USING GIS TO DEFINE GRADES OF POVERTY.

ABSTRACT

To establish priorities when planning the schedule for urban governmental interventions it is necessary to establish grades of poverty within squatter developments. Areas classified with the highest grade of poverty are assigned resources in the short term.

When developing proposals for Los Claveles, a squatter development located in Venezuela, ARC GIS was the supporting tool for analyzing spatial and no spatial data. Data measured and categorized through urban and environmental indexes allowed the definition of categories of poverty and terms for improvement interventions.

Environmental indexes measured the adequate insertion of buildings in the geography and urban indexes measured relations of built public open space, dwelling located within walking distances from schools and health services, square meters of built space per family, family size, etc

The analysis included the topology of social relationships, since community ties are topologically based and permanence of community relationships grounds any sustainable proposal.

1.- Introduction.

Cities in developing countries are faced with increasing urban problems that require immediate government actions for which there are no sustainable solution in sight in the conventional terms of the city planning. Urban poverty is difficult to address and its growth challenges planning agencies, too often ill equipped to handle the problem, not only because the lack of updated and accurate data, but because of the lack of advanced tools to manipulate and manage information.

The traditional planning and urban design analysis and methodologies that worked when the dimensions of the problem did not exceed 20 % of the urban areas, have showed their incapability to function in today conditions, where the urban areas occupied by squatter developments can reach up to 60% in Latin American cities.

Identifying the components of urban poverty conditions has become a general concern for planning agencies aware of their fundamental role when developing new strategies for managing and solving policies for development and upgrading. Therefore, the initial task faced when developing the upgrading plan for Los Claveles was a general description of the problem of urban poverty followed by the identification of its components. Identified components can be mapped in different layers and further combined to determine grades of poverty.

Visual analysis using maps is fundamental to understand levels of poverty, not only by governmental agencies, but also by the communities involved in the upgrading process.

Visualizing the problem through maps is a practical way of explaining the problem to community leaders. These leaders, once provided with a full understanding of the upgrading interventions, are more likely to get involved and participate in supporting the plan promoted by city managers.

Providing planning agencies with tools such as poverty maps will help identify critical areas where development lags and where Quality of Life ("QOL") requires urgent upgrading. Investments in infrastructure and services in these areas will have a great social and physical impact in the community. Using the adequate tools can mean political success for governmental planning agencies working with poverty upgrading.

2.- Measuring urban poverty.

Traditionally, urban poverty has been measured in terms of income levels using graphics and statistics to weight socio-economic conditions. Spatially related life quality indicators that are intimately embedded in poor habitats have been left aside or giving small attention.

Urban poverty can be measured and graded in terms of its physical and non-physical components. Measuring poverty using only the non-physical or non-spatial life quality indicators leaves aside key spatial indicators that are intimately embedded in poor habitats. Deteriorated urban scenes express spatial or physical components that every one can understand once exposed to the real and crude image of poverty.

Physical components of poverty can be hidden when the urban occupation occurs in flat lands, but can become an aggressive visual manifestation when it occurs in hillsides of valleys such as Los Claveles. These different expressions involve different complexities, and the high-density squatter developments occupying sloppy areas are the more complex of all.

Portions of the physical urban components measured are environmentally dependent such as the insertion of buildings in the geography.

The predominance of socio economical conditions has to change. A balanced measuring of spatial and non-spatial components of urban poverty is required.

The non-physical components of poverty are basically related to the fabric of social and community relations. These non-physical components are predominantly spatially dependant. The public space shared by groups to access their dwellings has proved to be a social tie between residents. To measure urban poverty requires measuring each of its components separately and in combination in order to accurately grade poverty.

Identifying grades of poverty has become a requirement to allocate the limited resources available for upgrading programs. Once a planning agency chooses a barrio for upgrading the internal sector requires poverty grading in preparation to balance distribution of their resources.

3.- Upgrading spatial poverty.

Upgrading spatial poverty conditions represented by a conglomerate of buildings or quasi buildings surrounded by abandoned public space often used for trash disposal, is a *sine qua non* condition for achieving the dignity required by the inhabitants to gradually become citizens.

There are multiple spatial manifestations of physical poverty, some more significant than others, depending on the settlements characteristics. These manifestations are expressions of one component or a combination of components. Both cases provide us with terms for measuring and mapping poverty, by individual or by a combination of components. Combinations of components allow an integral visualization of urban poverty.

The type of geographic occupation in built areas can affect grades of poverty. Indexes of environmental poverty related to the urban occupation measure the adequacy of the insertion of building in the geography of the site.

The most general expressions of urban poverty in high-density squatter development such as in Los Claveles are:

- Low quantity and quality of public space.
- Undifferentiated occupation of the geography.
- Difficult access to urban services, residential areas, water, employment, etc.
- High restrictions for morphological change.
- Precarious and chaotic urban image.

These physical manifestations were used as indexes for grading poverty. Additional components were added to give an accurate picture of poverty conditions within the squatter development.

3.1.- Low quantity and quality of public space.

When measuring the quantity of open space in high density squatter developments the most relevant aspect is the lack of open space. The percentage of public space in barrios is between 5% and 10% while in the average city is over 30% of the total space. This component can be treated individually when measuring the index “open space over total urban occupation.”

When analyzing the quality of public space the most relevant aspect are the absence of adequate infrastructure, urban furniture and maintenance. Combined these aspects produce unhealthy and insecure conditions. In this case, quality results from a combination of components that provide a major or minor index of poverty. Graphic 1 shows a typical example of public space from a squatter development.

Graphic 1: Typical Public Space. UPF 5- Maiquetía". Proyecto UDU 5.4 Los Claveles.

3.2.- Undifferentiated occupation of the geography.

Urban poverty can be measured in terms of the environmental adequacy of the urban occupation. A friendly insertion does not threaten the natural features of the site usually disregarded in squatter developments. Additionally, occupation of slopes higher than 20 % , developments adjacent to water courses without protection areas can increase measures weighing poverty indicators.

3.3.- Difficult access to urban services, residential areas, water, employment, etc

When measuring accessibility it is important to identify what we are accessing. When we deal with distance to some urban services the measurement is carried out in meters of walking distance or a combination of pedestrian walk plus time invested in public transportation. Access to water, disposal and waste facility is measured as a lack or existence of the facility.

When measuring the access to public transportation, distances to bus stops and routes are represented in meters or feet.

Access to surrounding facilities: One of the characteristics of urban poverty is the access in distance to facilities usually located in the formal city. These facilities that include health care, education and transportation in many cases do not have the capacity to absorb demand of additional population, aggravating the problem of the poor.

Access to residential areas: When illegal occupation occurs in hillside with very irregular topography access to residential areas is limited to a pedestrian access. Some cases of access become severe, and uphill inhabitants have to go up an equivalent of forty floors to reach their dwelling.

Downhill travel to access facilities of surrounding areas requires less physical effort, but inhabitants are aware of the difficult uphill return. A multiplier effect that increases poverty condition is added when pedestrian routes require strong physical effort. Graphic 2 shows typical pedestrian routes within a squatter development.

Graphic 2: Typical pedestrian routes. "Petare Norte". Proyecto UDU 4.2 Agricultura.

Access to water, sanitary, and solid waste disposal facilities: The access to these urban services can be measured separately or combined to obtain graded poverty. Having the access to none, one, two or all of these services can establish differences in poverty levels and therefore in life quality.

Access to employment opportunities: In physical terms, the access to employment opportunities is related to access to the surrounding formal city. When large employment

centers are located with the surroundings, the possibilities of accessing these centers using public transportation in an adequate time becomes a term for measuring life quality.

3.4.- High restrictions for morphological change.

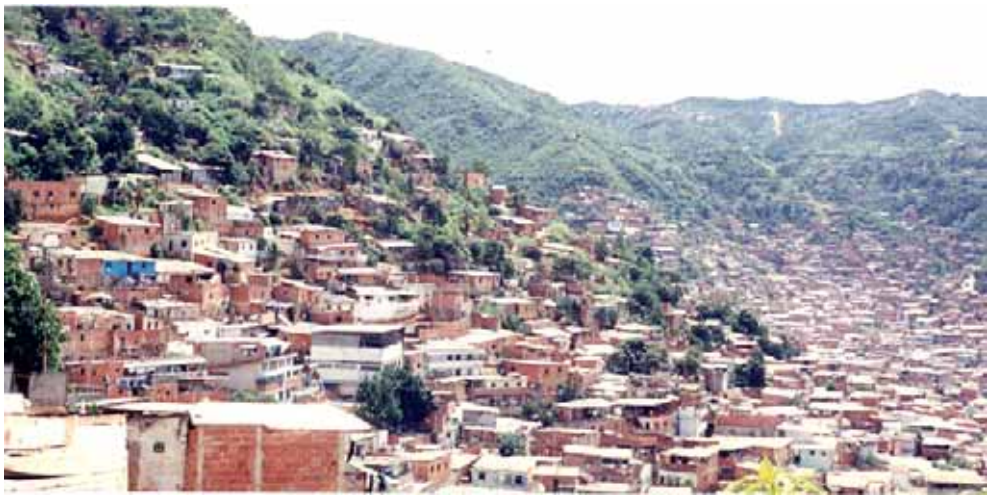
High density squatter developments generally occur on the hillside of the periphery of large cities. Settlements appear as a built indivisible group, conformed by piled up dwellings that share structural elements such as columns, slabs and dividing walls. This compact group functions as a massive unit difficult to modify, since removing a dwelling can make the group collapse.

Border dwelling if attached by one side can in some cases be removed without breaking the equilibrium of the whole. When proposing upgrading in this type of development, morphology is very difficult to change without affecting large areas.

3.5.- The precarious and chaotic urban image.

The vision we have of a precarious and chaotic urban space results from the combination of buildings in very bad shape, use of residual or waste materials, unhealthy and abandoned public space and use of the available space for waste disposal. Moreover, environmental problems such as landslides and absence of vegetation often affect developments already in place. This scene usually appears as chaotic and disorganized, but for dwellers an urban order is embedded within what they have built.

This urban order is a key element to be identified when carrying out site analysis. Graphic 3 is a dual example of a settlement with high restrictions for change and a typical urban image of a squatter development.



Graphic 3: Typical urban image with high restrictions for change. La Vega, Caracas.

4.- Upgrading non spatial poverty.

Poverty related to non-spatial elements includes the network of social and community relations. The lack of strong community ties is an expression of non-spatial poverty. Poor physical habitats, however, can house and contain a very rich network of social relations.

The built environment is the container for social relations, therefore when measuring non-spatial urban poverty it is fundamental to analyze and visualize the physical habitat. This fact is what guided the idea of grading and mapping spatial poverty without loosing the perspective that the upgrading of the physical environment can promote or disrupt social networks contained in the urban morphology.

Habitat physical characteristics can be strongly related to non-spatial components of urban poverty. One of the main physical characteristics that affect significantly the social fabric is the lack of quantity and quality of public space, another physical expression of poverty. Communities in squatter developments share security problems that force them to collaborate and develop a collective protection strategy for public spaces common to small groups. This dependency for survival generates strong community ties.

5.- Squatter Settlements in Venezuela: Characteristics.

Squatter developments called "Barrios" are settlements populated by poor people from all over the country, South America, and the Caribbean. It is a growth of a “city inside the city" that developed during a boom dating from the 1930s to 1990s. Venezuelan planning agencies following worldwide tendencies focused on the issue of poverty in rural areas while approaching urban poverty more as housing than a habitat problem. Today 85 % of Venezuelan population lives in cities and the problem is increasingly urban. Of the urban population more than 50% of the city population lives in squatter developments. Barrios unattended for years by the authorities are built over state-owned land or illegally on privately owned land.

The increase in the dimension and number of squatter developments in urban areas is affecting the ability of the city to function as a unified unit, creating a parallel city, the informal city. The informal city is becoming a conurbation of barrios with a tendency to generate a peripheral ring of poverty around the formal city.

The dimension and type of the occupation of squatter developments have threatened the sustainability of upgrading proposals. Changing for upgrading has limitations not only physical but cultural. Any effective development requires a through and detailed site analysis to identify the values of the cultural system embedded within the settlement.

Approaching the problem of upgrading has an additional ingredient, the lack of adequate data typical in Latin American, a condition that becomes severe in squatter developments.

The urgent need to deal with the problem of squatter developments as cities within the cities forced a change in national policies from housing to urban upgrading programs that visualize poverty has an integral problem of the habitat.

6.1.- Venezuelan National Programs for Upgrading Squatter Developments.

Government planning agencies such as the National Housing Council ("CONAVI") and the Institution for Community Development ("FUNDACOMUN"), developed a program for upgrading squatter developments. The program received the name of" Programas de Habilitación de Barrios." At the local scale, the upgrading programs concentrate in squatter developments. These upgrading programs include Plans for Planned Physical Units (Planes para Unidades de Planificación Física), Plans for Urban Design Units, (Planes de Unidades de Diseño Urbano), Integral Plans or Projects (Planes Integrales) and Condominium Structures (Estructuras Condominiales).

Los Claveles, the case study of this paper, is classified as an Urban Design Unit (UDU 5.4) that belongs to the Planned Physical Unit of Maiquetía (UPF 5). Generally, an urban design unit includes several barrios even thou the word barrio is used to name the UDU. Barrios are also subdivided in sectors.

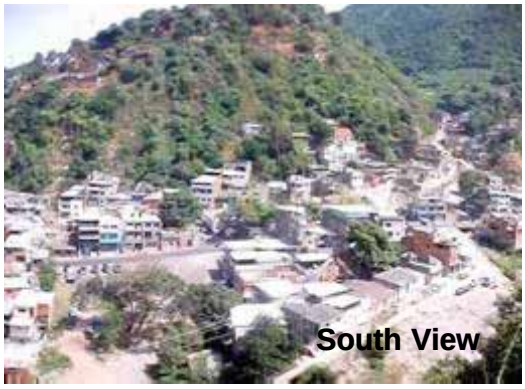
7.- .Upgrading plan for UDU 5.4, Los Claveles.

This paper describes the studies carried out to define grades of poverty and to map poverty for the squatter development called Barrio Los Claveles, located in the north central coast of Venezuela. With other six squatter developments Los Claveles constitute a continuous linear development that runs parallel to the city of Maiquetía located in the lowlands near the coast line. The Urban Design Unit of Los Claveles has five (5) barrios occupying a total area of 35 hectares. General views of Los Claveles are included in Graphic 4 and a map with barrio and sector subdivision is represented in Graphic 5.

Approaching the problem required thoroughly analyzing poverty conditions in the settlement. Once the significant components of urban poverty were identified and measured, several maps were developed. Doing this poverty analysis required reviewing and identifying its spatial manifestations and the ways to measure its components.

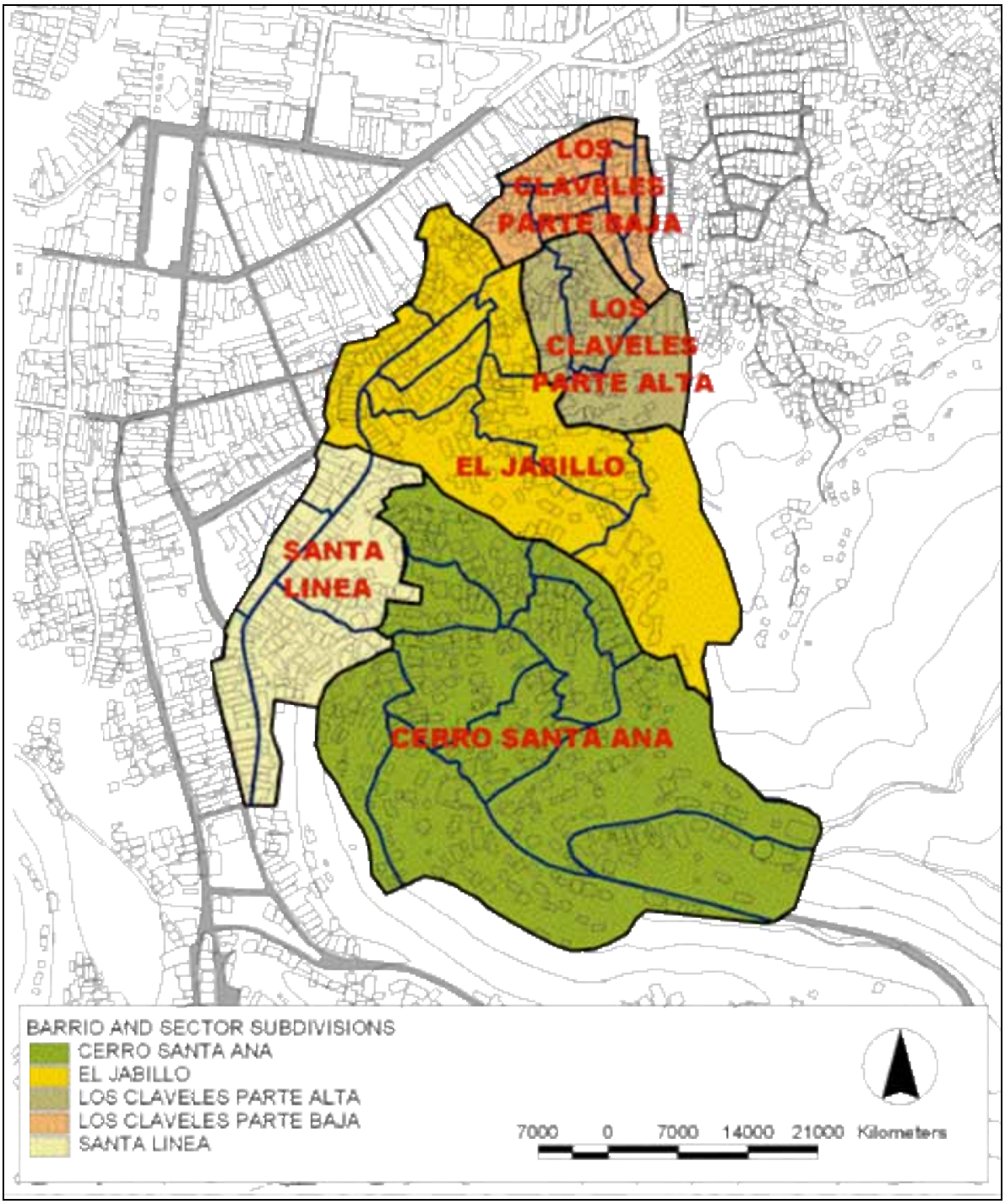
7.1.- Using GIS to map poverty.

Using GIS technology for Los Claveles provided an efficient tool for establishing and mapping grades of poverty. Having general and partial visions of physical poverty allowed identifying types and priorities of urban interventions and resource allocation. Additionally, GIS technology provided a basis for developing effective policies to address this pervasive problem.



Public Spaces

Graphic 4: Views of Los Claveles.



Graphic 5: Barrio and Sector subdivisions.

Developing GIS layers for each of the physical characteristics provided a detailed picture of the quality of life in different sectors of the settlement. Combination of layers allowed defining integral grades of poverty

7.2.- Grading and mapping spatial poverty.

Identifying grades of poverty has become a requirement to allocate the limited resources available for upgrading programs. Once a barrio is selected for upgrading, the internal sector also requires poverty grading for a balanced distribution of their resources.

We developed a spatial approach to describe urban poverty in Los Claveles in order to overcome the statistical vision of poverty. The basis for the analysis was a physical census carried out for the whole settlement (Census form is included in Appendix A). We measured separately different components listed under a variable number in the census, increasing accuracy in grades of poverty for the whole development. One of our first tasks was to identify the significant urban characteristics of poverty to be addressed in the settlement.

This paper emphasizes the analysis of spatial internal characteristics of the settlement to establish internal poverty as a combination of factors of the settlement per se. Finally to obtain an integral poverty we included as a multiplier factor access to the surrounding formal area where urban services are located. The process to obtain different poverty maps is included in the Appendix B.

7.3.- Establishing spatial internal poverty.

When analyzing spatial internal poverty we emphasized the cultural environment product resulting from urban occupation. To establish spatial urban poverty we used information from the physical census form. The information included conditions and characteristics of the dwellings, public space and infrastructure.

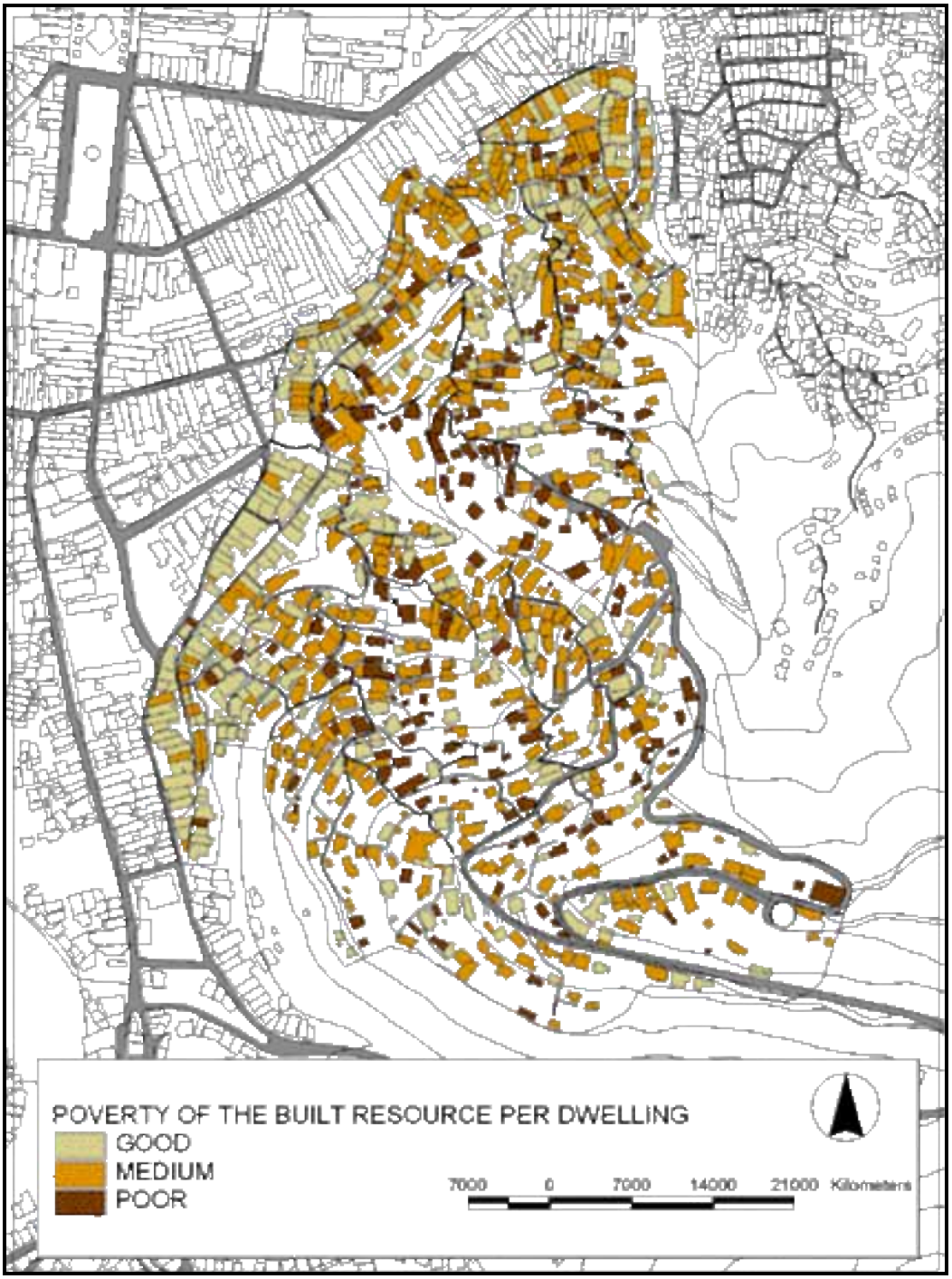
As complementary aspects, environmental problems affecting public space and accessibility from the formal city to the settlement were mapped to analyze the fitness of the urban form with the natural environment. Typically, these problems are characteristic of poverty.

Addressing the built resource, public space, and urban scene complemented with environmental fitness, allowed measuring and mapping the spatial internal poverty.

7.3.1.- Poverty of the built resource.

To establish the poverty of the built we used information regarding the quality and permanence of the dwelling building materials. We established four grades of poverty, assigning the highest grade of quality to concrete for roofs and structural components, combined with brick and block walls.

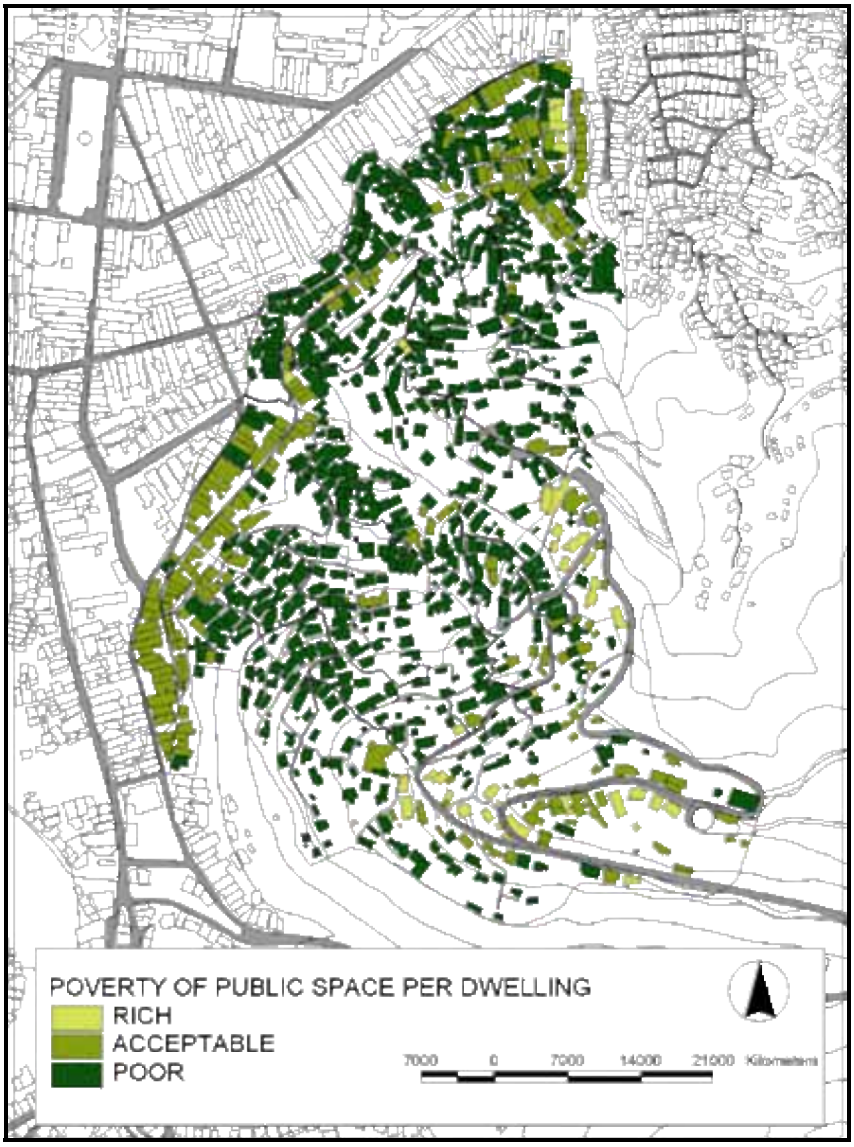
Further combinations provided three additional grades of quality, with the poorest as a result of combinations of wood, zinc and asbestos materials for roof and walls. Three categories were identified; good, medium and poor built conditions. Poverty Map of the built resource per dwelling is represented in Graphic 6.



Graphic 6: Poverty Map of the built resource per dwelling.

7.3.2.- Poverty of public space.

To establish the poverty of the public space we weighted two variables from our census chart: type of access to the dwellings and existence of an intermediate space between the public area and the entrance door. The access can be through a street, a path or a stair while the in between space can be a front garden or a porch. The existence of an intermediate space provides richness to the public area that otherwise suffers from a sense of excessive narrowness. The access through streets or path promotes social interaction. The access through stairs, usually narrowed prevents interaction. Poverty Map of the public space (Graphic 7) reveals grades of community ties. Groups of dwellings that shared streets and path and a richer common public space evidenced the existence stronger community. Three categories were identified; rich, acceptable and poor public space.

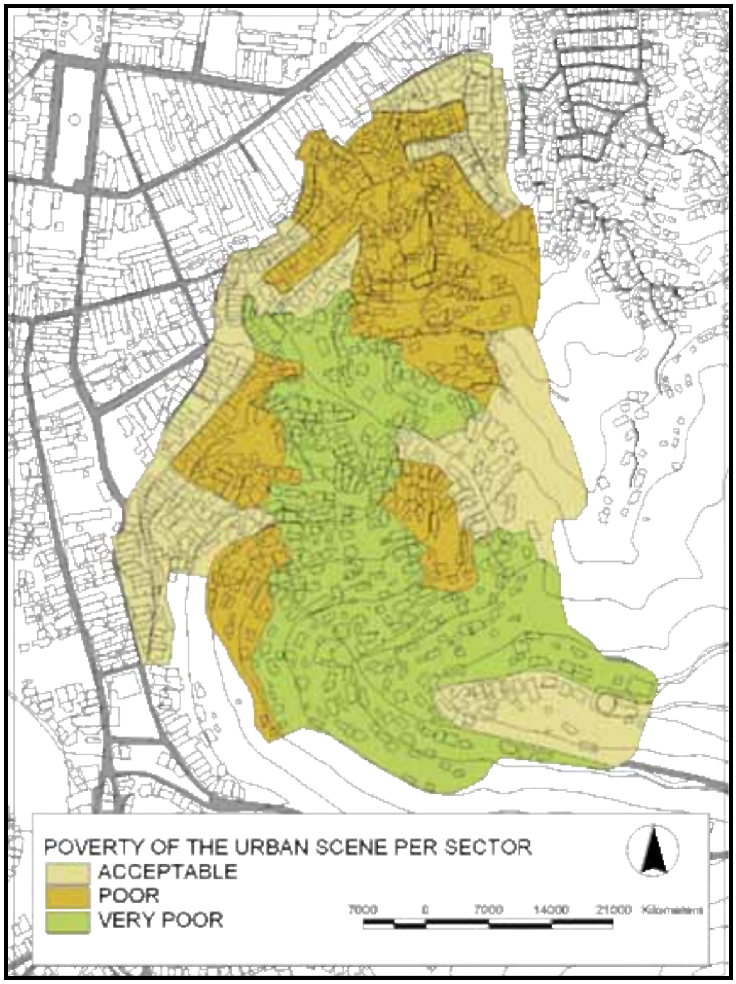


Graphic 7: Poverty Map of the public space for each dwelling.

7.3.3.- Synthesis I: Poverty of the urban scene

Community meetings carried out for different barrios evidenced the desire of the residents for a better quality environment. Improving the facades to achieve a better urban scene, considered by many as a useless makeup, is important for communities. Becoming citizens requires living a daily life in an urban habitat that has the appearance of finished, versus the usual unfinished aspect predominant in this type of development.

The poverty of the urban scene was established using a combination of two expressions, the poverty of the built resource and the poverty of public space. A combination by dwelling was developed as a first step. As a second step a map per sector was developed. Only three dwelling had a combination of good built conditions and rich public space, therefore the good category was not included. Three categories were identified: acceptable, poor and very poor urban scenes. A poverty map of the urban scene (synthesis of the built resource and the public space) is represented in Graphic 8.

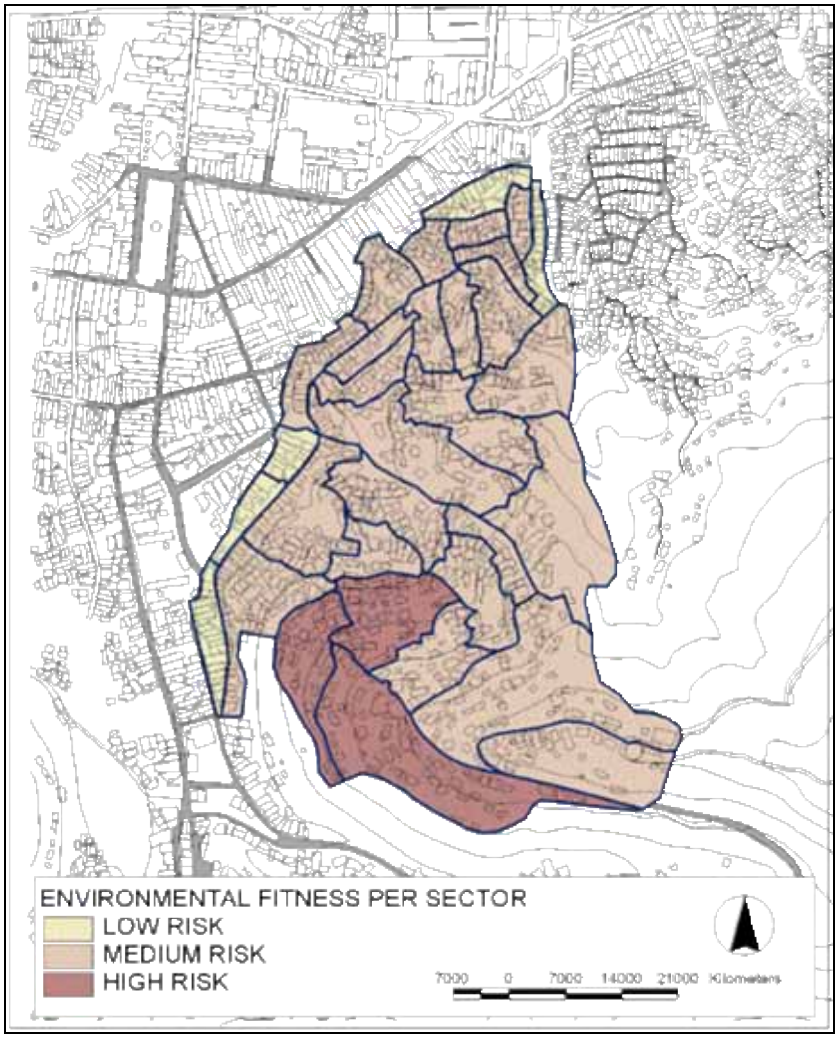


Graphic 8: Poverty map of the urban scene.

7.3.4.- Environmental Poverty.

Under environmental poverty the fitness of the occupation is weighted. In the case of Los Claveles the more significant aspects affecting the natural environment are occupations on areas of irregular topography with very steep slopes. An analysis of the urban occupation evidenced that 75 % of dwellings are located in slopes higher than 20 %.

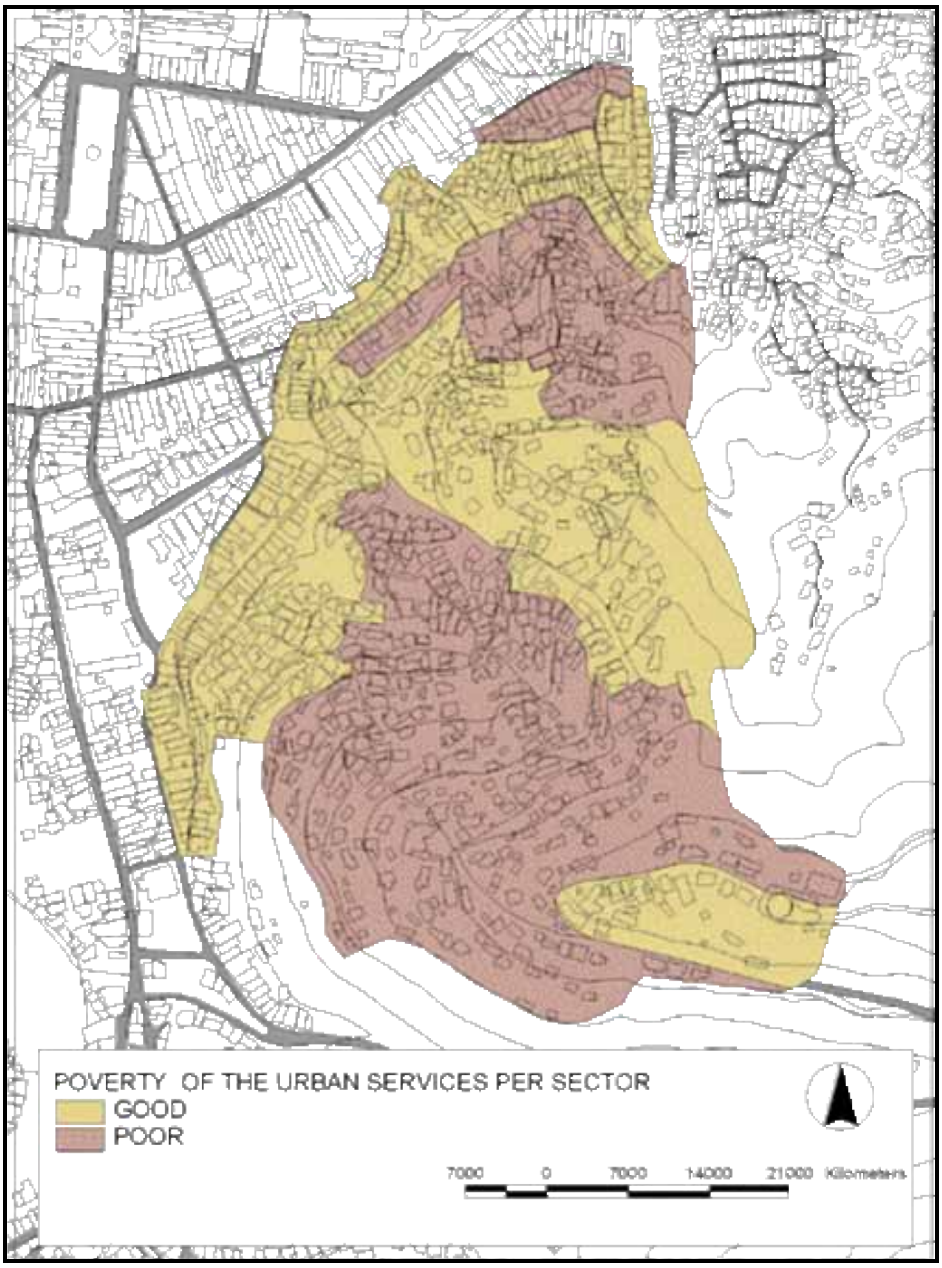
As a result of the analysis four categories were established for environmental fitness. A category of acceptable was assigned for dwellings located in terrains with slopes lower than 20%. A category of medium risk was assigned for dwellings located in terrains with slopes between 21 and 30%. A category of high risk was assigned for dwellings located in terrains with slopes higher than 30%. The amounts of dwellings per category are the following: 149 (14 %) acceptable, 785 (75 %) medium risk and 115 (11%) high risk. A map of environmental fitness per dwelling was developed as a first step. Using this map as an input allowed establishing predominant conditions per sector (Graphic 9).



Graphic 9: Map of Environmental Fitness.

7.3.5.- Poverty of urban services.

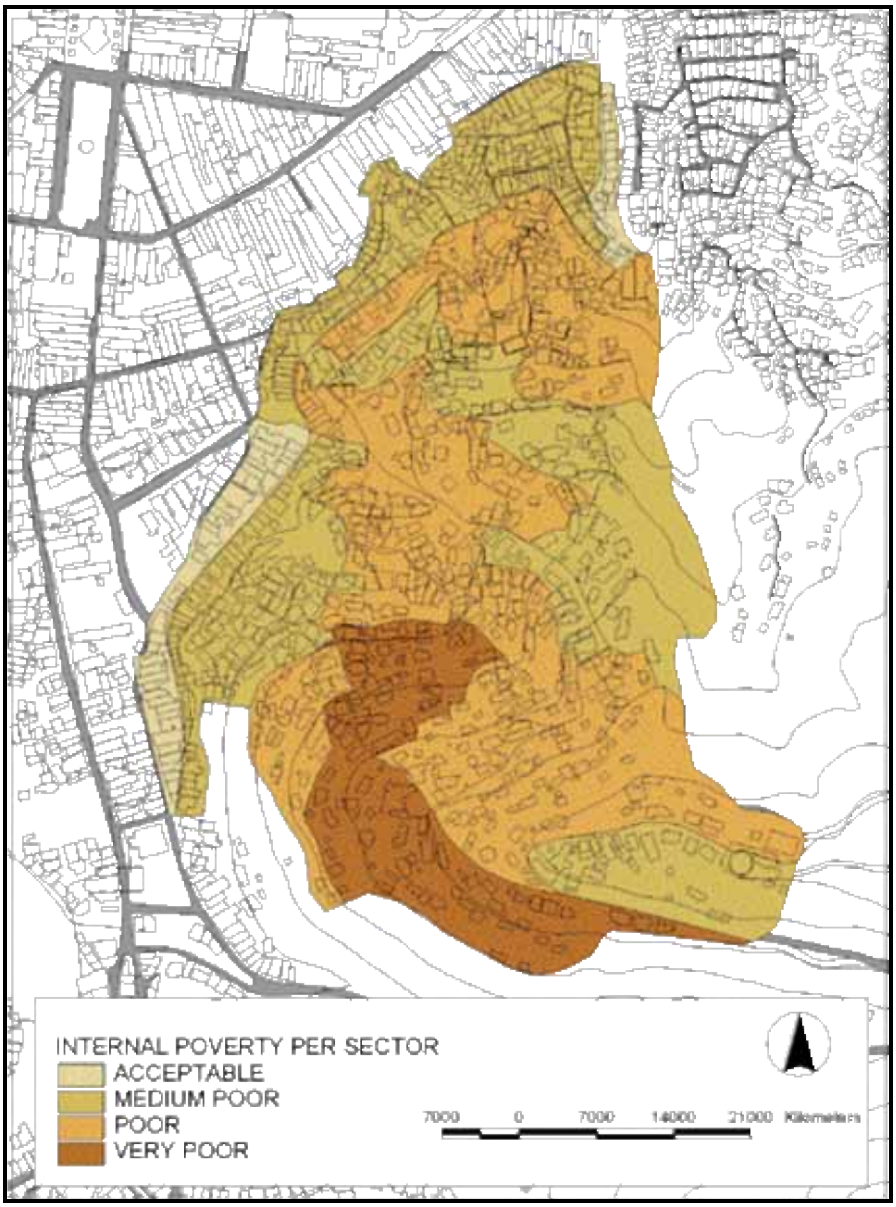
Since all the settlement has electrical and water supply, only the existence or absence of sewerage was used for measuring the poverty of urban services. Water supply can be very primitive from wells or hose, but every one has access to it. Two categories were established: good and poor. A map of poverty of urban services by dwelling was developed as a first step. Using this map as an input allowed the development of a map pf poverty of urban services by sector (Graphic 10).



Graphic 10: .Map of poverty of urban services

7.3.6.- Internal Poverty.

When analyzing spatial internal poverty we emphasized the cultural environment product resulting from urban occupation. To establish spatial urban poverty we used information from the physical census form. The information included conditions and characteristics of A combination of the poverty of the urban scene, environmental fitness and poverty of urban services is used to define internal poverty for each sector. Four categories were identified; acceptable, medium poor, poor and very poor urban development. Internal Poverty Map is represented in Graphic 11.

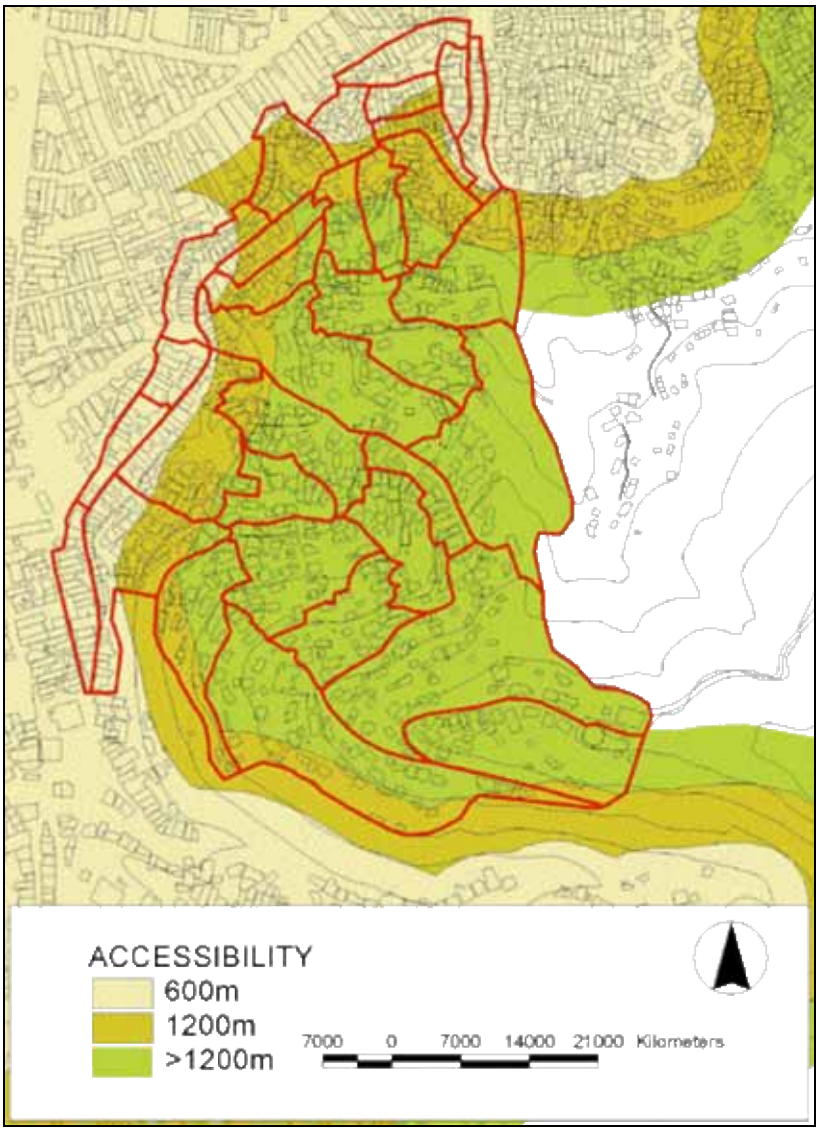


Graphic 11: MAP of Internal Poverty.

7.4.- Accessibility Map.

The access to urban services and benefits is always difficult for residents of squatter developments located on the hillsides. The lack of roads and the difficult pedestrian routes result in a general lack of accessibility to the settlement. This problem is one of the most common measures used for establishing poverty. In Los Claveles the lower areas have a good accessibility, but after 600 meters uphill the accessibility becomes poor. After 1.200 meters uphill slopes become steeper and accessibility is considered very poor.

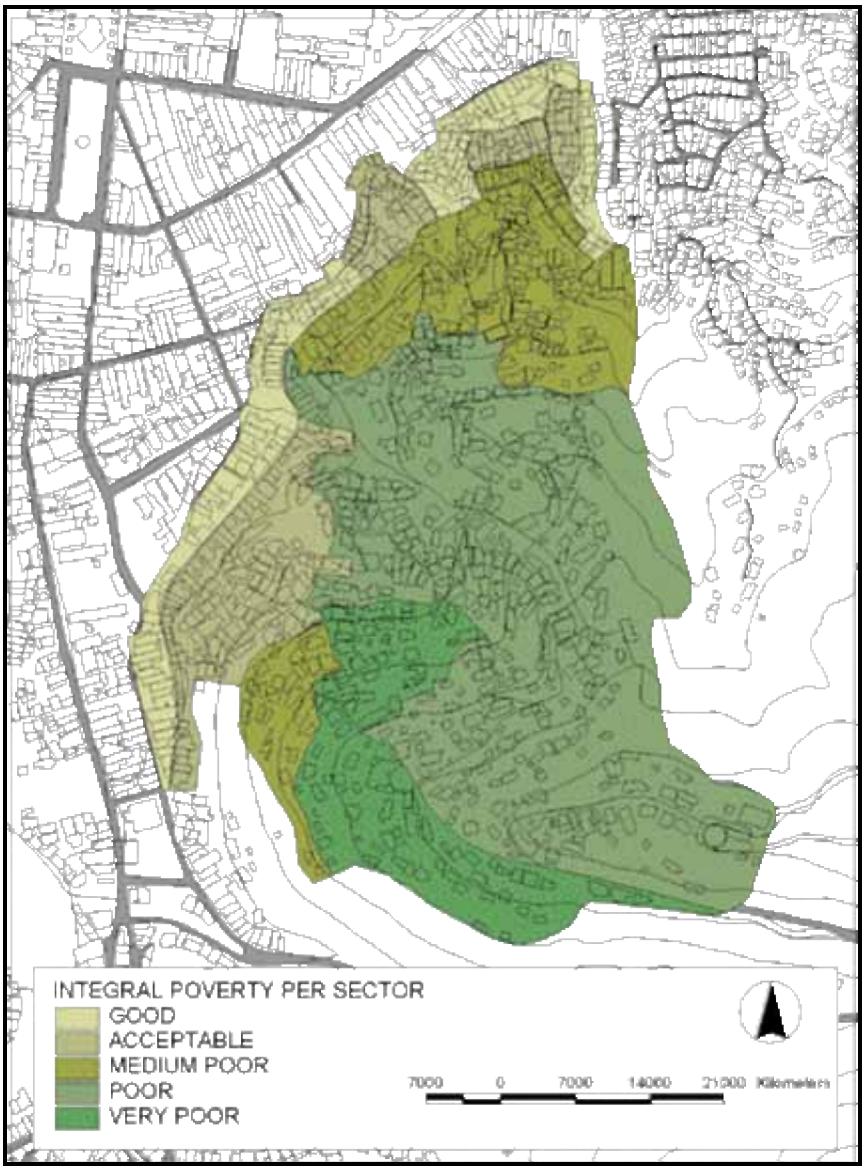
An accessibility map was established identifying two categories: good and poor. These categories were referred to sectors to obtain an accessibility map (Graphic 12).



Graphic 12: Accesibility map.

7.5.- Integral Urban Poverty.

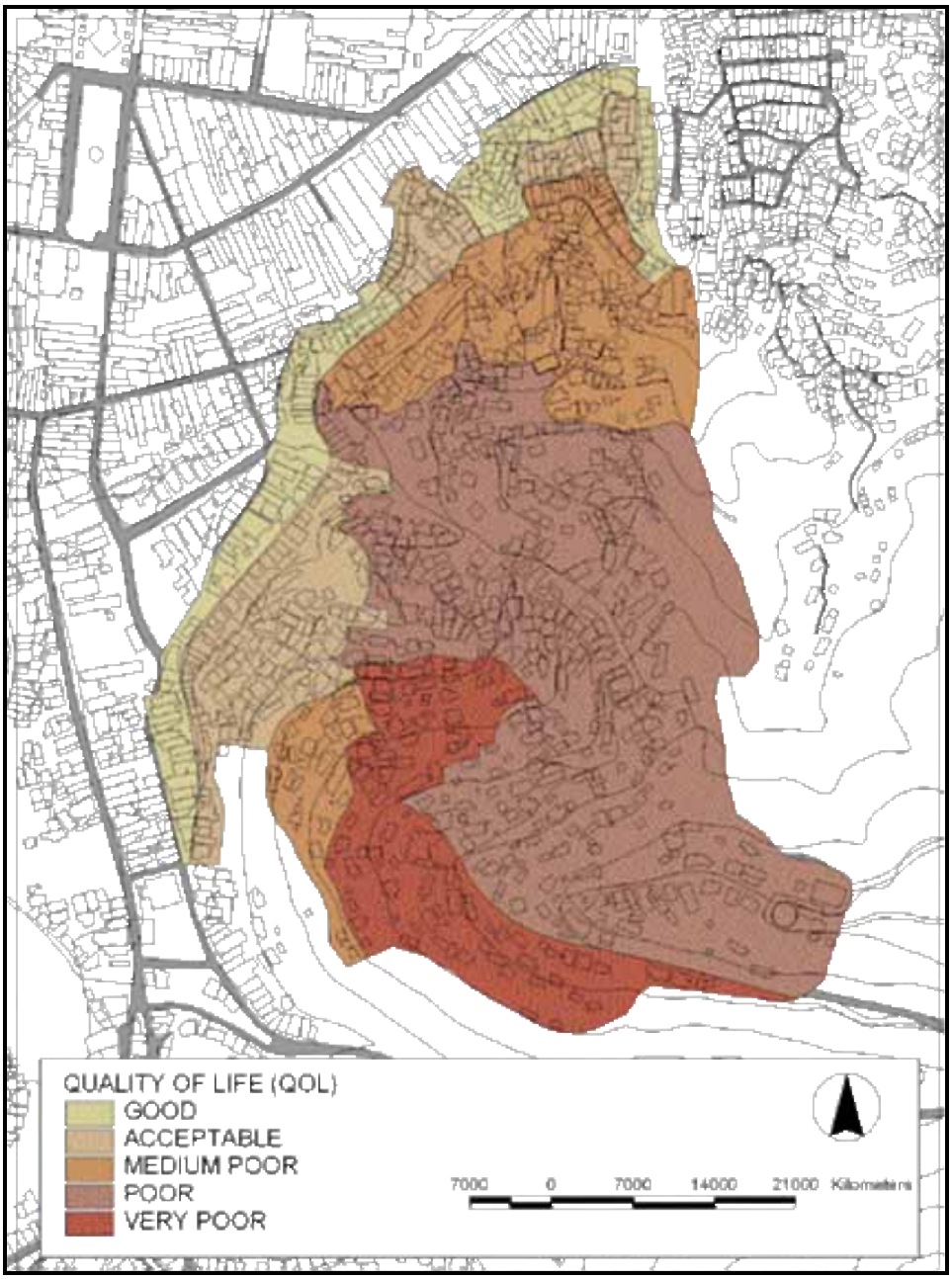
Integral poverty is a combination of internal components with the possibility of access to outside components that can increase or decrease the general poverty of some areas. A combination of accessibility with the internal poverty was used to define the integral urban poverty for each sector. In this case the lack of access to the formal city where educational and health services are located, has a multiplier effect on poverty conditions. The different grades obtained allowed us to identify which type of urban interventions and for which sector are required short term to attain a balanced distribution of the resources assigned for Los Claveles. Five categories were identified; good, acceptable, medium poor, poor and very poor. An Integral Urban Poverty Map is represented in Graphic 13.



Graphic 13: Integral Urban Poverty Map.

Grades of Poverty and Quality of Life (QOL) of the urban residents.

The different grades of poverty identified in the Integral Urban Poverty Map were translated into Quality of Life ("QOL") for the residents in Los Claveles. Three categories were established: acceptable, poor and extreme poverty. These categories were used as an input to develop urban intervention policies per sector to balance QOL for the whole settlement. The short term goal is to upgrade categories of poor and extreme poverty to acceptable. Map of QOL for Los Claveles is represented in Graphic 14.



Graphic 14: Map of QOL.

8.- Conclusions.

Using GIS for defining grades of poverty and as a tool for site analysis became a success for our team. The planning agencies promoting the development of the Physical Planning Unit of Maiquetía (UPF 5) where Los Claveles is located, requested the other six Urban Design Units to use Arc GIS.

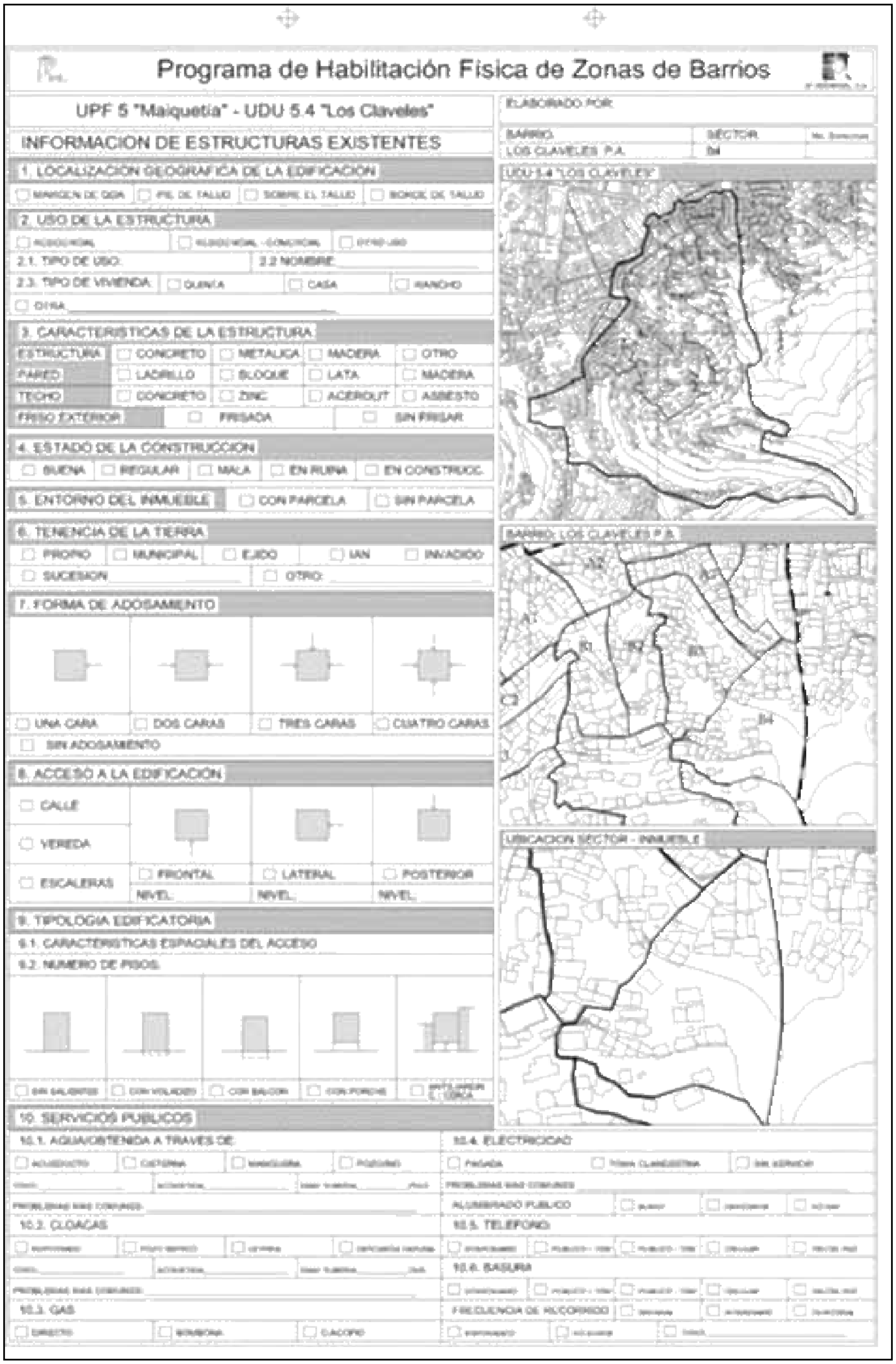
Once we defined grades of poverty identifying QOL for Los Claveles' residents were able to obtain support from community leaders. For the first time they could see the location of the people in most precarious situations.

Planning agencies in developing countries are becoming aware of poverty mapping for decision making, but translating grades of poverty to QOL seemed more accessible for the community than merely displaying maps of poverty.

ACKNOWLEDGMENTS.

To Miss Elia Villalobos who helped me developing poverty maps.
To Francisco Pérez Giusti who helped in the model building.
To all community residents that helped collect the data used for developing the poverty maps.

APPENDIX A



Programa de Habilitación Física de Zonas de Barrios

UPF 5 "Maiquetía" - UDU 5.4 "Los Claveles"

ELABORADO POR:

INFORMACION DE ESTRUCTURAS EXISTENTES

BARRIO: LOS CLAVELES P.A.

SECTOR: B4

1. LOCALIZACION GEOGRAFICA DE LA EDIFICACION
MARGEN DE QDA. | PIE DE TALUD | SOBRE EL TALUD | BORDE DE TALUD

2. USO DE LA ESTRUCTURA
RESIDENCIAL | RESIDENCIAL - COMERCIAL | OTRO USO
2.1. TIPO DE USO:
2.2 NOMBRE:
2.3. TIPO DE VIVIENDA: QUINTA | CASA | RANCHO
OTRA

3. CARACTERISTICAS DE LA ESTRUCTURA

ESTRUCTURA	CONCRETO	METALICA	MADERA	OTRO
PARED	LADRILLO	BLOQUE	LATA	MADERA
TECHO	CONCRETO	ZINC	ACEROLIT	ASBESTO
FRISO EXTERIOR	FRISADA		SIN FRISAR	

4. ESTADO DE LA CONSTRUCCION
BUENA | REGULAR | MALA | EN RUINA | EN CONSTRUCC.

5. ENTORNO DEL INMUEBLE: CON PARCELA | SIN PARCELA

6. TENENCIA DE LA TIERRA
PROPIO | MUNICIPAL | EJIDO | IAN | INVADIDO
SUCESION | OTRO:

7. FORMA DE ADOSAMIENTO
UNA CARA | DOS CARAS | TRES CARAS | CUATRO CARAS
SIN ADOSAMIENTO

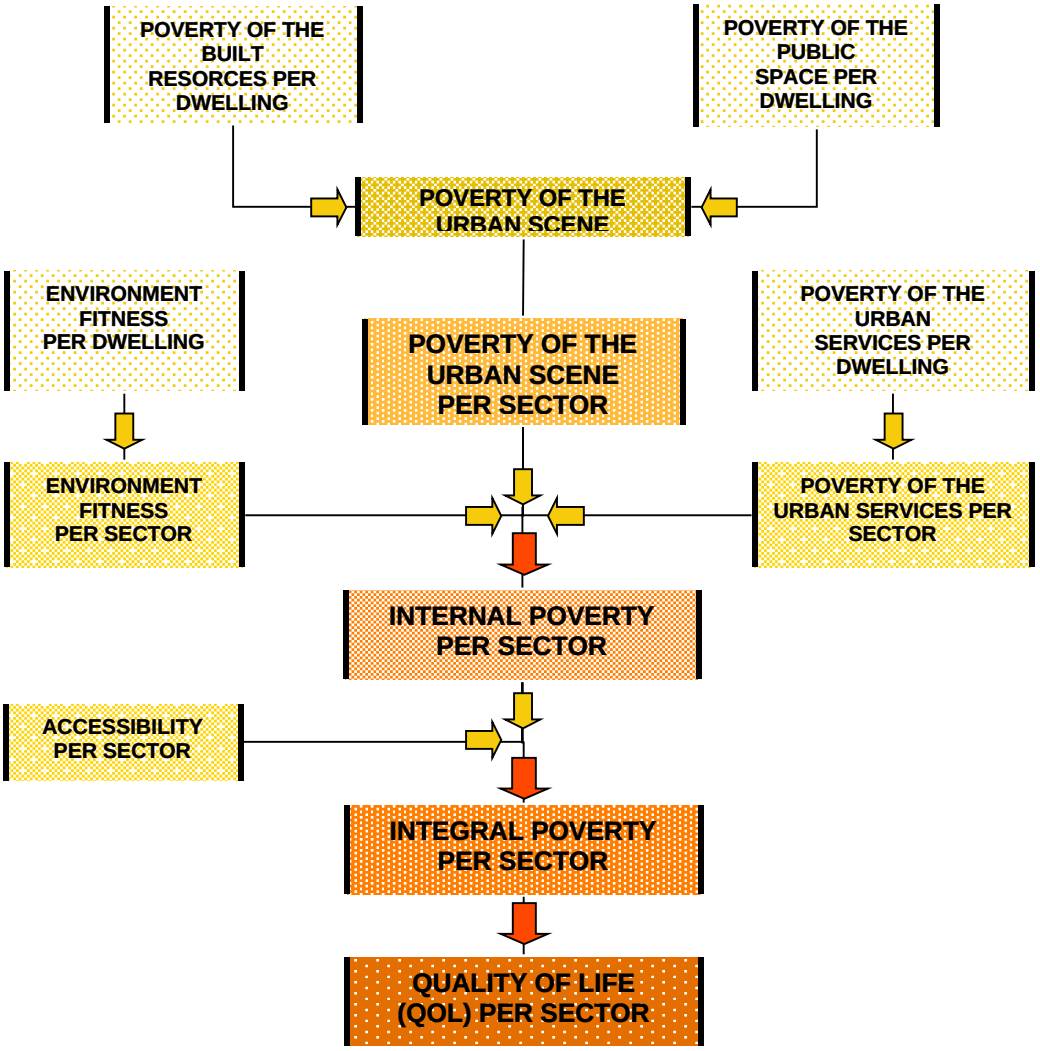
8. ACCESO A LA EDIFICACION
CALLE | VEREDA | ESCALERAS
FRONTAL | LATERAL | POSTERIOR
NIVEL: | NIVEL: | NIVEL:

9. TIPOLOGIA EDIFICATORIA
9.1. CARACTERISTICAS ESPACIALES DEL ACCESO
9.2. NUMERO DE PISOS:

10. SERVICIOS PUBLICOS
10.1. AGUA/OBTENIDA A TRAVES DE:
10.2. CLOACAS
10.3. GAS
10.4. ELECTRICIDAD
ALUMBRADO PUBLICO
10.5. TELEFONO
10.6. BASURA
FRECUENCIA DE RECORRIDO

APPENDIX B

PROCESS TO OBTAIN MAPS OF INTEGRAL POVERTY AND "QOL"



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