piped water, 89.1% of drainage, 90.1% of sanitary service, 98.9% of electric energy.

As mentioned above, of the total number of private homes inhabited in Tlataya, 8,561, it was estimated that the housing deficit is equal to 62%, taking into account some variables of the Housing Gap Update of the Population and Housing Census 2020. CONAVI Mexico. In which there are 3 components, a, b and c. The a are the deteriorated materials where the variables within this are Walls (Waste material: cardboard sheet; reed, bamboo or palm; in mud or bajareque) and Roof (Waste material; cardboard sheet; palm or straw). In b are the regular materials and the variables are walls (asbestos or metal sheet; wood), roof (metal sheet roof; asbestos sheet; wood or tile; tile) and floor (dirt floor). In the c is the precariousness of spaces such as overcrowding (more than 2.5 people per room) and service (toilet, no toilet).

The population resides in localities with less than 2,500 inhabitants, being a municipality with a rural population in dispersed settlements except for the locality of San Pedro Limón, which is considered an urban settlement because it has 2,503 inhabitants. In the municipality of Tlatlaya, rural housing is predominant, as well as its construction materials, which range from deteriorated materials such as cardboard, reed, bamboo or palm leaves; mud, palm or straw, to regular materials such as asbestos or metallic sheeting; wood, or shingles; roof tiles, for use in the construction of walls and roofs. In the municipal capital, houses are predominantly built with brick or brick walls and tile or sheet metal roofs. The average number of occupants per dwelling is 3.7 and the average number of occupants per room is 1.1. Over the years, the average number of occupants per dwelling has decreased from 5.43 to 4.72 and finally to 4.37 inhabitants per dwelling in the years 1990-2000-2010.

The environment in the municipality of Tlatlaya is affected in different localities where the activities of the population are the main cause of the alterations of the resources: air, water and soil. For example in the larger localities such as: San Pedro Limón, Santa Ana Zicatecoya, San Antonio del Rosario and Tlatlaya (Municipal Head) where hydrological contamination is given by the discharge of domiciliary wastewater, since the rivers are used as the drains of the sanitary infrastructure in addition to the solid waste that the population throws into them, also the use of fertilizers that erodes the soils, the over exploitation of aquifers, daily activities such as burning fossil fuels for transportation and the traditional combustion of firewood in domestic uses. However, the final disposal site for solid waste is in a sanitary landfill located in the community of Peña Blanca in the western part of the municipality and where the estimated volume of solid waste collected in 2017 was 4,060 tons and in 2018 it is estimated to have increased to 4,500 tons of solid waste. Although at this site, efforts are made to provide proper treatment and separation of garbage, there is a risk of affecting the 48 inhabitants of the community, due to respiratory and gastrointestinal diseases as in the main urban centers.

According to the National Population and Housing Census conducted by DANE (2020), in the municipality of Pacho there are 8.856 households in total of which the predominant material of the exterior walls are rough wood, board or plank, cane, matting or other vegetable and waste materials; cane, matting or other vegetable and waste materials, as for the material of the floors are earth, sand or mud and overcrowding of housing can be mitigable (With more than two people per room to sleep) with an average of 937 homes of the total, unmitigable (Households

with more than four people per room to sleep) that apply to 25 homes of the total, and cohabitation (There are three or more households, or there are more than 6 people in total in the house) where 65 homes of the total have this characteristic.

It is important to note that the census found that there are 6 "type" dwellings, referring to container, tent, boat, wagon, cave, natural shelter. On the other hand, it was found that 54 households prepare their food in a space outside the dwelling or do not have an adequate kitchen for food preparation. Public services are fundamental and play an essential role in economic and social development, the present investigation showed that of the total number of homes in the municipality of Pacho 305 homes do not have electricity service, 691 homes in which the toilet service has no connection; latrine, direct discharge to water sources (low tide), and 2.641 households obtain water for cooking from a well without a pump, cistern, jaguey or auger; rainwater; river, stream, spring or birth; carrotanque; aguatero; or bottled or bagged water. (DANE, 2020).

According to the Pacho Development Plan (2020), to date there is no known census regarding the use of renewable energies, which differ from conventional use, being almost null the use of photovoltaic systems due to the difficult economic access by the community (Alcaldía municipio de Pacho, 2020). Regarding the use of energy in heating and cooking processes for rural areas, it is common to use firewood from native forests associated with eco-systematic processes for each of the thermal floors of the municipality, being not only problematic due to the displacement of fauna, loss of vegetation cover but also corresponding to the emission of carbon dioxide, particulate matter, among others, that affect the health of the individual in contact and are part of the factors that increase the incidence in relation to global warming, leaving aside alternatives such as the construction and implementation of biodigesters as a tool for the promotion of energy from the use of organic waste. The municipality has deposits of some minerals for industrial use, such as iron, coal, and rocks used in road maintenance and as construction material after processing.

Taking into account the above information, it was obtained that the housing deficit or social gap in the municipality of Pacho is 44.22%, which identifies households living in homes that have deficiencies and for which it is necessary to add new homes or make interventions so that they are in the necessary conditions to ensure the habitability of households.

It is worth mentioning that, at the national level there is a public policy oriented to sustainable housing design, although for the region specifically there is no theoretical evidence of manuals that propose bioclimatic design (Ministry of Housing, City and Territory, 2020), likewise these policies lack cohesion and their applicability for the rural sector has been deficient, which translates into inappropriate housing projects forced to the rural context (Garcia-Puentes and Bernal-López, 2022).

Sustainability concepts for housing in Mexico

Some of the sustainability principles that can be taken into account for Tlatlaya's constructions, to obtain a good habitability, in addition to saving water, gas and electricity in a warm sub-humid climate with an average annual temperature that is above 20°C, where temperatures reach more than 35°C in warm seasons (spring and summer) and less than 20°C in cold seasons (autumn and winter).

According to the Manual for Sustainable Housing, CONAVI 2021 it is important to consider the following:

Table 1. *Variables to consider for sustainable housing. Source: Own elaboration based on the Manual for sustainable housing, CONAVI (2021).*

INDICATORS	CONCEPT
Orientation	The orientation of the house is the first important action to consider in order to have a fresh and comfortable house, taking advantage of air ventilation and sunlight.
Home design	Plan the areas of the house in such a way that everyone feels comfortable using the different spaces.
Vegetation	Helps to shade and reduce heating.
Materials to be used	The materials chosen should be decisive for the comfort of the families. If materials that are not suitable for the climate are chosen, the house could be very hot throughout the day and it will be very difficult to cool it down.
Due to the use of household appliances	Appliances should have a yellow Energy Efficiency label and in that label the most important thing is the energy savings. Also take into account that LED bulbs save up to 80%.
Water catchment	In Tlatlaya it rains between May and October but from June to September is where the rains are more intense. Therefore, it is advisable to use water for consumption in your home, this will help you to depend less on the public network because you will save water.

The above table shows data taken from the manuals of sustainable housing for different climates of the National Housing Commission (CONAVI) 2021, which are very useful for the construction, expansion and improvement of housing according to the place where it is located with respect to climate, in this case we put the most general points that should be taken into account in each construction and in any climate.

Colombia does not have any type of manuals like these, however, many countries are currently looking for different strategies to achieve sustainable development and it is expected that this will also be done in Colombia. On the other hand, the World Commission on Environment and Development published its report in April 1987, where the concept of sustainable development is defined for the first time.

"It is up to humanity to make development sustainable, that is, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development implies limits (not absolute limits, but limitations imposed on environmental resources by the present state of technology and social organization, and the capacity of the biosphere to absorb the effects of human activities); but both technology and social organization can be managed and improved in such a way as to open the way to a new era of economic growth [...]" (World Commission on Environment and Development, 1988).

With this concept, we are seeking to meet our needs, but also thinking about not affecting future generations, so many countries are beginning to work in accordance with the 2030 Agenda for Sustainable Development and seeking to meet the goals.

Sustainability concepts for housing in Colombia

From the Colombian government, one of the most important steps taken in the recognition of sustainable construction is the issuance of CONPES 3919 in 2018: National Policy on Sustainable Buildings. Additionally, sustainability criteria have been formulated at the regulatory level for the building sector, mostly focused on saving water and energy consumption. In parallel, there are voluntary certifications in the construction market, which provide guidelines for projects that seek the possibility of going beyond the minimum requirements proposed by the standards (Consejo nacional de política económica y social república de Colombia & departamento nacional de planeación, 2018).

The CONPES 3919 document seeks to promote public policies around sustainable construction in Colombia, aligned with the fulfillment of the commitments assumed in the international sustainable development agenda, especially with regard to the fulfillment of the Sustainable Development Goals (SDGs), with emphasis on goal 11 on sustainable cities and communities.

Therefore, the national policy for buildings proposed in this CONPES document recognizes the need to incorporate and promote sustainability criteria in buildings of all types of use. However, in the current regulations there is a weak inclusion of sustainability criteria in the life cycle stages of buildings (i.e. design, construction, operation, and use), both new and used. Among its objectives, specific actions for buildings are highlighted, including the inclusion of information systems, the construction of baselines for water and energy savings, and the reduction of deforestation. It should be noted that the benefits associated with sustainable buildings are numerous and involve society as a whole. In addition, they cover the investment extensively, both from the financial approach and from the environmental and social benefit approach.

Likewise, within the framework of the Urban Environmental Management Policy, the Ministry of Environment and Sustainable Development (2012), developed and published the document "Environmental Criteria for the Design and Construction of Urban Housing", which contains a set of environmental management proposals with a mainly preventive approach, since it focuses on the identification and definition of management proposals for the main environmental problems of urban housing, related to soil, water, energy and materials. This document includes general proposals for the planning, design, construction and use of housing, thus defining guidelines that not only contribute to the protection and conservation of the environment, but also to the health and quality of life of the Colombian population, especially the most vulnerable groups.

The fundamental principles of sustainable architecture were applied to the topics defined in the document in order to establish the efficient use of resources in relation to the mitigation of the environmental impact generated and the quality and comfort required for the best quality of urban housing. The proposal of environmental criteria for the design and construction of urban housing is based on four main axes: Water, Soil, Energy and Materials; these being primary components of the building and the strong interrelation between them, since the lack or deficiency of any of them directly affects the habitability conditions and environmental sustainability of housing.

These criteria are intended to guide the inclusion of integral guidelines throughout the life cycle of buildings and, within this same framework of ideas, use should be made of the integral sustainability of a building, which refers to the incorporation of differential instruments (urban, rural, climatological zone) that should be adapted to the particular characteristics of each building (existing new conservation, among others).

- The proposed criteria focus mainly on three objectives:
- Rationalizing the use of renewable natural resources
- Substitute with alternative systems or resources
- Managing and minimizing the environmental impact produced

Throughout the research, the similarity in the terms housing deficit and social backwardness is identified, since in Colombia the housing deficit is composed of the quantitative deficit and the qualitative deficit, each of these dimensions has its own components, which identify households living in deficient housing; In Mexico, the social gap is a weighted measure that summarizes four indicators of social deprivation (education, health, basic services and housing space) in a single index that aims to order the units of observation according to their social deprivation. It is not a poverty measurement, since it does not include income, social security and food indicators. Considering this, it is recognized that the objective of the housing deficit or social backwardness is to quantify the deficiencies of households, which is composed of some similar variables, such as the material of floors and walls, overcrowding and public services.

In Colombia, according to the National Population and Housing Census 2018 the total number of households is 14,060,645, with a housing deficit or social gap is 36.59% and in Mexico according to the National Institute of Statistics and Geography, there is a housing deficit or social gap of 24.4%. Cundinamarca is the fourth most populated Department in the country, it has 945,401 total housing units (DANE, 2020) with a housing deficit or social gap of 29.71%, which is 6.88 percentage points below the national level, and the State of Mexico is the state with the largest population in Mexico, with a total of 4,481,007 housing units (INEGI, 2020) of which 14.3% are identified with a housing deficit or social gap.

In Pacho-Cundinamarca, out of 8,856 total households, 44% have a housing deficit or social backwardness (DANE, 2020); for Tlatlaya-State of Mexico, the total number of inhabited private homes is 8,561, with which the housing deficit or social backwardness was estimated at 62%. It is observed then, that in Tlatlaya-State of Mexico the deficiencies in homes are greater than in Pacho-Cundinamarca.

Considering the above, for homes identified as having dirt floors (sand or mud), in Pacho-Cundinamarca 439 homes of the total have this characteristic, likewise 626 homes of the total in Tlatlaya-State of Mexico (INEGI, 2020). For public services it was evidenced that, for the homes in Pacho 70.18% have Aqueduct, 92.19% Sewerage, and 96.55% Energy, the homes in Tlatlaya 34.3% have piped water, 89.1% with Drainage 90.1% sanitary service and electric energy 98.9%. These data can be seen in the following table:

Table 2. *Similar variables between Tlatlaya-Mexico and Pacho-Colombia. Source: Own elaboration based on data from INEGI (2020) and DANE (2020).*

Variable	Category	Tlatlaya, State of Mexico	Pacho, Cundinamarca
Total households		8,561 households	8,856 households
Housing shortage or social backwardness		62%	44%

Floor material	Earth, Sand or Mud	7,31%	4,96%
Availability of basic services	Piped water/ Aqueduct	34,3%	70,18%
	Sewerage / Drainage	89,1%	92,19%
	Electric power	98,90%	96,55%

The state of the construction systems of the houses in Pacho varies between those of great design and those built with adobe, zinc roof tiles, cement floors and floors in earth, sand or mud; in Tlatlaya their construction materials range from deteriorated materials such as cardboard sheeting, reeds, bamboo or palm; In Tlatlaya, their construction materials range from deteriorated materials such as cardboard, reed, bamboo, bamboo or palm; in mud or bajareque and palm or straw to regular materials such as asbestos or metallic sheeting; wood, or tejamanil; tile, for use in the construction of their homes in walls and roofs; in the municipal capital, houses built with brick walls, brick and tile or sheet roofs predominate.

It should be noted that, in Colombia, there are no guidelines for building sustainable housing, which according to the climate, recommendations are made taking into account the orientation and its environment, unlike Mexico, which does have them with the sustainable housing manuals, created by the National Housing Commission (CONAVI) this year, where the concepts and the importance of applying the principles of sustainability in the design of housing are recognized, starting from the reduction of energy consumption, water resource management, materials and orientation. Undoubtedly, the need for the application of these concepts is evident, also taking into account Conelly (2005): Rural houses built with sustainable criteria are affordable, energy efficient, recycle the harvest, manufacture materials responsibly, use less water, promote the health of their inhabitants, preserve the habitat and ecosystems, promote the community, are of higher quality and are less costly to operate.

The housing policy for rural settlements needs to consider rural housing from a holistic approach and with the characteristics that the inhabitants have configured according to the activities and social interactions, requirements and specific conditions of a way of life, ensuring that it is a dignified space, integrated to the territory and that it provides adequate conditions for the well-being of its occupants (Acevedo Agudelo and Hurtado Sarmiento, 2022; and Sánchez, De La Cruz-De La Cruz, López-Becerril, and Arana-Ovalle, 2021). A differentiated treatment for rural housing is essential to implement public policies that effectively respond to the needs, demands and way of life of rural communities (Garcia-Palacios and Moyano-Estrada, 2020).

On the other hand, in Colombia the document CONPES 3919 in 2018: National Policy on Sustainable Buildings, is among the most important steps taken by the country with respect to the recognition of sustainable construction, seeking to promote the inclusion of sustainability criteria established by the National Council for Economic and Social Policy of Colombia (CONPES), in conjunction with the National Department of Population, which can only be carried out if there is joint cooperation from each of the parties that make up the value chain of the construction sector.

Conclusions

The data obtained from national, departmental or state and municipal surveys were classified, achieving the qualification and quantification of housing deficiencies in the municipalities of Pacho-Cundinamarca and Tlatlaya-State of Mexico. In this way, it was possible to identify the technical aspects, construction systems and materials of housing in accordance with the principles of sustainability, making it possible to establish or orient the design and construction process, seeking to ensure that the housing has a lower associated environmental impact and meets the needs of the population. Consequently, the importance of cultural factors and family traditions was recognized in the construction of new housing, taking into account sustainable aspects, since the purpose is that the inhabitants accept partial or total transformations of their homes.

Finally, it is necessary to emphasize that this research was able to obtain guides or manuals for sustainable housing, however, it is necessary to apply the principles of sustainability so that the houses are decent, habitable and safe, in addition to being sustainable by optimizing natural resources, and if these houses have everything necessary, their inhabitants would most likely stay in the countryside.

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