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Housing Evaluation Methodology in a Situation of Social Poverty to Guarantee Sustainable Cities: The Satisfaction Dimension for the Case of Mexico

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Abstract: Currently, one in eight people live in neighborhoods with social inequality and around one billion people live in precarious conditions. The significance of where and how to live and in what physical, spatial, social, and urban conditions has become very important for millions of families around the world because of mandatory confinement due to the COVID-19 pandemic. Today, many homes in poor condition do not meet the basic requirements for residential environments in the current framework. Theoretical models for the urban evaluation of this phenomenon are a necessary starting point for urban renewal and sustainability. This study aims to generate a model for evaluating homes in a situation of social inequality (hereinafter Vrs) with indicators on physical, spatial, environmental, and social aspects. The methodology used in this study evaluates housing, taking into consideration habitability factors (physical, spatial, and constructive characteristics), as well as the qualitative characteristics assessing the satisfaction of users with the adaptation and transformation of the housing and its surroundings. The application of 51 indicators distributed in four previous parameters was established for this study. This quantification identifies the deficiencies of the dwellings and sets the guidelines for the establishment of future rehabilitation policies for adapting the dwellings to current and emergency scenarios. The innovation of this study is the construction of a tool for social research surveys designed to include individual indicators from the dwellings' users, to provide a more dependable representation of the problems found in Vrs. The results of this research identified the deficiencies of precarious housing and could be used for applying effective proposals for improvement of habitability and their surroundings in the future. Furthermore, the results showed that when all the indicators were considered, the level of lag reached would be similar to that of a real housing situation, further confirming the suitability of the methodology applied in this investigation.

Keywords: city; indicators; social gap; urban regeneration; pandemic

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1. Introduction

One in eight people worldwide live in socially disadvantaged neighborhoods. This means that, in total, there are about one billion people living in substandard conditions [1], a situation which is expected to worsen in the future.

Between 2000 and 2014, developed countries saw a visible improvement in the situation of these neighborhoods and the urban population living in such situations decreased from 39 to 30%.

The Social Lag Index is a weighted measure that summarizes four indicators of social deprivation (education, health, basic services, and spaces in the home) in a single index

which aims to order the observation units according to social deprivation. Nowadays, social lag in housing continues to be a critical factor in the persistence of poverty [2]. In fact, 90% of urban growth occurs in developing countries where every year, urban areas gain 70 million new residents. Over the next two decades, the urban population of the two poorest regions in the world, South Asia and Africa, is expected to double, leading to an increase in the number of precarious settlements. In Africa, where 59% of the urban population lives in disadvantaged neighborhoods, the number of urban dwellers is expected to reach 1.2 billion by 2050 [1].

In Asia and the Pacific, this would affect around 28% of the population, despite successful efforts from Asian governments in recent years to improve the quality of life of the 172 million inhabitants of these neighborhoods [3,4]

In Latin America and the Caribbean, where regulations on Vrs improvement have long been in place, approximately 21% of the population still lives in these buildings, although this figure has dropped by 17% [5]. In Arab countries, these figures range from a minority to 67–94%, depending on the country.

In Europe, soaring housing costs in the richest major cities have led to an increase in the number of urban dwellers unable to afford rent. In fact, over 6% of the urban population in Western Europe lives in extremely precarious conditions [6]. At the same time, in the USA, housing precariousness can be observed among low-income inhabitants in rural settings [7].

One of the Millennium Development Goals for 2020 is to significantly improve the lives of at least 100 million slum-dwellers, ensuring access to basic housing and services for all by 2030.

Therefore, this study aims to create an evaluation model for socially disadvantaged homes, in order to analyze, evaluate, and propose improvements to ensure adequate housing habitability currently and in emergency scenarios. This could lead to the proposal of improvement solutions suiting the real needs of users. Following an in-depth study of the bibliography, the social parameters and indicators for housing satisfaction are identified and combined with other research indicators which could be generalized and replicated in other case studies. In addition, based on the results of this study, a data collection tool for social research on the occupants of the homes studied is designed to address the real needs of the users.

1.1. Socially Disadvantaged Homes

During the state of alarm caused by COVID-19, homes became a refuge from the pandemic, but they also became workspaces, places of leisure, games, etc. However, the lockdown experience has not been the same for everyone and has been greatly conditioned by the type of housing. The experiences of living in single-family or multi-family homes or in situations of social inequality are not comparable [8].

The importance of how and where to live and in what physical, spatial, social, and urban environment conditions has hugely increased for millions of families around the world following the compulsory lockdown enforced during the COVID-19 pandemic. Housing is one of the issues at the center of this battle, as social distancing and good hygiene practices cannot be guaranteed without suitable housing [9].

The social dimension and urban environment have been affected by overcrowded coexistence in Vrs. Increased stress levels were observed as the limited space available in the vast majority of these homes could not meet the needs of their inhabitants. This has also led to an increase in instances of violence against women, transmission of the disease due to having to live in close quarters, and psychological issues in children and adults stemming from the absence of well-lit green open spaces. This pandemic has highlighted the importance of social cohesion and urban development, and therefore the urban agenda should be placed at the center of public policies [10].

Worsening of quality of life and well-being in precarious housing during lockdown has prompted a search for urgent solutions, which have now been added to previous actions set out in international agendas, such as the Sustainable Development Goals for 2030.

For the sustainable development of cities, extensive research has been carried out by experts such as Mona Atia in Morocco [11], D. Rockwood [12] and Mª José Rúa [13] on the issue of action and rehabilitation processes in depressed urban environments experiencing social poverty. To carry out this task, the authorities and local communities in particular, play a key role in urban regeneration and planning human settlements, while the transformative power of urban policies and territorial planning tools for sustainable development is undeniable [14–16].

In Africa, programs have been set up in partnership with local communities to improve the population's living conditions, prioritizing rainwater and sanitation facilities in public spaces [1] In Australia, the New Office of Urbanization developed the country's first 2010–2030 urbanization policies to reduce urban poverty in unplanned settlements [17] In South America, governments are implementing programs for sustainable urban and rural development, such as the ICHP housing project and a water project [18].

In addition, according to the Diagnostic Study of the Right to Proper Housing in 2018 [19], in Mexico there are fourteen million homes in need of new construction or substantial improvement. This represents 45% of the overall housing stock, although, in rural areas, this figure can reach up to 97%.

At the urban level, socially disadvantaged areas are considered to be those occupied by groups of people in situations of marginalization and social exclusion, and the issues affecting them are rarely addressed in policies, especially in developing countries [20]. These settlements form as a result of internal migrations of population in search of better job opportunities brought about by the injection of foreign capital and the transition from agricultural to industrial and service economies [21]. Whereas habitability conditions should be tackled in order to improve living conditions in housing, ignoring social objectives and focusing on the development of cities could result in a negative cycle of imbalances within the structure of the city [12], to the detriment of the global objectives of achieving resilient cities.

Therefore, an urban study of social lag is important for policy formulation, especially as few studies have attempted in-depth examinations of this issue using real data in situ, as highlighted by Sebastián Galiania [22]. Different governments have selected a range of approaches for the improvement of the quality of life of the occupants of these neighborhoods. One example of this was the proposed relocation of these neighborhoods to other places in the 1970s, usually to cheaper land where homes could be rebuilt [23]. However, in the 1980s, programs emerged which were based on a series of policies for the improvement of urban infrastructure and services. The current situation is the direct result of these initiatives for improvement.

At present, theoretical models are a necessary starting point for assessing the habitability of homes on an international scale. However, attempts to implement this practice in real cases in a given physical and socioeconomic context could lead to different housing models, considered unsuitable for the case study [13].

An example of this can be found in the Right to Housing Plan, drawn up to relieve pressure on the housing situation in Barcelona. Taking into consideration access to urban resources and equipment services, this plan aimed to reverse inequality by improving habitability conditions in the housing and its surroundings [24]. Certain proposals presented aimed to expand the housing stock in order to reduce real estate speculation, while others focused on Spanish and European policies for urban regeneration and rehabilitation of these neighborhoods, restoring their importance within the city. However, since these neighborhoods were in central areas, the housing fell prey to speculators [25].

Given the worsening quality of housing, poverty, and unemployment conditions in the Netherlands and Great Britain, housing diversification plans have tended to recommend demolishing, selling, or updating these dwellings. In this case, the main objective was not

just to improve housing but, more so, to improve the economies of cities to the advantage of urban areas in the regional housing market [26].

The habitability of housing, which inherently conditions the well-being of individuals and their environment, is essential for ensuring sustainable global development [27]. Habitability and quality of life are conditions determined by the psychosocial profile of individual families, and are seen as habits, behaviors, and ways of being consolidated over time. Quality of life in their homes is an influential factor in the way of life of its residents, covering specific characteristics to meet their needs, while also providing some degree of satisfaction.

As described above, although the issue of habitability is global, its intensity is determined by the particular economic and social characteristics of individual regions. This is the case in Mexico, where the situation has worsened, especially in city centers. At present, housing in Mexico is an urban problem stemming from the housing policies put in place to guarantee families access to this constitutional right [28]. Marginalized sectors of the population outside the economic structure of the industrial city and the lack of purchasing power have prevented the population from accessing decent housing. According to calculations made in recent years, one million homes in Mexico need retrofitting or adaptation. In addition, 220,000 new homes must be built every year in order to cope with population growth. Since the 1950s, the population of Mexico City has increased from 3.4 to 21.3 million inhabitants and the city is expected to be one of the top ten in the world population growth ranking for the year 2035, as seen in Figure 1 [29].

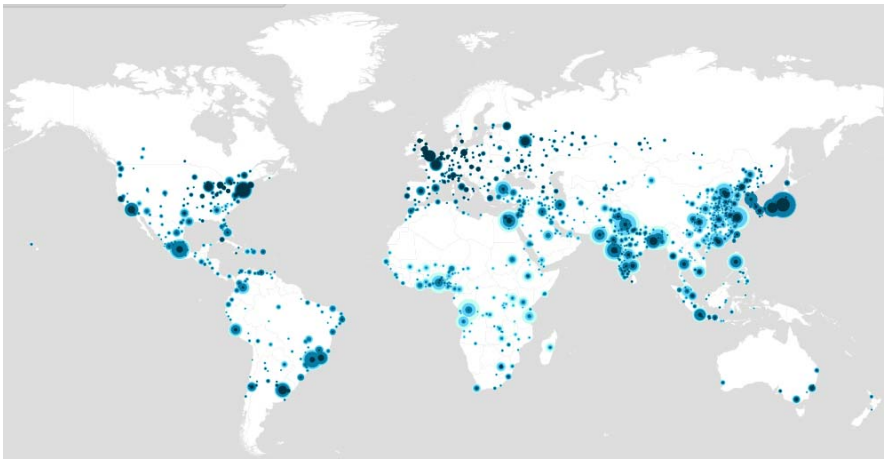

Figure 1. World city populations 1950–2035. Dark Blue (current population), light blue (future population). © Colaboradores de OpenStreetMap.

1.2. Urban Sustainability Indicators

Given the large number of factors to be considered and correlated in the growth of cities, the assessment process for this situation is complex. It requires the use of indicators, which are tools that provide concise information through the description and analysis of complex situations [13]. The task of establishing a list of suitable indicators is challenging, as these are becoming increasingly important tools for drawing up policies on management performance in key problems for contemporary cities [30].

The indicators, i.e., parameters that provide information or a value derived from them, describe the status of a given phenomenon [31], summarize a situation, and are developed for specific objectives. When applied in cities, they make it possible to evaluate certain processes or aspects of a reality geared toward previously defined objectives, identifying improvements, changes, etc. [13,32].

Among the current wide range of indicators for different purposes, we find the BUES comprehensive evaluation model which uses multidisciplinary indicators on physical, urban, environmental, and social conditions to formulate policies on vulnerable housing [33].

Other indicators are used in the evaluation of the vulnerability of an urban environment to climate change [34,35] the energy reconditioning of social housing [36,37] and housing spaces and their construction materials [38]. Therefore, given the multiple scientific, political, and social fields involved, establishing a methodology to standardize the indicators is a complex task.

Most studies have reviewed indicators suited to the case study for existing sustainable development, ascertaining which indicators are most appropriate with the help of experts in the field [13,39].

These indicators, which are influenced by the scale and unique features of an urban study environment [40,41] are of importance in renewal policies. According to the studies by Marta Braulio et al. [42], these indicators vary from one region to another and must be suited to the specific conditions of the context of the study region if they are to be used as tools.

At present, these indicators are of importance in decision making on renewal policies in European countries. This is the case of the Sustainable Growth Operational Programs (2014–2020) for smart, sustainable, and inclusive growth and the 2018–2021 Housing Plan, which reinforce the Spanish Ministry of Development's commitment to rehabilitation and energy efficiency. For example, in social housing, dating from 1939 to 1979 in Zaragoza (Spain), physical performance indicators were developed in collaboration with the local administration at the neighborhood and district levels. This made it possible to identify the buildings with the worst performance in energy efficiency, sound insulation, accessibility, etc., with a view to retrofitting [43].

In Barcelona, these indicators are geared toward the retrofitting of homes for energy savings [44]. This is also the case in Malaga, where Spanish and European policies for urban regeneration and rehabilitation of neighborhoods have been implemented, as seen in the case studies of the areas of Trinidad and Perchel between 2005 and 2012 [25]. The approval of the General Plan of Urban Planning for Malaga jeopardized the traditional neighborhoods, which were targeted by major speculative interests, prompting mass protests from city residents.

Other international regeneration plans for homes and neighborhoods, including that for the new Urban Habitat Agenda III (NAU) in Quito in Ecuador, address the issue of human settlements [45]. In Colombia, for instance, a subsidy was awarded for 100,000 homes [46] under the national development plan (2014–2018) aimed at the population in extreme poverty.

Despite all of these policies, the participation of administrations, and intervention programs for social housing, it has not yet been possible to halt the development of informal housing built by the population in extreme poverty. These studies clearly highlight why public policies should focus on solving the needs studied by an evaluation tool. Target users must be willing to embrace the improvement solutions if these are to succeed. If attention is paid only to the development of cities, but neglecting social objectives, the structure of these cities is subjected to a negative cycle of imbalances to the detriment of the global goals of achieving resilient cities. This research develops a tool which incorporates the indicators to be used, following an in-depth selection process from those internationally available and combined with those obtained from in situ fieldwork on Vrs.

2. Material and Methods

The evaluation methodology in this study focused on housing, taking into consideration habitability factors (physical, spatial, and constructive characteristics), as well as on the qualitative characteristics assessing user satisfaction regarding the adaptation and transformation of housing and its surroundings. The following five phases in the evaluation model meet the lower-level objectives established hierarchically in order to guarantee the main objective, as seen in Figure 2:

- The first phase is based on a review of international, national, and local scientific studies on the use of indicators for detecting and analyzing dwellings in situations of social lag.
- The second phase describes the study area and sample size in order to define appropriate indicators, based on the analysis in areas of social inequality.
- In the third phase, the hierarchy matrix of indicators applicable to the Vrs is generated through fieldwork in the social context of the sample determined in the previous phase, with social, physical-spatial, and surrounding indicators from relevant international and national bibliographical and institutional sources [5,19,47–49]. The indicators of physical-spatial characteristics of the homes and the urban context of the neighborhood and social considerations of the users are all used as a starting point for the development of the data collection tool. Qgis software version 3.6.2 is used to display the results obtained by territory.
- The fourth phase uses the database obtained to evaluate and quantify user satisfaction for the social, physical-spatial, and housing environmental indicators. This makes it possible to establish a habitability scale, as well as guidelines for rehabilitation and urban regeneration. For the purposes of comparing results, the level of social lag is represented in five strata (very low, low, medium, high, and very high), determined through statistical sampling using computer programs such as Statistical Package for the social Sciences SPSS (IBM) and statistics for excel XLSTAT.
- Finally, in the fifth phase, these statistical data are used to formulate the evaluation model, containing all the indicators to be considered, including the results obtained from the research. The evaluation model is validated in a real case in a situation of social inequality in Mexico. Recommendations and actions are proposed for the reduction of social lag based on the results obtained.

The methodology is described in the subsections below.

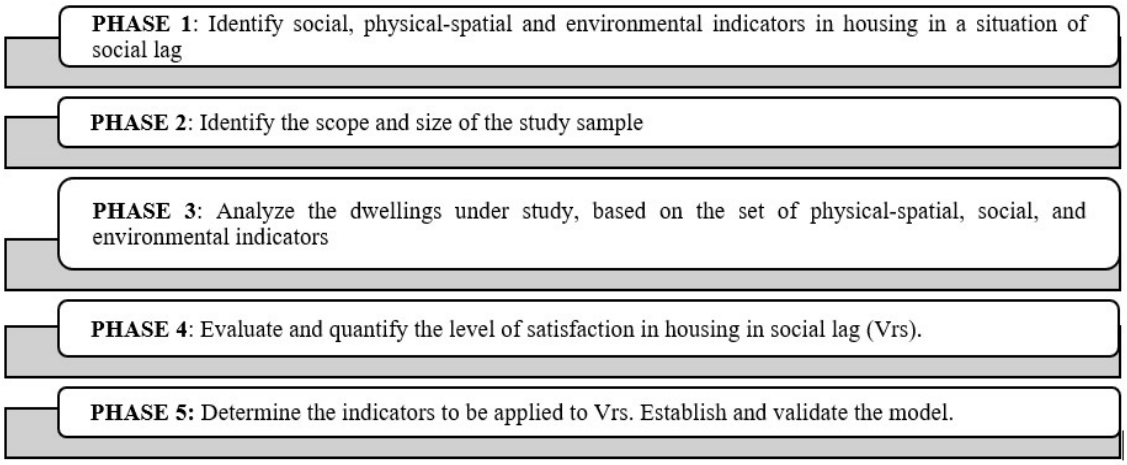

Figure 2. The process for developing a set of urban sustainability indicators. Source, author.

2.1. Phase 1: Identifying Social, Physical-Spatial, and Urban Environment Indicators for Housing Satisfaction

In this phase of the methodology, the satisfaction parameters and indicators for housing are determined based on the social, physical, spatial, and inter-urban aspects. These are obtained from the analysis of bibliographical sources, from the ethnographic analysis carried out on the housing occupants, and from the research contrasting the previous points, for which a number of steps is necessary, see Figure 3.

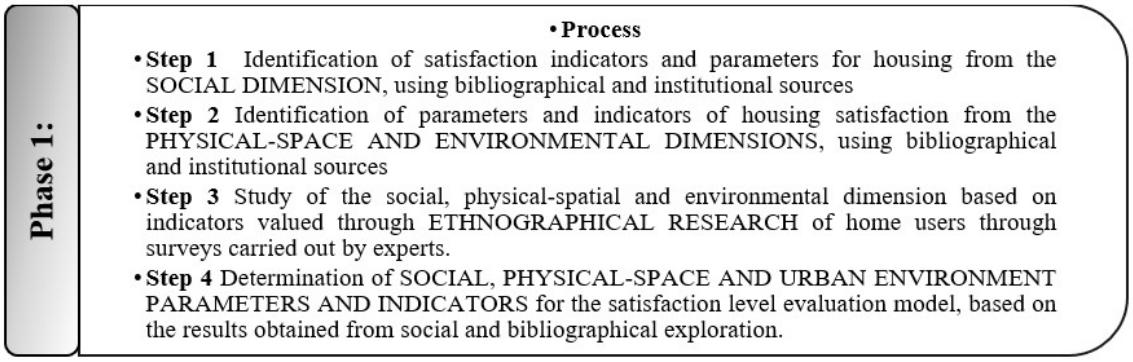

Figure 3. Detailed steps of Phase 1 of the process in order to obtain a list of indicators for housing satisfaction. Source, author.

Similar studies selected in the analysis of indicators from other bibliographical sources have considered social, physical-spatial, and environmental aspects. For the social dimension, academic models have been used in the evaluation of residential habitats, notably the indicators for social diagnosis by Maite Muñoz [50], the quality of life in the home [47,51,52], the social lag indices of the National Council for Social Development Policy Evaluation [19] and its social measurement dimensions [53].

In addition, parameters and indicators of the social dimension have been identified using international institutional sources including: Sustainable development of communities: Indicators for city services and quality of life [48]; UN-HABITAT indicators [54]; indicators for social diagnosis [50]; the index of quality of life in housing by María Salas [55]; and study dimensions for precarious housing [5]. The social, physical, spatial, and urban environment indicators were all identified based on the studies and bibliographical models analyzed (see Appendix A. The frequency, the number of times in which the study models were repeated, and their link with the Vrs were established. An ethnographic analysis was carried out to identify the indicators best suited to the different case studies. A questionnaire was drawn up with the indicators identified, as well as their frequency and relation to the Vrs in all three aspects studied, i.e., physical-spatial, social, and urban environment (see Appendix B). Finally, any indicators considered to be important by over 50% of the sample were selected and included in the final survey tool to assess satisfaction in Vrs. In the same questionnaire, users were asked questions for each dimension about which aspect would improve their satisfaction and well-being in housing. Any results of this social exploration that exceeded 60% of the answers were included as new indicators for this tool to assess the level of social lag.

The indicators of the physical, spatial, and urban environment dimensions were rated following a trichotomic scale, that is, with "1", "2", and "3" responses representing highly deficient, deficient, and adequate levels, respectively. The assessment of the social dimension followed a dichotomous scale, with "yes" or "no" answers, justified in the analysis of other studies [5,47,48,50]. In this case, the aim was to detect the shortcomings of housing in order to include them as indicators; therefore, the response scale was not decisive, as shown in Table 1.

Where n, n1, and ni, are the number of dwellings in the sample. R is the response of home users in the ethnographic analysis.

This phase of the methodology was completed with the social, physical-spatial, and urban environment parameters of the model evaluating the level of social lag, based on the results obtained from social research, satisfaction level, and adaptation of the existing bibliographical sources (Table 2).

Table 1. Questionnaire scheme of indicators applicable to Vrs.

Space Dimension Indicators					
	n	n1	Ni		Assessment
Bedroom					
Ventilation-window				1	Very lacking
Solar Lighting				2	Deficient
Space				3	Suitable
Kitchen					
Garage					
Garden					
Which aspects of your home's structure, spaces, and equipment do you think would improve the well-being of family members? Consider as indicator if R $\geq$ 60%					
Physical Dimension Indicators					
	n	n1	Ni		Assessment
Sanitary Sewerage					
Electricity				1	Very lacking
Water				2	Deficient
Gas				3	Suitable
Wall finish					
Floor finish					
Roof finish					
Which aspects of your home's facilities do you think would improve family well-being? Consider as indicator if R $\geq$ 60%					
Urban Environment Indicators					
	n	n1	Ni		Assessment
Urban lighting					
Bench				1	Very lacking
School				2	Deficient
Primary school				3	Suitable
Medical Care					
Market					
Commercial area					
Children´s park, sports tracks					
Which facilities in the neighborhood do you think would improve your family's satisfaction and well-being? Consider as indicator if R $\geq$ 60%					
Social Dimension Indicators					
	n	n1	Ni		Assessment
Participation in social movements					
Participation in community support crews				1	YES
Access to educational networks for children and/or adults				2	NO
Access to public transport					
Security, relationships (perception of the neighborhood)					
Security, relationships (perception of the neighborhood)					
Your children go to school in the neighborhood					
There is a health center nearby					
You have access to gardens, courts, or other spaces					
You feel settled in your neighborhood					
You feel you belong in the neighborhood					
You identify with the neighborhood					
Which aspects of the neighborhood do you think would improve your family's satisfaction and well-being in terms of equipment? Consider as indicator if R $\geq$ 60%					

Table 2. Evaluation model: System of parameters and indicators for the evaluation of satisfaction in Vrs. Source, author.

Dimension	Parameters	Indicators	Indicator Code
Social	Access to urban resources	Access to community health services	3
		Access to education (schools)	5
		Access to public transport	8
		Access to recreation and recreation spaces	101
	Social cohesion	Security, perception in the neighborhood	0
		Access to educational networks for children and adults	10
		Neighborhood organization and participation	11
	Households	Others in the home	24
		Separate animal-human environments	26
		More than 2 occupants per room	83
	Legal	Land ownership	4
Physical	Infrastructure	Other means of drinking water supply	0
		Sanitary drainage connection to municipal network	1
		Connection to municipal drinking water network	5
		Mains connection	32
	Furniture and Facilities	Bathroom inside the house	0
		Laundry facilities in yard	0
		Access to gas for cooking	103
		Use of water and electricity saver system	0
		Use of water heater	0
		Drinking water container	0
		Bathroom with shower	0
		Indoor toilet	0
		Kitchen sink	0
		Suitable doors	0
		Suitable windows	0
	Housing envelope	Fourth extra bedroom	0
		Wall finish	0
		Floor finish	0
		Roof finish	0
Spatial	Inside	Sunlight through the window	0
		Dining space	0
		Living space	135
		Window ventilation inside the house	169
		Separate spaces between bedrooms	195
	Outside	Space for extension	45
		Pedestrian access to the home	145
		Garden area in the home	0
Urban Environment	Equipment	Playground in the neighborhood	0
		Community medical care	0
		Paved roads	60
		Elementary school	67
		Commercial area	68
		Church	70
		Bank	114
		Areas for neighborhood sports	151
		Green spaces in the neighborhood	159
	Services	Street lighting	64
		Guardhouse	65
		Waste collection	66
		Nearby transport	72

The evaluation model obtained was composed of 51 indicators structured into four dimensions: social (11 indicators), physical (19 indicators), spatial (8 indicators), and urban

environment (13 indicators). The key innovation of this phase of the methodology was the introduction of indicators proposed by technicians who knew the area under study and the home occupants themselves.

The numbering in the "indicator code" column corresponds to the numbering that appears in the general list from the study of the existing literature (see Appendix A) while "0" corresponds to the indicators proposed by the research. Indicators shaded in gray were obtained from social research.

2.2. Phase 2: Identification of the Scope of Study and Scale of the Study Sample

An area with a high Vrs index where major population growth is expected was selected in order to establish the scope of the study and scale of the sample. This step increases the global impact of the application of the Vrs evaluation model proposed. The level of social lag in the field of study, and the physical environment and surroundings, should be considered in order to base the study on logical processes and on-site data collection of the actual case study, outlining a specific area (Figure 4).

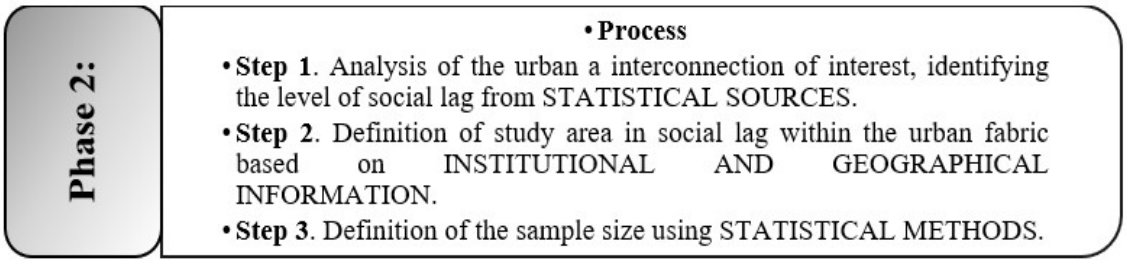

Figure 4. Detailed steps of Phase 2: Determination of the scope of study and scale of the study sample. Source, author.

The use of qualitative mixed method, in this case, provides richer and more varied results thanks to more dynamic inquiries, physical-spatial, and social issues. This, in turn, ensures more reliable results from the data research, by integrating qualitative and quantitative data based on collection, analysis, and integration. According to Sampieri [56], one of the reasons for using mixed methods (qualitative and quantitative) is that the weaknesses of either method is counteracted, and their individual strengths are reinforced. Taking the aforementioned into consideration and following J. C. López Alvarenga [57], the following calculation formula was used to determine the sample size from the population size (Formula (1)):

Formula (1) is the sample calculation formula based on population as follows:

$$n = \frac{Z^2 \times P(1 - P)}{e^2} / 1 + \frac{Z^2 \times P(1 - P)}{e^2 \times N} \quad (1)$$

where n is the sample size, Z is the confidence level value, N is the population size, e is the margin of error, and P is the percentage of the population with the study characteristic. The result of n must have a level of confidence of 90% with an error of ±10%, for the qualitative questions of the study based on surveys.

As this study aims to analyze dwellings within a specific area, with a finite population known to expert technicians, the sampling technique used was discretionary rather than probabilistic. The selection was determined by the physical and spatial characteristics of the housing studied and its occupants, allowing the habitability conditions and the perception of the immediate environment to be established. Study subjects were selected by the technicians after the relevant on-site examinations. It did not matter if the final sample was small, as long as the characteristics mentioned above were highly variable. The study sample was, then, determined and verified through application to the case study.

2.3. Phase 3: Analysis of the Housing Studied, Based on the Set of Physical-Spatial, Social, and Environmental Indicators

At this phase (Figure 5), the conditions of the dwellings under study (social, space, physical, and urban environment) were initially analyzed through in situ data collection.

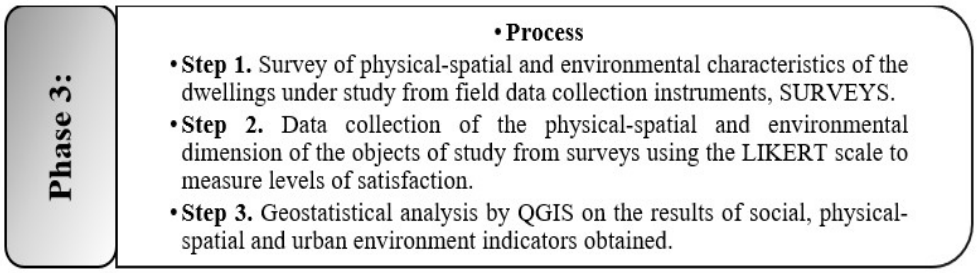

Figure 5. Detailed steps of Phase 3: Analysis of the housing studied, based on the set of physical-spatial, social, and environmental indicators. Source, author.

The survey of physical-spatial and environmental characteristics of the dwellings was carried out using field data collection instruments (see Appendix C), i.e., files designed for this purpose containing the graphic information, construction elements, and materials and distribution of spaces of each dwelling.

At this phase, a survey model was also designed which included the system of parameters and indicators detailed in Phase 1 (Table 2) and allowed the level of satisfaction in the Vrs of the defined sample to be assessed (see Appendix D). The Likert psychometric scale (system of indicators used in questionnaires for research to evaluate the opinions and attitudes of a person, measuring the level of agreement or disagreement of the respondent) was chosen in order to obtain information which statistically showed a mean or average trend. This scale was considered to be suitable for measuring the degree of satisfaction of the users of the socially disadvantaged homes studied, establishing the validity and confidence of the results obtained for the spatial, physical and urban environment dimension. This follows the methodology used in another study [58] which recommended an evaluation system with five response categories, i.e., totally unnecessary, somewhat necessary, moderately necessary, necessary, and very necessary.

For the social dimension, the two response categories established were YES and NO. The results obtained were used to identify the indicators with the highest level of need among the population. Then, the group of indicators most often with the highest need was statistically analyzed for each dimension, which translated into the requirement to satisfy existing needs.

The results of individual sample units were synthesized in georeferenced graphics using the QGIS version 3.6.2 program (Figure 6).

The indicators of the satisfaction evaluation system for the Vrs must be linked to the existing support policies of the study area. Although this relationship with existing policies is not binding, as regards the possible results obtained, it does suggest a correlation between the indicator and the aid model and recommends the most appropriate support policy, depending on the indicators most in need. This is important, as one of the biggest problems in the Vrs is the owners' lack of knowledge of support programs for the improvement of their homes.

2.4. Phase 4: Evaluation and Quantification of the Level of Satisfaction in Housing in Social Lag

At this point, based on the information obtained from the previous phase, the attributes of the indicator system were mathematically weighted to quantify and evaluate the level of satisfaction in the Vrs. Once the users of the homes rated these and the level of satisfaction of the different dimensions was established through the Likert survey, the data obtained were treated statistically through a numerical stratification of values and satisfaction levels. The steps of Phase 4 are shown in Figure 7.

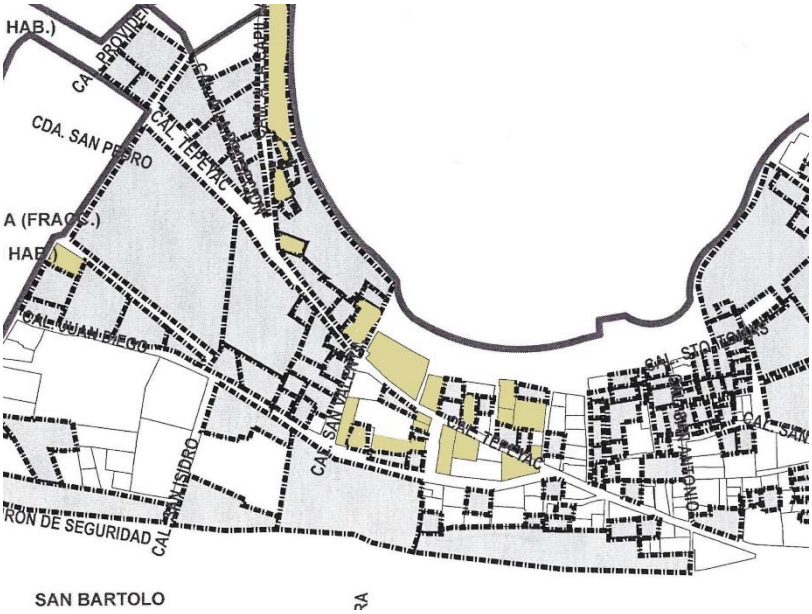

Figure 6. Georeferenced maps of the sample. QGIS version 3.6.2. Source: author.

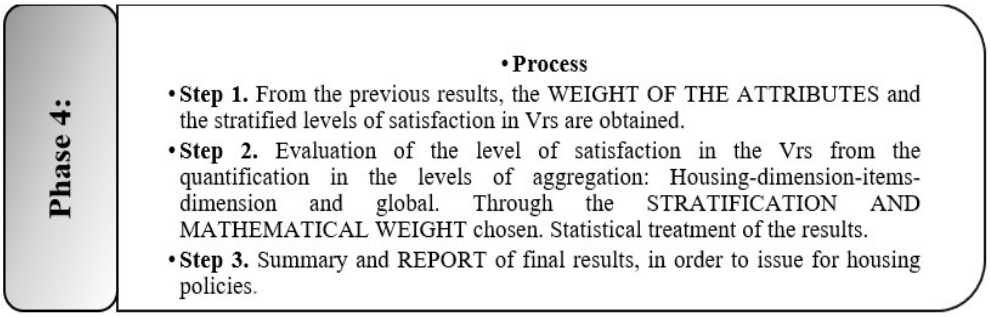

Figure 7. Detailed steps of Phase 4: Evaluation and quantification of the level of satisfaction in housing in social lag. Source: author.

The weight of the attributes and the stratified levels of satisfaction were determined mathematically based on the results of the previous evaluation of the characteristics relating to the physical-spatial, social, and urban environment dimensions treated with the Likert scale method in socially disadvantaged housing.

To do so, the results obtained were homogenized to consider the attributes of the indicators. In this case, a value was assigned to the data generated by transforming and combining these attributes to create a set of results. Then, a weight was assigned to the indicators, from 0 to 1, with each of them contributing a value to individual components or dimensions. These results were assessed on a scale from 1 to 5 by the user, the occupant of the dwelling, who determined the level of needs to be satisfied in ascending order (see Appendix F). The level of need ranged from Number 1, determining the lowest level of need, considered unnecessary to Number 5, assigned to analyzed indicators which were considered very necessary. Each level of satisfaction was weighted based on a mathematical equation determined by experts in the field from the University of Seville. This mathematical technique uses absolute frequencies to determine an expected value that goes from 0 to 1, and therefore the previous satisfaction scale between 1 and 5 represented 100% of the total dimension.

Cronbach's alpha method was used [59] to validate this psychometric scale tool (Likert scale), in order to measure the correlation between the items. It was assumed that they measured the same variable and were highly correlated, and the approximate result of 0.8–1 was considered to be highly acceptable based on the results of other studies by S.

Welch [60], J.A. Gliem [61], Victor Corral-Verdugo et al. [62]. The software used was IBM Statistical Package for the Social Sciences (SPSS).

Formula (2) for Cronbach's alpha procedure to obtain the results from the correlations between the items:

$$\alpha = \left[\frac{k}{k-1}\right]\left[1 - \sum_{i=1}^{k} \frac{S^2 i}{S_t^2}\right] \quad (2)$$

where S^2 is the variance of the item or indicator, S_t^2 is the variance of the total values observed, and K is the number of questions or items.

Once the tool was validated, a data distribution normality test was carried out using XLSTAT software for the purpose of making comparisons, including data distribution (median, average, maximum, and minimum).

These methodologies aim to obtain a score of the valuations from the data collected in the field using the Likert scale surveys. These indicators must be weighted by assigning a specific value matching the importance of the characteristic being measured in order to quantify and evaluate the characteristics and dimensions of the sample units.

For this, the five levels of satisfaction initially measured on the Likert scale represented a quantitative ratio number, obtained through Formulas (3) and (4). Then, a specific value (between 0 and 1) was established, with 1 indicating a higher level of dissatisfaction. As Table 3 shows, the degree of satisfaction by dwelling (vertical reading) and by indicator (horizontal reading) could be obtained for all dwellings analyzed.

Table 3. Summary of previous results of dimensions on evaluation of housing satisfaction in social lag and its symbols. 1, Unnecessary (very satisfied); 2, somewhat necessary (satisfied); 3, medium (moderately satisfied); 4, necessary (dissatisfied); 5, very necessary (completely dissatisfied).

Indicators by Dimension	Space Characteristics															
	N	**n1**	**n2**	**Ni**												
					Previous Results											
A	3	3		4	2	5	3	1	1	5	5	1	3	5	5	
B	3															IAi
C	5				Item-dimension											
D	5															IBi
E	5															
F	1															
G	1															
I	4				Item-dimension											
	Ivn	Ivn1	Ivn2	Ivni												Σ global

This formula must be weighted by function (attributed to the user), as the weights and values were variable, guaranteeing that the data obtained from the in situ measurements depended directly on the results of the dwelling occupants, and not on the researcher, as recommended by J. L. P. Gómez [63].

Thus, help was sought from experts from the field of mathematics and statistics in the Faculty of Mathematics of the University of Seville [64] to create a weighting formula for a new approach to the weighting strategies known to date.

Formulas (3) and (4), weighting for the level of satisfaction in socially disadvantaged housing were as follows:

$$\text{Iv} = \frac{\sum v.o - n.c}{n.c\,(L) - n.c} \quad (3)$$

where Iv is the index for housing, $n.c$ is the number of indicators in the column, L is the upper limit of the assessment, and $v.o$ is the levels observed.

$$\text{Ii} = \frac{\sum v.o - n.i}{n.i\,(L) - n.i} \quad (4)$$

where Iv is the index by item, *n.i* is the number of indicators in the row, *L* is the upper limit of the valuation in the row, and *v.o* is the levels observed (refers to the sum of the levels in the row in this case).

The data for the values of the degree of satisfaction per item per dimension and per housing dimension were defined by applying these formulas. An average value was established for both dimensions, determining the value of the dimension studied $(\sum global)$.

Considering the items for the set of dwellings studied, in order to calculate the degree of satisfaction for each of the dimensions, the results were treated and sorted in ascending order (from lowest to highest) on an Excel sheet in order to calculate the amplitude (A) of the statistical dataset (the amplitude calculates the difference between the highest and lowest value scores). This value was added to the minimum value and these data were considered the first level of satisfaction. Then, this procedure was repeated with the remaining values until the existing upper limit of the group, as shown in Table 4, was reached. Stratum 1 indicates maximum satisfaction while Stratum 5 represents the level of minimum satisfaction.

Table 4. Degree of satisfaction sorted in ascending order and stratification by levels according to dimension.

Dwelling	Observations from Lowest to Highest	Stratum	Stratification by Dimension			
			A	(Ivni − Ivn)	Stratum	Satisfaction Level
Av	Ivn	1	Ivn	M = Ivn + (Ivni − Ivn)	1	Very satisfied
Bv	Ivn1	2	M	N = M + (Ivni − Ivn)	2	Satisfied
Cv	Ivn2	3	N	O = N + (Ivni − Ivn)	3	Moderately satisfied
Dv	Ivn3	4	O	P = O + (Ivni − Ivn)	4	Dissatisfied
Xvi	Ivni	5	P	Ivni	5	Very dissatisfied

Where (Av, Xi) is study dwellings, Ivn is the minimum value of observations, and eIvni is the maximum value of observations Ivni.

The left hand table shows the number of dwellings and satisfaction data for housing and stratum. The right hand table shows the calculation of the amplitude and level of satisfaction by stratification and dimension.

Phase 4 of this investigation concluded by establishing the degree of satisfaction for each indicator in each dimension and global dimension.

2.5. Phase 5: Determination of the Indicators Applicable to Vrs. Establishment and Validation of the Model

Finally, the model was applied to a real case in order to validate this tool for the evaluation of housing in social inequality, as a strategy for urban renewal and regeneration (Figure 8).

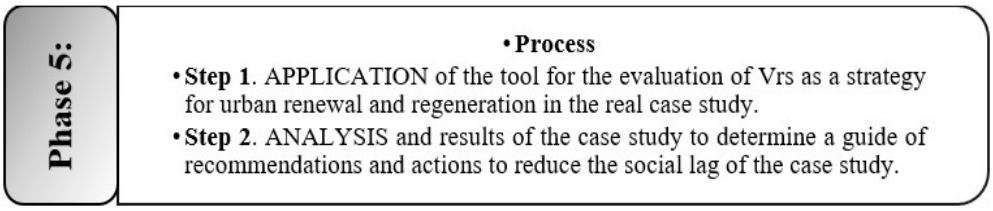

Figure 8. Detailed steps of Phase 5. Determination of the indicators applicable to Vrs. Source, author.

This study focused on Mexico, where currently more than half of the housing stock needs improvement and almost 47% of homes are in situations of social inequality. Because it is also one of the cities with the highest population growth predictions, the model for assessing socially disadvantaged housing is expected to have a greater impact on a global scale.

The analysis of social lag in the Mexican Republic at the national, state, and local levels showed that Mexico City, Hidalgo, and Pachuca de Soto displayed the highest levels of social lag. The level of social lag for each of the thirty-two federal entities within Mexico is shown in Figure 9.

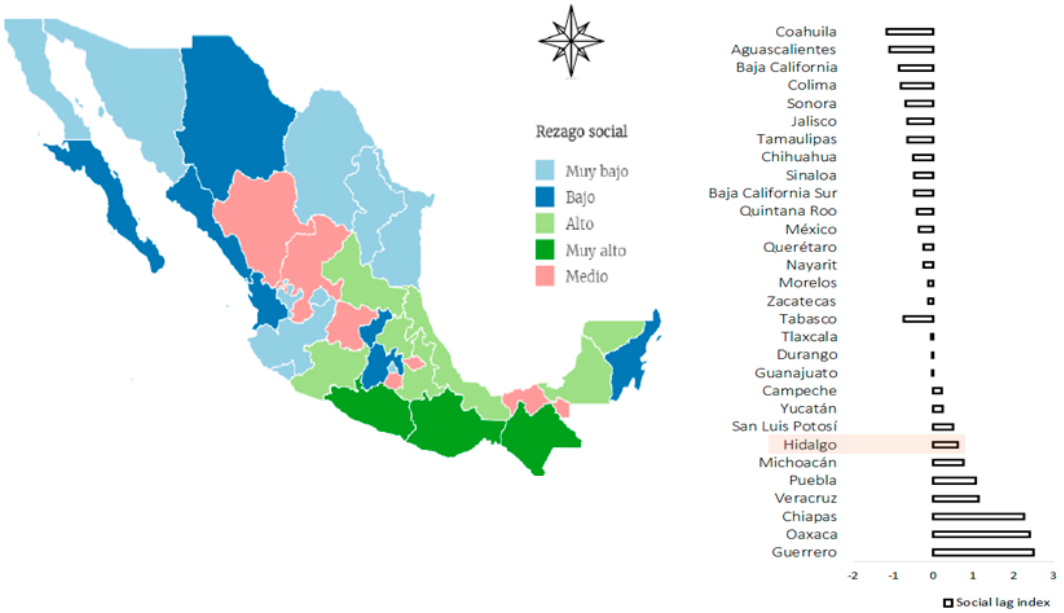

Figure 9. Left: Social lag by federal entity in the Mexican Republic, in 5 levels of stratification, i.e., very low, low, medium, high, and very high; Right: social lag indices of the federal entities of the Mexican Republic. Red (Hidalgo). Source, author.

As can be seen in Figure 9, in terms of the level of social lag, the State of Hidalgo is seventh among the thirty-two states that make up the Mexican Republic. According to the National Institute of Statistics, Geography, and Informatics [49] it has one of the highest levels of social lag, despite a decrease in recent years. The municipal government is in charge of managing the state, made up of 84 municipalities including the capital city, Pachuca de Soto, which has areas of social inequality in the periphery and where an area has been outlined for the application of the study methodology. Of the 84 municipalities in the State of Hidalgo, 12. municipalities display a very low level of social lag, followed by 31 municipalities with a low level, 25 municipalities with a medium level, and 16 municipalities with a high level [49]. With almost 53 million poor people in the country, these levels are comparable to a European city like Barcelona.

The starting point for this research was the socially disadvantaged housing, which according to CONEVAL, was defined in areas based on the construction of a single index with 5 indicators, considering information on education, access to health services, quality of housing, basic services in housing, and household assets.

The study sample selected was the city of Pachuca, which has 277,325 inhabitants and is classed as an average city according to the national urban system. Currently, this is a physically fragmented city, with social disintegration due to migratory flows, and it absorbs the population of the federal capital. Pachuca is one of the territories most affected by the new socio-spatial dynamics, most notably the construction of extensive urban peripheries, hence, the interest in studying this geographical area. The study area within the city is an urban settlement with high levels of social inequality and eligible for subsidies. The Cruz del Cerrito neighborhood is one of the oldest in the urban peripheries of the City of Pachuca. It dates from approximately the 1950s, a time when Mexico was moving away from rural activity in favor of industrial activity in the city. An area of this population was outlined, considering the level of social lag, the physical environment, and surroundings, in order to carry out a study based on logical processes and data collection from the case study. A homogeneous sample with the same characteristics was selected from the field of study.

In order to ensure an accurate representation of this study, based on the previous formula (Formula (1)) the sample size (n) should be 21. With 21 dwellings, the level of confidence of the sample is 90% with an error of $\pm$10%. Finally, 23 dwellings were selected for this case study, representing 80% of the population. The study sample was characterized

as dwellings with deed-holding owners, since ownership is essential to ensuring eligibility for subsidies at local and national level.

Formula (1):

$$n = \frac{Z^2 \times P(1-P)}{e^2} / 1 + \frac{Z^2 \times P(1-P)}{e^2 \times N} \quad (5)$$

where Z is the confidence level value, in this case 90% = 1.65; N is the population size, in this case = 29; E is the margin of error, in this case 10%; and P is the percentage of the population with the applicable study characteristic, in this case 0.5 as constant.

The dwellings selected are domestic units occupied by one or several families, sometimes sharing a common access. These are small houses, built using precarious or recycled materials. Most are built of cement blocks covered with corrugated iron or fiber cement. The floors are also finished in cement, without any type of flooring and the metal windows are single glazed. Figure 10 shows the most representative housing examples within the study sample.

Figure 10. Examples of case studies. K (Kitchen), B (Bathroom), D (dining room), Bd (Bedroom).

3. Results

The results obtained from the analysis and evaluation of the study sample in the different phases of the methodology above are described in this section.

The results on social, physical-spatial, and environmental indicators were based on the ethnographic analysis (see Appendix E).

Figure 11 shows the results of the social research on the spatial dimension, providing trichotomic data on the needs of the users of the 23 dwellings. These results highlight users' needs for more space in their home, as many would like to have additional rooms for use as bedrooms. In addition, most of them would like more open space in their homes, which is very limited due to the spatial dimensions of the different areas in the dwellings.

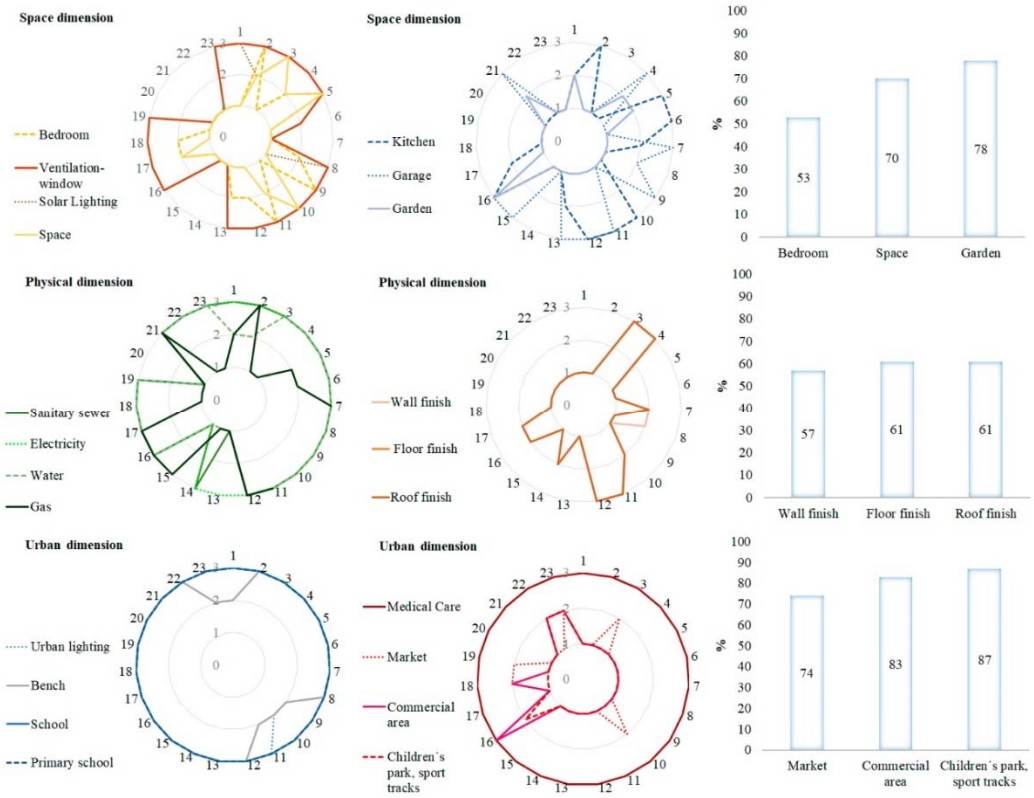

Figure 11. Results of the response of the users of the 23 dwellings studied with spatial, physical, and urban dimensions based on seven preliminary indicators, considering whether they perceive these as adequate (3), deficient (2), or highly deficient (1).

For the physical dimension, determined by seven indicators (sanitary sewerage, electricity, water, gas, and wall, floor and roof finishes), users would improve the finishes on walls, floors, and roofs. It was observed that housing users perceived greater deficiencies in finishes in cases where recycled materials had been used as protection; 61% of housing users felt the need for wall and floor finishes and 57% for wall cladding.

The results of the urban dimension were determined by eight indicators (urban lighting, bench, school, primary school, medical care, market, commercial area, and children´s park). In this case, users would improve recreational areas (87%), commercial areas (83%), and markets (74%).

Finally, Table 5 shows the results of social dimension indicators based on social research and considered the most deficient of the indicators stated.

Other social, physical-spatial, and urban environment indicators from bibliographical sources were added to these indicators. In order to simplify these, those with a greater weight in the valuation of housing were identified. The purpose of this was to choose the indicators relevant to the objective of the investigation. Finally, a model for assessing satisfaction for socially disadvantaged housing was designed (see Table 1).

The results of the main housing deficiencies were obtained from the physical survey of physical-spatial characteristics of the dwellings studied, with the tool described above.

As regards urban services, only 78% of the dwellings had access to piped drinking water, while the rest had a water tank close to the house. In addition, 52% of the dwellings had access to a gas supply and the rest used wood or coal. Furthermore, only 74% of the dwellings had access to urban sanitation, while the remaining 26% had no access at all.

Regarding the physical conditions of the partition elements, 87% of the dwellings were built with cement blocks, but only 23% were finished off, while 8% incorporated recycled materials in their walls.

Table 5. Indicators to incorporate for the evaluation of satisfaction in Vrs.

Dimension	Indicators of Social Research
Space	Bathroom with toilet Bathroom with bath Kitchen with sink Suitable doors and windows Garden area
Physical	Water heater Water tank Wall finish Floor finish Roof finish
Urban Environment	Commercial areas Recreation and leisure areas
Social Environment	Social participation, cohesion Transport

For the finishes of the dwelling floors, 26% had earth floors, 70% concrete, and 4% stone; 52% of the roofs were concrete, 39% sheet metal, and 11% recycled materials.

Next, we describe the results of evaluation and quantification of the level of satisfaction in socially disadvantaged housing.

The levels of housing-dimension aggregation were calculated, as were those on item dimension using the formulas from Phase 4 and the results obtained from the evaluation tool regarding the level of satisfaction in socially disadvantaged housing in the case study (see Appendix F).

The results of the evaluation of satisfaction of the different dimensions in the Vrs showed a dissatisfied (I) level of satisfaction for the spatial dimension, while the physical dimension and medium-sized urban environment were moderately satisfied (MS), and the social dimension was dissatisfied (I). The overall result was moderately satisfied (MS), as can be seen in Table 6a.

Table 6. Result of the dissatisfaction value for the item-by-dimension segregation level.

	Degree of Dissatisfaction	Weight	Final Value	Satisfaction Level			
a	**Lower Limit**	**Upper Limit**	**Value**	**Stratum**	**Importance**	**Final Value Weighted**	**Satisfaction Level**
Space dimension	0.25	0.97	0.69	4	0.3	0.207	I
Physical dimension	0.13	1.00	0.63	3	0.29	0.1827	MS
Urban environment dimension	0.25	0.63	0.43	3	0.2	0.086	MS
Social dimension	0	1.00	0.45	4	0.21	0.0945	I
			0.55			0.5702	MS
	Degree of Dissatisfaction	**Weight**	**Final Value**	**Satisfaction Level**			
b	**Lower Limit**	**Upper Limit**	**Value**	**Stratum**	**Importance**	**Final Value Weighted**	**Satisfaction Level**
Space dimension	0.35	1.00	0.64	3	0.34	0.2176	MS
Physical dimension	0.1	0.80	0.35	2	0.19	0.0665	I
Urban environment dimension	0.34	0.64	0.42	2	0.23	0.0966	I
Social dimension	0	0.51	0.51	3	0.24	0.1224	MS
			0.48			0.5	MS

The table shows the summary of results for the satisfaction evaluation of individual dimensions in the Vrs, as well as the weighted final value and the level of satisfaction in the two right hand columns.

The evaluation process was repeated using only indicators from bibliographical and institutional sources in order to compare the impact and contribution of this study to the methods traditionally used. The indicators obtained from the social research proposed in this study were excluded, and each dimension was evaluated again (Table 6b).

The comparison of results (Table 6) shows that the novelty of this study, as compared with earlier studies, is that it considers the particular situation of individual families. From the needs of the user in the first case, it is possible to observe a high level of social lag in social and spatial dimensions, while the level of satisfaction is moderately satisfied when considering only the state indicators. Despite the similar overall results, variations are observed among the data of the different dimensions. Thus, it is clear that social development programs at the federal, state, and municipal levels have carried out general analyses of the situation of socially disadvantaged housing, without delving further into the true needs of families, which can be identified following the methodology used in this research.

The importance of this study is that by including these new YES indicators, recommendations can be obtained to improve the satisfaction of the Vrs by study dimension. In turn, urban rehabilitation and regeneration policies designed are accepted by the user and alleviate the social lag (see Appendix G).

On the basis of the results, the programs defined are linked to the sample country and could meet the needs of the indicator guide, based on the results of the satisfaction assessment of Vrs.

Analysis of the programs of the sample country showed that these programs focus on the expansion and improvement of socially disadvantaged housing.

As these programs do not provide solutions for each indicator in deficit, it is necessary to follow procedures which sample users cannot carry out due to their lack of knowledge.

Furthermore, programs to improve the urban environment should clearly be carried out directly by the state or municipal government.

It was also observed that a person with the appropriate knowledge in this field was needed to explain to the users the necessary steps for achieving the objectives of housing improvement. The participation of other organizations and upper-secondary education was clearly needed with specialized social service actions to contribute to improving the conditions of habitability, health, and social integration and cohesion.

Thanks to the results obtained in all the phases of the methodology applied to the sample, it was possible to visualize the real physical and spatial conditions of the houses.

4. Conclusions and Discussion

One of the negative consequences for society worldwide, as a result of the current COVID-19 crisis, is that it has highlighted how its impact is greater in the more socially vulnerable and poorer neighborhoods of our cities. Overcrowding and increased stress during lockdowns, in spaces which are far from meeting the minimum habitability and hygiene conditions, have become a further concern to be added to the social dimension and the urban environment of these neighborhoods and the absence of public spaces or green areas for leisure. According to media reports, this has led to an increase in gender-based violence and has even affected mental health. This pandemic has emphasized the importance of social cohesion. Urban development and urban agendas should be at the center of public policies, taking into consideration the real needs of the user. Thus far, these have not been examined in similar studies, and therefore this research constitutes an innovation in the field of the creation and management of indicators for sustainable development of our cities. The quality of life and well-being in precarious housing has been greatly compromised by the lockdown situation during this global pandemic.

While international agendas have already warned of the need for urgent solutions within the 2030 sustainable development goals, it is now a pressing priority. This study provides a methodology which has proved its validity in a neighborhood in a precarious situation in Mexico, and which prior to the pandemic already had a high index (67%) of social vulnerability in housing. In fact, 67% of the almost 9.5 million Mexicans living in extreme poverty would represent 1.43 times more than the population of Madrid, Spain (6642.00 inhabitants).

Among endless potential solutions, this research has developed an alternative from observations of the needs and perceived deficits from the users of this type of housing. To the best of our knowledge, this has never before been taken into consideration with a response based on spatial needs and physical, social, and urban environments. This is combined with indicators identified through a painstaking analysis of national and international institutional and bibliographical sources linked to precarious housing. The ultimate goal is to provide the relevant guidelines for the reform of existing public policies with effective solutions to suit the real needs of the target users.

In this study, user satisfaction in socially disadvantaged housing was analyzed using indicators quantifying physical, spatial, environmental, and social aspects. Determining the shortcomings of this typology established a guide for urban rehabilitation and regeneration in the current situation and in emergency scenarios. The application of 51 indicators distributed in four previous parameters was established for this study.

The results of this study have identified the deficiencies of precarious housing in order to apply effective proposals to improve habitability and surroundings in the future.

One of the innovations of this study is the construction of a tool for social research surveys designed to include individual indicators from dwelling users, to provide a more dependable representation of the problems found in Vrs. One of the biggest contributions is social exploration based on the inclusion of the community, assessing the deficiencies in the characteristics of their own homes. Likewise, the evaluation of the level of satisfaction in socially disadvantaged housing, based on the evaluation by aggregation level, has allowed us to observe results both at the dimension level (spatial, physical, urban and social environments) and at the global level, as well as providing the satisfaction status of each dwelling by dimension.

This tool, built with the participation of a socially disadvantaged community and national-international global indicators, has the potential to analyze homes and user satisfaction anywhere. Likewise, the results of this study were compared with the results of the area studied by the CONEVAL evaluation commission of social development policies. In both cases, the results obtained indicated a degree of average satisfaction at the global level. At the same time, these results were compared with those which would be obtained if only the indicators specific to the local subsidies were applied. These results showed that, when all the indicators (bibliography, contributed by the technician and obtained from social research) were considered, the level of lag reached was similar to that of the real housing situation, further confirming the suitability of the methodology applied in this investigation.

However, a notable limitation of this study was the time needed to carry out the social research and the effort to explain the application of the surveys directly to the users, as continuous visits to the place of study were required.

The case study results highlighted the degree of dissatisfaction of socially disadvantaged housing for the different dimensions; the results showed a moderately dissatisfied value (high social lag) mainly in the spatial and physical dimension, followed by urban and social environments. These results are in keeping with the data obtained from the initial surveys where users reported green spaces as one of the most deficient aspects of their home environment, together with the relationship between spaces and their function within the dwelling.

This study concludes that the methodology, techniques, and procedures for evaluation, weighting, and valuation of indicators serve as an application guide for policies to rehabilitate precarious housing, both rural and urban.

This study serves as a basis for proposals for rehabilitation and improvement of social disadvantaged housing. It has considered a population that is living in and linked to the social fabric of a neighborhood, fully aware of their needs over time and with the same family development.

Socially lagging housing is a definition coined in housing policies in Mexico but also refers to precarious housing, which exists worldwide. The indicator guide can be applied anywhere in the world, not only in Mexico, based on the specific needs, customs, and culture of the place under study. There is a pressing need for policymakers to stop thinking collectively, that is, thinking that everyone requires the same solution either for political or financial convenience, as in the case of cities such as Malaga or Barcelona.

The study models reviewed in the state-of-the-art, authors, and procedures which have been widely referenced, are mostly weighted using multicriteria. This is based on the authors' own experiences, and the procedures correspond to techniques by agreement. It should be noted that the result may be affected by the arbitrary assignment of the importance values to the study dimensions.

The evaluation of satisfaction in housing in social lag has been linked to the level of well-being and quality of life. These criteria are based on Abraham Maslow's theory of motivation, presenting housing within the five levels to achieve self-realization. The state-of-the-art shows that some authors relate these three terms as if they were all the same, but satisfaction in this research refers specifically to habitability, to the housing envelope, and the relationship with its immediate environment, considering physical-spatial and social dimensions. While other studies analyze psychological aspects, which are valid of course, architecture itself deals with the psychological impact stemming from elements such as texture or color.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. All participants, were previously informed.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data are not publicly available due to ethical reasons.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Indicators Linked to Evaluation Methodologies of Previous Studies. Indicators of Social, Physical, Spatial and Urban Environment Dimension

MODELS OF EVALUATION OF PRIOR INVESTIGATIONS SOCIAL DIMENSION

- Mod. 1 Academic model for the evaluation of residential habitat. Falabella
- Mod. 2 Indicators for social diagnosis. MM Muñoz
- Mod. 3 Quality of life in rural housing. Sánchez y Jiménez
- Mod. 4 Measurement of social habitat in Mexico. Hernández y Velásquez
- Mod. 5 Residential Satisfaction Index of S.H.F. Y CIDOC.
- Mod. 6 Quality of life index linked to housing. (ICVV)
- Mod. 7 Social Lag Index. CONEVAL
- Mod. 8 Quality of life in the city ISO 37120
- Mod. 9 Post occupancy evaluación (POE)
- Mod. 10 UN-HÁBITAT (GUO) Indicator
- Mod. 11 Study dimensions for precarious housing UN-HÁBITAT GLOBAL III

Orange shading shows indicators more frequently or that have a relationship with some other indicator

Table A1. Indicators of the social dimension.

	INDICATORS OF THE SOCIAL DIMENSION	Mod.1	Mod.2	Mod.3	Mod.4	Mod.5	Mod.6	Mod.7	Mod.8	Mod.9	Mod.10	Mod.11
1	Access to housing											
2	Access to employment											
3	Access to health service											
4	Land tenure											
5	Access to education											
6	Pride of belonged to the neighbourhood											
7	Outdoor activities											
8	Access to public transport											
9	Obtaining own achievements											
10	Educational networks											
11	Neighbourhood Organizations											
12	Social movements											
13	Religious											
14	Professional organizations											
15	Non-governmental organizations											
16	Policies											
17	Trade unions											
18	Other											
19	Language, culture, ethnicity											

20	Internment										
21	Special features										
22	Other										
23	Privacy										
24	Rest areas										
25	Family relationships										
26	Separate animal-human environments										
27	Hygiene										
28	Security										
29	Relationships with the community										
30	Sense of community										
31	Social cohesion										
32	Efficiency of means of production										
33	sustainable domestic life										
34	respect for the sociocultural and ecological context										
35	Social equity in the community and housing										
36	Respect and conservation of customs										
37	Planning of housing needs										
38	Social Security										
39	Support for agricultural production										
40	Human well-being										
41	Personal growth										
42	Sense of affiliation										
43	Sense of parting										
44	Comfort										
45	Aesthetic delight										
46	Order										
47	Tranquillity										
48	Silence										
49	Temperature										
50	Light										
51	Colour										
52	Contrast										
53	Identity										
54	Status										
55	Belonging										
56	Uprooting										
57	Spatial Provision										
58	Communicability										

59	Practicality										
60	Effectiveness										
61	Comfort										
62	Amplitude										
63	Dynamism										
64	Adaptability										
65	Displacement										
66	Security										
69	Interaction										
70	Modulation										
71	Neighbourhood Organization										
72	Set perception										
73	Social and community equipment										
74	Perception of the city										
75	Coexistence with the community										
76	Illiterate population										
77	Illiterate population that does not attend school										
78	Population aged 15 to 29 with basic education										
79	Population of 29 years or more with primary										
80	Population without health services										
81	Homes that do not have a refrigerator										
82	Homes that do not have a washing machine										
83	Average occupants per room										
84	Unemployment										
85	Young employees										
86	Number of new patents/100 thousand hab.										
87	Poverty										
88	Population with primary education/100 thousand Ha										
89	Fire/100 thousand inhabitants										
90	Deaths from disasters/100,000 inhabitants										
91	Number of emergency calls										
92	Level of participation in municipal elections										
93	% Of women elected in municipal positions										
94	Index of convictions for corruption/100 thousand hab.										
95	% Of women employed by Gob. Municipal										
96	Life expectancy rate										
97	No. Of hospital beds/100 Thousand Hab.										
98	Mortality in children under 5 years/100 born										
99	Suicide rate/100,000 inhabitants										

100	Mental health professionals/100Mil Hab.										
101	M2 of open recreation space/person										
102	M2 of closed recreation space/person										
103	No. Of property crimes/100Mil Hab.										
104	Violent crimes/100 Thousand Hab.										
105	Emergency response time										
106	% of poor people/100 Thousand Hab.										
107	No. of homes without legalization										
108	You have green areas/100 Thousand Hab.										
109	No. Of jobs per home										
110	Delivery and reception at the end of construction.										
111	Delivery process and final adjustments.										
112	Cost of energy, water and waste, cleaning										
113	Rent and insurance cost										
114	Initial cost of construction										
115	Operating and maintenance costs										
116	Amenities and amenities										
117	Adaptability to changes due to rehabilitation										
118	Tenure security level										
119	% of regularized homes										
120	% Of women and men who run a home										
121	% of population able to read and write more than 15										
122	% of enrolment from primary to professional										
123	Water price/100 lts in Dlls in expensive season										
124	Water consumption per day/hrs/inhabitant										
125	Title of land, housing or both										
126	Rental contract										
127	Customary tenure										
128	% Of men and women evicted the last. 10 years										
129	% Of bosses and households who do not believe they are evicted										

MODELS OF EVALUATION OF PRIOR INVESTIGATIONS PHYSICAL-SPACE DIMENSION AND URBAN ENVIRONMENT

- Mod. 1 Methodology for the design of quality of life index (Burgoin Rooms)
- Mod. 2 Parameters and indicators for the assessment of habitability (Alarcon and Justinian)
- Mod. 3 Parameters and indicators of the spatial and environmental physical dimension (Hdz and Velasquez)
- Mod. 4 Indicators of the physical-spatial dimension and environment for social diagnosis (MM Muñoz)
- Mod. 5 Residential satisfaction index of S.H.F. And CIDOC.
- Mod. 6 Housing quality index. ICAVI (INFONAVIT)
- Mod. 7 Accident satisfaction index. ISA (INFONAVIT)
- Mod. 8 Index of quality of life linked to housing. (ICVV)
- Mod. 9 Quality of life in the city ISO 37120.
- Mod. 10 Post occupancy evaluation (POE).
- Mod. 11 UN-HABITAT (GUO) Indicators
- Mod. 12 Study dimensions for precarious housing UN-HABITAT GLOBAL III
- Mod. 13 CONEVAL Social Delay Index

The indicators are valued by four criteria: indicators linked to housing in social lag (Vrs), not representative, redundant and inaccurate. These are previously analyzed by their frequency and their relationship between them, to determine under the four criteria above the most appropriate to be part of the satisfaction assessment tool in Vrs.

Table A2. Assessment for the selection of indicators.

ASSESSMENT FOR THE SELECTION OF INDICATORS.		
	AVAILABILITY-RELIABILITY-QUALITY	**COMPARISON FEATURE**
1	**Linked to housing in social backwardness**	Consistent, accessible, easily interpreted, applicable, feasible
2	**Not representative**	Not relevant for the research objectives.
3	**Redundant**	Repetitive data with others presented in the study models
4	**Imprecise**	There is no specific breakdown for your measurement
	Indicator more frequently or that has a relationship with some other indicator	

Table A3. Physical-space and urban environment indicators.

	PHYSICAL-SPACE AND URBAN ENVIRONMENT INDICATORS.	Mod.1	Mod.2	Mod.3	Mod.4	Mod.5	Mod.6	Mod.7	Mod.8	Mod.9	Mod.10	Mod.11	Mod.12	Mod.13
	Excreta disposal													
1	Poet connected to sewer													
2	Poceta connected to septic tank													
3	Poceta offline													
4	Latrine													
5	It has no pot or well													
	Rooms with shower													
6	One to five													
	Type of housing													
7	Fifth or fifth house													
8	Home													
9	Ranch													
10	Refuge													
11	Other class													
	Materials in walls													
12	Block or brick													
13	unframed block or brick													
14	Sawn timber													
15	Adobe, tapia bahareque frisado													
16	Adobe, wall, barefrisk													
17	Palms, boards or similar													
18	Cement or concrete													
19	Flooring materials													
20	Marble, mosaic, granite													
	Flooring materials													
21	Marble, mosaic, granite													
22	Cement or concrete													
23	land													
24	Others													
	Roofing Materials													
25	Platabanda													
26	Roof tiles													
27	Asphalt sheet													
28	Metal sheet													
29	Palm, board or similar													

30	Other class													
	Number of rooms													
31	One to five													
32	Has													
33	Does not have													
	Water supply													
34	Aqueduct or pipe													
35	Public battery or pond													
36	Well with pipe or pump													
37	Well or protected spring													
38	Others													
39	Cooking fuel													
40	Gas													
41	Electricity													
42	Kerosene													
43	Firewood or carbon													
44	Infrastructure (From bad to very good. 5 levels)													
45	Allegation (From bad to very good. 5 levels)													
46	Overcrowding (From bad to very good. 5 levels)													
47	Community equipment (from bad to very good)													
48	Expansion space (from bad to very good)													
49	Overcrowding (5 levels)													
	Space													
50	Number of bedrooms													
51	housing surface													
52	Number of bathrooms													
53	parking drawers													
	Shape													
54	Ground surface													
55	Number of floors													
	Overcrowding													
56	Inhabitants/Bedrooms													
	Service													
167	Building Cleaning													
168	Building Security													
	Operational management													
169	Temperature													
170	ventilation													
171	Acoustics													

	Physical systems												
172	Illumination												
173	Air conditioner												
174	Durability												
	Durable structures												
175	Durable structure outside risk zone												
	Access to safe water												
176	% Housing with drinking water												
177	% Solid waste landfills												
178	% Closed solid waste												
179	% Solid waste landfill												
	Home Connections												
180	% Of homes connected to drinking water												
181	% Of homes connected to the sewer												
182	% Of homes connected to electricity												
183	% Of homes connected to the phone												
	Risk areas												
184	% of population subject to risk areas												
185	Transportation time in round trip minutes												
	Access to drinking water												
186	% Of people with connection to drinking water												
187	% of homes with a shared tap max 2												
188	Access to water from other sources												
	Access to basic sanitation												
189	% Of population connected to the drainage service												
190	% Of population connected to a septic tank												
191	% Of connected to a latrine with connection												
192	% Of connected to a non-public latrine												
	Housing durability												
193	Construction quality in flooring materials												
194	Construction quality in wall materials												
195	Construction quality in roofing materials												
	Enough area to live												
196	% Of homes with at least 3 per room												
197	Quality and spaces in the house												
198	% of houses with dirt floor												
199	Average number of occupants per room												
200	Basic housing services												

201	Unexcused homes													
202	Housing without connection to drinking water													
203	Homes without connection to sanitary sewer													
204	Housing without connection to electricity													

Appendix B. Data Collection Instrument for Social Exploration on Indicators. This Questionnaire Presents Existing Indicators Related to Socially Lagging Housing

Table A4. Data collection instrument for social exploration on indicators.

A series of characteristics that your home has or should have is presented as a list, mark with an X the degree of deficit that you find in the home that you and your family live in, or if the appearance is appropriate. In the second part, check the box with an X after reflecting your answer			
SOCIAL COMPONENT TO EVALUATE BY HEAD OF FAMILY			
NUMBER:	**Informant Name:**		
BETWEEN STREETS:			
COORDINATES:	**Date:**		
TOPOGRAPHY:			
INDICATORS	**NEEDS FOR YOUR SATISFACTION**		
ASPECTS SATISFACTORY TO EVALUATE WITH RESPECT	**SUITABLE**	**DEFICITARY VERY**	**DEFICITARY**
SPACE DIMENSION			
ROOMS/INHABITANTS RELATIONSHIP			
WINDOW VENTILATION			
SOLAR LIGHTING			
RELATIONSHIP OF SPACES AND THEIR FUNCTION			
KITCHEN SPACE			
PARKING AREA			
GARDEN AREA			
PHYSICAL DIMENSION			
ACCESS TO SANITARY DRAINAGE			
ACCESS TO ELECTRICAL ENERGY			
ACCESS TO DRINKING WATER BY CONNECTION			
ACCESS TO A GAS INSTALLATION			
FINISHES IN WALLS			
FINISHES IN FLOORS			
COVERED AS PROTECTION FOR INCLEMENCIES			
URBAN ENVIRONMENT			
ACCESS TO PUBLIC LIGHTING			
BANQUETS			

PRE-SCHOOL			
PRIMARY SCHOOL			
CLINIC			
COMMERCIAL AREA			
SPREADING (GAME AREAS, ETC COURTS)			
ACCESS TO GREEN AREAS			
ACCESS TO PUBLIC TRANSPORTATION			

SOCIAL DIMENSION	**EVALUATION OF SOCIAL CONDITIONS**	
	YES	**NO**
HAS NEIGHBORHOOD PARTICIPATION		
PARTICIPATE IN SOCIAL MOVEMENTS		
PARTICIPATE IN CLEANING AND MAINTENANCE BRICKS		
PARTICIPATE IN EDUCATIONAL NETWORKS OF ANY KIND		
EASILY ACCESS TO TRANSPORT		
HAVE A GOOD PERCEPTION OF THE COLONY (SECURITY)		
YOUR CHILDREN GO TO SCHOOL IN THE COLONY		
ACCOUNT WITH SOME NEAR HEALTH CENTER		
YOU HAVE ACCESS TO GARDENS, COURTS, OR OTHER		
FEEL ROOTED TO YOUR NEIGHBORHOOD (FOR THE TIME IT LEADS)		
FEEL IDENTIFIED WITH YOUR NEIGHBORHOOD (PROUD)		

Appendix C. Instrument for Data Collection of Physical-Spatial and Urban Environment Characteristics for Sample Units

Table A5. Instrument for data collection of physical-spatial and urban environment characteristics.

HOUSING NUMBER	Regular Lot Irregular:	Photography Direction: Head of the family					
SQUARE	Measures: Coordinates						
		Housing spaces and occupational structure		Physical, spatial and urban environment characteristics of housing			
			Existed	FLOOR	WALLS	ROOF	DOOR/ WINDOWS
		Garage					
		Yard					

	Room					
	Dining room					
	Kitchen					
	Bath. inside					
	Shared bathroom					
	Occupants/no. Bedrooms					
	Cto. Round					
	Serv patio					
	Space for extension					
	Infrastructure and urban environment					
	Drain connection					
	Drinking water connection					
	Cooking fuel					
	Distance to transport					
	Observation					

Physical, spatial and urban environment characteristics:		
1 Connection to municipal sanitary sewer network	13 block walls seated with mortar	25 Concrete Deck
2 Sanitary sewer connection to septic tank	14 stacked block or partition walls	26 Laminate cover
3 Use of latrine with drain connection	15 Walls with any type of coating	27 Wood and tile roof
4 Use of latrine with septic tank	16 adobe walls	28 Mixed deck
5 Connection to municipal drinking water network	17 Stone walls seated with mortar	29 Palm cover
6 Access to drinking water by community well	18 stacked stone walls	30 Cover with recycling materials
7 Access to drinking water by auto-tank distribution	19 Wall of recycled material (laminate, wood	31 It has a service patio
8 Access to rainwater	20 Mixed Composition Walls	32 Urban transport distance
9 Access to drinking water by cistern or public battery	21 Ground floors	33 Paved Roads

10 Access to gas l.p for cooking	22 cement floors	34 Roads in dirt roads
11 Access to firewood for cooking	23 ceramic floors	
12 red partition walls seated with mortar	24 floors with tile or stone	

Appendix D. Survey Instrument Used in the Model of Evaluation of Indicators for the Evaluation of Housing Satisfaction in Social Lag

Table A6. Survey instrument used in the model of evaluation of indicators.

Please read carefully each aspect that you have or should have your home, marking with a line the most important box according to the need of you and your family						
INDICATORS TO EVALUATE						
STREET: TEPEYAC						
NUMBER: WITHOUT NUMBER HOUSING COUNT: 21						
BETWEEN STREETS: CALLEJON DE TEPEYAC AND SAN NICOLAS						
COORDINATES:						
TOPOGRAPHY: ACCIDENTED						
INDICATORS		**SATISFACTION FROM NEEDS**				
INFORMATOR NAME: **Sr. Antonio Garcia Reyes**		**Do you think it is necessary to increase the satisfaction of you and your family considering in your home?**				
Indicator code	**SATISFACTING ASPECTS TO EVALUATE REGARDING THE SPACE, PHYSICAL, URBAN AND SOCIAL ENVIRONMENT**	Completely unnecessary	Little necessary	Medium necessary	Necessary	Very necessary
	SPACE DIMENSION					
0	Sun lighting inside the house					
169	Window ventilation inside the house					
195	Separate spaces between bedrooms and other housing					
135	Living space					
0	Dining space					
145	Pedestrian access to your home					
45	Space for extension					
0	Garden area in the house					
	PHYSICAL DIMENSION					
1	Sanitary drainage connection to municipal network					
5	Connection to municipal drinking water network					

0	Other means of drinking water supply					
32	Mains connection					
103	Access to gas for cooking					
134	Use of water and electricity saving systems system					
0	Use of water heater					
0	Drinking water container (Tinaco)					
0	Bathroom with shower					
0	Toilet with toilet					
0	Bathroom inside the house					
0	Kitchen sink					
0	Suitable doors.					
0	Suitable windows					
0	Laundry in service yard					
0	Wall coverings					
0	Floor coverings					
0	Roof Coatings					
0	Fourth extra bedroom					
	URBAN ENVIRONMENT DIMENSION					
159	Green areas in the neighbourhood					
0	Playground in the neighbourhood					
151	Area for sports in the neighbourhood					
114	Sidewalks					
68	Commercial area					
60	Paved roads					
70	church					
67	Basic Education School					
0	Community medical care					
66	Waste collection					
65	Guardhouse					
64	Street lighting					
72	Nearby transport					
	SOCIAL DIMENSION	**E S C A L A D I C O T O M I C A**				
		YES	**NO**			
0	Perceive Security in the colony					
10	Has access to educational networks children and adults					
11	neighbourhood organization and participation					
3	You have access to community health service					
5	Has access to basic education schools					
101	Has access to recreation and recreation spaces					

8	You have access to public transport					
26	It has separate animal-human environments					
24	You have rest in your home					
83	There are more than 2 occupants per room in your home					
4	Land tenure (Deed or in process)					

Appendix E. Results on Social, Physical-Spatial and Environmental Indicators Based on Ethnographic Exploration Based on a Survey Aimed at the Inhabitants of the Study Housing

Table A7. Results for housing tricotomic scale survey.

INDICADORES DE DIMENSION ESPACIAL	**RESULTS FOR HOUSING TRICOTOMIC SCALE SURVEY**																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Homes under study
DIMENSION ESPACIAL																								
BEDROOM	1	3	1	2	3	1	1	2	3	1	3	2	2	1	1	1	2	2	1	1	1	1	1	
VENTILATION/ WINDOWS	3	3	3	3	3	2	1	3	3	3	3	3	3	1	1	3	3	3	3	1	1	1	3	
SOLAR LIGHTING	3	2	3	2	3	2	1	3	1	3	3	3	3	1	1	3	3	3	3	1	1	1	3	
SPACE RELATIONSHIP-FUNCTION	1	2	3	2	3	1	1	1	1	3	2	1	1	1	1	1	2	1	1	1	1	1	1	
KITCHEN	2	3	1	1	3	3	2	1	1	3	3	3	2	1	1	3	2	1	1	1	1	1	1	
GARAGE	2	3	1	3	1	1	3	2	3	1	3	3	3	1	3	3	1	1	1	1	3	1	1	
JARDEN	2	1	1	2	2	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	2	1	1	

1	Very lacking
	Deficient
2	
3	Suitable

What aspects within your home regarding its structure, spaces and equipment would you consider that would improve the well-being of your family?			**Indicators according to social exploration results**
1	Bathroom with shower and toilet bowl	**13**	Bathroom with shower and toilet	**Bathroom with shower**
2	Watering can and toilet for the bathroom	**14**	Watering can and windows	**Toilet with toilet**
3	Sink and a quarter more	**15**	Sink, toilet, windows and shower	**Kitchen area with sink**
4		**16**	A quarter more	**Suitable doors and windows**
5	Watering can and toilet for the bathroom	**17**	A quarter more	
6	A quarter more	**18**	Sink, toilet and shower	
7	A quarter more	**19**	One more room, sink, toilet, doors and windows	
8	Put glass on the windows, toilet and shower	**20**	sink, toilet and shower	

9	Toilet with cup and watering can	**21**	Suitable windows and doors
10	Wider windows, toilet and shower	**22**	Sink, toilet and shower
11	A quarter more	**23**	Toilet, shower, laundry
12	Bathroom with shower and toilet		

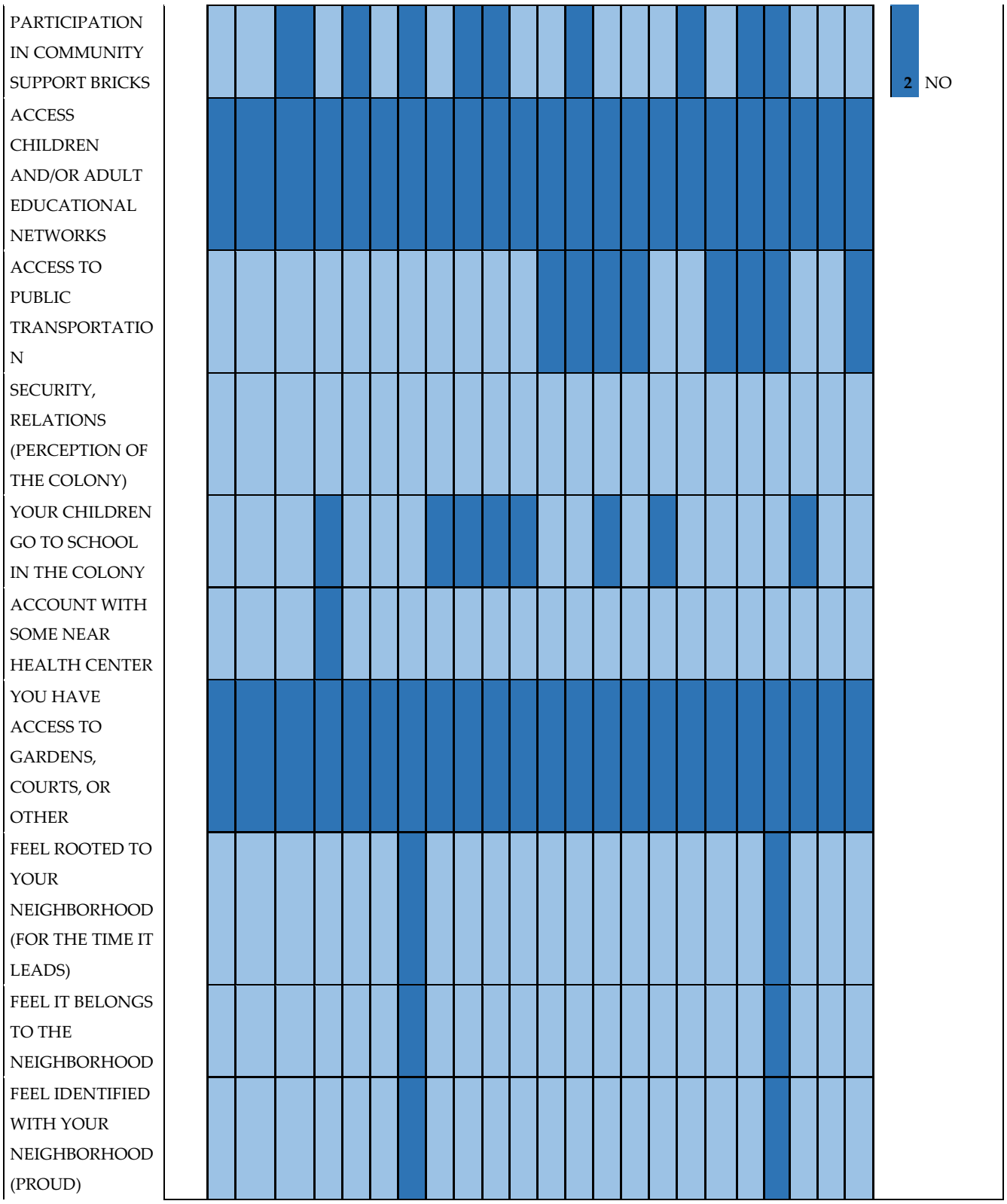
PHYSICAL DIMENSION INDICATORS	**RESULTS FOR HOUSING TRICOTOMIC SCALE SURVEY**																							Homes under study
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
SANITARY	3	3	3	3	3	3	3	3	3	3	3	3	1	3	1	3	3	3	3	1	3	3	3	1 Very lacking
DRAINAGE	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	1	3	3	3	
INST. ELECTRICAL	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	1	3	3	3	2 Deficient
INST. OF WATER	2	2	3	3	3	3	3	3	3	3	3	3	1	1	1	3	3	3	3	1	3	3	3	3 Suitable
INST. OF GAS	2	3	1	1	2	2	3	3	3	3	3	3	1	1	3	3	3	1	1	1	3	1	1	
FINISHES IN WALLS	1	1	3	3	1	1	2	2	1	2	3	3	1	2	1	2	2	1	1	1	1	1	1	
FINISHES IN FLOORS	1	1	3	3	1	1	2	1	1	2	3	3	1	2	1	2	2	1	1	1	1	1	1	
FINISHES IN COVERS	1	1	3	3	1	1	2	1	1	2	3	3	1	2	1	2	2	1	1	1	1	1	1	

What aspects within your home regarding its structure, spaces and equipment would you consider that would improve the well-being of your family?			**Indicators according to social exploration results**
1	Flattened walls and paint, water heater	13 Water heater	**Water heater**
2	Tile floor	14 Water heater and water tank	**Drinking water container**
3	Water heater	15 Concrete tile and slab floor	**Water heater**
4	Tinaco and water heater	16 Water tank and water heater17 Water heater	**Drinking water container**
5	Flattened walls, water heater and water tank	17 Water heater	
6	Water heater and flattened walls	18 Water heater and water tank	
7	Water heater and water tank	19 Flattened walls and floor tile, heater and water tank	
8	Water heater and water tank	20 concrete slab, water heater and water tank	
9	Wall finishes	21 Concrete slab, water heater and water tank	
10	Tinaco and water heater	22 Tinaco, water heater and flattened	
11	Water heater	23 Water tank and water heater	
12	Flattened walls and paint, water heater		

URBAN DIMENSION INDICATORS	**RESULTS FOR HOUSING TRICOTOMIC SCALE SURVEY**																							Homes under study
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
STREET LIGHTING	3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	**1** Very lacking
SIDEWALK	2	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	3	3	3	3	2	**2** Deficient
PRE-SCHOOL	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**3** Suitable
PRIMARY SCHOOL	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
COMMUNITY MEDICAL CARE	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
MARKET	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	3	1	2	2	1	1	1	2	
COMMERCIAL AREA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	2	1	1	1	2	2	
RECREATION (GAME AREAS)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	

What aspects of the neighbourhood do you think would improve the satisfaction and well-being of your family in terms of equipment?			**Indicators according to social exploration results**
1	A market and green areas	13 Green Areas	Green areas
2	Playground, green areas	14 Market and green areas	Sports area
3	Green areas and sports fields	15 sports fields and green areas	Playground for children
4	Green areas and sports fields	16 children's play areas and sports courts	green areas
5	Green areas and playgrounds	17 green areas and playgrounds	
6	Paint on garnishes, green areas	18 sports fields and green areas	
7	Sports courts and playgrounds	19 Children's play area and green areas	
8	green areas	20 Courts and green areas	
9	Children's games and sports courts	21 Best conditions on sidewalks	
10	Common parking and green areas	22 sports fields and green areas	
11	Sports courts and green areas	23 Children's play area and green areas	
12	Security booth and green areas		

SOCIAL DIMENSION INDICATORS	**RESULTS FOR HOUSING DICOTOMIC SCALE SURVEY**																							Homes under study
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
PARTICIPATION IN SOCIAL MOVEMENTS																								**1** YES


PARTICIPATION IN COMMUNITY SUPPORT BRICKS
ACCESS CHILDREN AND/OR ADULT EDUCATIONAL NETWORKS
ACCESS TO PUBLIC TRANSPORTATIO N
SECURITY, RELATIONS (PERCEPTION OF THE COLONY)
YOUR CHILDREN GO TO SCHOOL IN THE COLONY
ACCOUNT WITH SOME NEAR HEALTH CENTER
YOU HAVE ACCESS TO GARDENS, COURTS, OR OTHER
FEEL ROOTED TO YOUR NEIGHBORHOOD (FOR THE TIME IT LEADS)
FEEL IT BELONGS TO THE NEIGHBORHOOD
FEEL IDENTIFIED WITH YOUR NEIGHBORHOOD (PROUD)
2 NO

	What aspects of the neighbourhood do you think would improve your family's satisfaction and well-being in terms of equipment?	Indicators according to social exploration results
1	That people participate in community tasks	Community participation
2	That transport be closer	
3	Best organization to do community work	Distance accessible transport
4	That people participate in community tasks	
5	That people participate in community tasks	
6	That people participate in community tasks	
7	That people participate in community tasks	
8	That people participate in community tasks	
9	That the transport was closer	
10	That the transport was closer	
11	That people participate in community tasks	
12	That the transport was closer	

Appendix F. Results Obtained in the Application of the Survey Described in the Previous Points Consisting in the Issuance of Responses of the Heads of Household of the Dwelling under Study Based on the Indicators of the System of Evaluation of the Level of Satisfaction in Housing in Social Lag in Five Categories of Possible Answers (1: Unnecessary, 2: Little Necessary, 3: Moderately 4: Necessary and 5: Very Necessary). In the Case of Social Dimension, Two Categories of Possible Answers (Yes, No)

Table A8. Results obtained in the application of the survey described in the previous points consisting in the issuance of responses of the heads of household of the dwelling under study based on the indicators of the system of evaluation of the level of satisfaction in Vrs.

	DIMENSIONS AND INDICATORS	SPACE CHARACTERISTICS																						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Code	**DIMENSION ESPACIAL**	**PREVIOUS RESULTS**																						
0	Window ventilation inside the house	3	3	3	4	2	4	5	3	2	2	2	1	1	5	5	2	2	1	3	5	5	5	3
169	Sun lighting inside the house	3	4	2	4	2	4	5	2	5	2	2	2	1	5	5	2	2	1	3	5	5	5	3
195	Separate spaces between bedrooms and other housing	5	4	2	4	1	5	5	5	5	2	4	5	5	5	5	5	4	5	5	5	5	5	5
135	Living space	5	4	2	5	5	5	5	3	4	5	4	5	5	5	5	2	5	4	4	2	2	5	5
0	Dining space	5	4	4	5	5	5	5	4	4	5	4	5	5	5	4	4	5	4	4	2	2	4	5
145	Pedestrian access to your home	1	4	4	4	3	5	4	4	5	5	4	1	4	5	5	4	5	5	5	5	5	5	4
45	Space for extension	1	1	1	1	1	1	1	3	1	1	3	4	1	1	1	1	1	3	4	4	4	5	2
	Garden area in the house	4	5	5	4	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	4	5	5
	PHYSICAL DIMENSION																							
1	Sanitary drainage connection to municipal network	1	1	1	1	1	1	1	1	1	1	1	1	5	1	5	1	1	1	1	5	1	1	1
5	Connection to municipal drinking water network	4	4	1	1	1	1	1	1	3	3	1	1	5	5	5	1	1	3	3	5	1	1	1
0	Other means of drinking water supply	5	5	1	1	1	1	1	1	1	1	1	1	5	5	5	1	1	1	1	5	1	1	1

32	Mains connection	1	1	1	1	1	1	1	1	1	1	1	1	3	1	5	1	1	1	1	5	3	1	1
103	Access to gas for cooking	4	1	5	5	4	4	3	5	1	5	1	2	5	5	3	3	3	5	5	5	1	5	5
134	Use of water and electricity saving systems	1	1	4	4	5	5	5	2	2	2	2	2	2	2	2	2	5	5	5	1	5	1	1
	Use of water heater	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Drinking water container (Tinaco)	5	5	4	5	5	4	5	5	1	5	1	1	1	5	5	5	1	4	5	5	5	5	5
	Bathroom with shower	5	5	3	5	1	5	5	5	5	2	5	5	5	5	5	5	4	5	5	5	5	5	5
	Toilet with toilet	5	5	3	5	1	5	5	5	5	2	5	1	1	5	5	5	4	5	5	5	5	5	5
0	Bathroom inside the house	1	1	5	2	5	5	5	5	5	5	1	3	5	5	5	5	5	3	1	1	1	1	5
	Kitchen sink	4	1	5	5	3	2	5	5	5	2	3	1	4	5	5	3	4	5	5	5	5	5	5
	Suitable doors.	4	3	1	4	3	5	5	5	5		4	5	5	5	5	3	5	3	1	1	2	2	5
	Suitable windows	1	2	4	1	5	5	5	5	4	4	1	4	5	5	5	3	5	2	5	3	3	5	5
0	Laundry in service yard	1	1	1	1	4	5	5	4	3	3	1	4	5	5	5	4	4	1	1	1	1	5	5
	Wall coverings	5	5	2	3	5	5	4	4	5	4	2	2	5	4	5	4	4	5	5	5	5	5	5
	Floor coverings	5	5	2	3	5	5	4	5	5	4	2	2	5	4	5	4	4	5	5	5	5	5	5
	Roof Coatings	5	5	2	3	5	5	4	5	5	4	2	2	5	4	5	4	4	5	5	5	5	5	5
0	Fourth extra bedroom	5	4	5	4	3	5	5	5	3	5	3	5	5	5	5	5	5	4	5	5	5	5	5
	URBAN ENVIRONMENT DIMENSION																							
159	Green areas in the neighbourhood	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	5	5	5	5	5	4	4
0	Playground in the neighbourhood	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5
151	Area for sports in the neighbourhood	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
114	Sidewalks	1	1	1	1	1	1	1	1	4	2	1	1	2	1	1	1	1	1	2	1	1	1	1
68	Commercial area	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	5	4	5	5	5	4	4
60	Paved roads	1	1	1	1	1	1	1	1	1	1	1	4	5	5	5	1	1	1	1	1	1	1	5
70	church	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
67	Basic Education School	1	1	1	1	1	1	1	1	2	1	1	1	2	1	2	1	1	1	1	1	1	1	1

0	Community medical care	1	1		1	1	1	1	1	2	1	1	1	2	1	2	1	1	1	1	1	1	1	1
66	Waste collection	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	3	3	3	3	3	3	4
65	Guardhouse	2	2	2	2	2	2	2	2	5	2	2	4	4	4	4	2	2	2	2	2	2	2	2
64	Street lighting	1	1	1	1	2	2	2	3	3	4	1	1	1	2	2	1	1	1	2	1	3	1	1
72	Nearby transport	1	1	1	1	1	1	1	3	3	4	4	4	4	4	5	1	1	1	1	1	1	3	3
	SOCIAL DIMENSION																							
0	Security, perception in the colony	Y	Y	Y	Y	Y	Y	Y	Y	No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10	Access to educational networks children and adults	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
11	Neighbourhood Organization and Participation	Y	Y	No	Y	No	Y	No	Y	No	No	Y	Y	No	Y	Y	Y	No	Y	No	No	Y	Y	Y
3	Access to community health service	Y	Y	Y	No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	Access to basic education schools	Y	Y	Y	No	Y	Y	Y	No	No	No	No	Y	Y	No	Y	No	Y	Y	Y	Y	No	Y	Y
101	Access to recreation and recreation spaces	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
8	Access to public transport	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	No	No	No	No	Y	Y	No	No	No	Y	Y	No
26	Separate animal-human environments	Y	Y	No	No	No	No	No	No	Y	No	Y	No	No	No	No	No	No	Y	Y	Y	Y	Y	No
24	Rest in the house	No	Y		No	No	No	No	No	Y	No	Y	No	No	No	No	Y	No	Y	Y	Y	Y	No	No
83	2 or less occupants per room	Y	No	No	No	No	No	No	No	Y	Y	Y	No	No	No	Y	Y	Y	Y	No	No	Y	No	No
4	Land tenure	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Appendix G. Proposal on Recommendations to Improve Housing Satisfaction in Social Lag by Study Dimensions. The Actions to be Taken as a Proposal on Recommendations to the Solutions of the Results Obtained on Very High Dissatisfaction and Needs of Socially Lagging Housing Are Shown, the Dimensions and Indicators Marked in an Orange Box that Require Priority Action Are Shown

Table A9. Proposal on recommendations to improve housing satisfaction in social lag by study dimensions.

DIMENSION	PARAMETER	INDICATORS WITH HIGH NEED AND VERY LOW SATISFACTION	LINE OF ACTION	MEASURES SOLUTION	ORGANISM
SOCIAL	Cohesion Social	Security, perception in the colony Access to educational networks children and adults Neighbourhood Organization and Participation	Encourage the cultural and educational activity of the community among young children and adults	Educational networks based on actions of government agencies, with active participation of the community through an agency	State, municipal, DIF Civil organization, Secretary
	Access to the resources urban	Access to community health service Access to basic education schools Access to recreation and recreation spaces Access to public transport	Rehabilitation of green areas under the land use regulation in areas intended for it	Under the regulation of parks and gardens of the State of Hidalgo, regulation of municipal land use and with community participation with prior information on procedures to rehabilitate green areas and gardens	Ministry of Public Works municipal, civil organization community secretary environment and resources natural
	Housing	Human Animals Separate Environments Rest in the house More than 2 occupants per room	Enabling housing in social lag	Characterization of housing, project and budget, enabling measures with sustainable materials, easy execution, durable and low maintenance costs	Universities, application of material research sustainable. SEDATU_FONAHPO. Housing state commission.
	Legal	Land trend			

PHYSICAL	Infrastructure	Sanitary drainage connection to municipal network Connection to municipal drinking water network Other means of drinking water supply Mains connection			
	Mobility and Facilities	Access to gas for cooking Use of water and electricity saving systems Use of water heater Drinking water container (Tinaco) Bathroom with shower Toilet with toilet Bathroom inside the house Kitchen sink Suitable door Suitable windows Laundry in service yard	Enabling adequate indoor bathroom spaces in socially lagging homes, as well as adequate equipment for basic toilet and kitchen needs. Rehabilitation in openings for doors and windows appropriate to their function.	Within the characterization of the house, analysis of the facilities and basic equipment of the homes under study, identify the deficiencies and project solutions, make a budget with the condition of having them more efficient equipment and materials in saving water and energy	SEDATU (Development Secretar agricultural, territorial and urba medium of its support dispersin for rehabilitation in areas in FOHAPO social lag (Fund national of populous rooms) conavi (national commission of housing) State commissions and municipal housing.
	Mobility and Facilities	Wall covering Coating in floors Roof Coatings Fourth extra bedroom	Characterization, projection and budget of the dimensions of the deficiencies in high need	Refurbishment of coverings in walls, floors and roofs with sustainable materials and low maintenance costs	SEDA TU, FONHAPO, CONAV state and municipal commission living place.
SPACIAL	INDOOR	Sun lighting inside the house Window ventilation inside the housing	Enabling spaces in homes with this priority need based on projects and budget	Enabling spaces with adequate horizontal circulation in order to have a better function for the tailoring of its inhabitants	SEDATU, FONHAPO, CONAV state and municipal commission living place

		Separate spaces between bedrooms and other housing Living space Dining space			
	OUTDOOR	Pedestrian access to your home Spaces for expansion Garden area in the house	Refurbishment of access to homes and gardens	Refurbishment actions with community action from the civil organization and municipality	Government Public Works Secre Municipal for access and garden civil organization
URBAN ENVIRO NMET	Equipment	Green areas in the neighbourhood Playground is in the neighbourhood Area for sports in the neighbourhood Area for sports in the neighbourhood Sidewalks Commercial area Paved City Churches Elementary school Community medical care	Enabling existing spaces for these purposes under the land use regulation, project of spaces for sport.	Refurbishment of green areas from civil organization and actions with the secretary of public works and gardens of the municipality.	Municipal Public Works Secreta community civil organization, se of the environment and natural
	Services	Waste collection Guardhouse Street lighting Nearby transport			

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