SUSTAINABLE SOLUTIONS FOR UPGRADING SQUATTER DEVELOPMENTS.

ABSTRACT

This paper describes sustainable solutions for improving quality of life in squatter developments. Experiences gained through upgrading high-density squatter developments located in Venezuelan cities has provided evidence that improving poverty conditions requires a full understanding of the function and organization of the development.

Typically a major removal of the existing settlement is the first idea considered when planning improvements for squatter developments. In practice, however, any available funds will probably not be sufficient to implement major changes. What to improve and how much? What is feasible and what is not? The answer to these questions, were obtained as a result of projects developed for the "Barrio of Petare", where use of GIS tools was key for supporting sustainable answers, In "Petare", a combined evaluation of the site's environment, urban built conditions and social networks provided the framework for spatial change that guided the improvement plans.

Introduction

Understanding complex high-density squatter developments can become a difficult task. Social values hidden behind complex built environments can be easily neglected in a traditional site analysis. In poor urban areas, where social ties support daily survival, the urban built should be evaluated as a container of social values. A sustainable scenario for development must fit buildings and social needs within the conditions dictated by the geography of the site, therefore we also need a full understanding of the site's environmental conditions.

Environmental limitations are the main constraint for urban development. Yet we don't manage these constraints in squatter developments as we do in the formal areas of the city. In formal areas, established development rules guide occupation. In squatter developments, the inhabitants' imperative need for land, whatever environmental restrictions the site has, guide occupation.

Development programs for squatter developments, currently addressing problems of urban order and function, need solutions strongly related to morphology and the conformation of public space. This is the clue to evolve from a utilitarian towards a quality urbanism and from disruptive towards sustainable interventions.

Petare our case study, was part of a five-year World Bank program for upgrading squatter developments in Caracas. The plan covered different scales from the whole Urban Design Unit to the small neighborhoods or condominiums as they called them.

1.- Physical Change and Environmental Limitations.

Site analysis is usually the first step when developing plans for improvement, and planning for squatter developments is no different. We need a full understanding of the site's environmental conditions to establish occupation rules and to determine whether or not the urban built is adapted to these conditions.

Environmental limitations are the main constraint for urban development. Yet we don't manage these constraints in squatter developments as we do in the formal areas of the city. In formal areas, established development rules guide occupation. In squatter developments, the inhabitants' imperative need for land, whatever environmental restrictions the site has, guide occupation.

Urban planning agencies do not have alternative policies for squatter developments, other than declaring the areas unsuitable for urban development. Although establishing some rules might seem awkward, when sites have environmental limitations, improving the quality of life requires finding answers. General development guidelines can help us improve living conditions whenever relocation is not a policy.

2.- Analyzing the natural features of the site with GIS

In squatter developments GIS can help overcome the absence of basic terrain data usually available in developed countries. Using simple overlays and relationships between different themes, GIS helps to locate and describe the behavior of the site.

To overcome the lack of data for terrain analysis, planners from developing countries use indirect ways to analyze terrain. Usually basic maps come from various sources and have diverse scales, resolutions, and precisions. Overlaying requires that these maps be standardized, rescaled, and adjusted to fit and recognize common borders and limits.

2.1.- Environmental site evaluation using GIS.

In squatter developments, environmental analysis must identify relevant issues that affect community health, terrain stability, flooding risks, and other subjects. The lack of open space, excessive population density, a high criminal index, and other social and environmental limitations require a special review. A combined evaluation of all issues is easier if the proper data is spatially interrelated through GIS.

3.- Site Analyses and the urban built.

In squatter developments the complexity of the urban form and the network of social relations require an understanding and appraisal of the built form produced by vernacular initiatives. An adequate morphology reading will allow the identification of the social linkages associated and dependant on urban occupation. A valid urban reading must be supported on a study of the residential fabric within which there is a general absence of other activities. This condition produces the homogeneity of the urban form and the appearance of sameness that makes orientation for foreigners difficult (Graphic 1).

3.1.- Evaluation of the Urban Built.

To identify the internal physical and social networks contained within the built environment, site analysis must emphasize studies of urban form. We need to establish the capacity of the urban form to support changes without affecting the social network and the inhabitants' systems of orientation. Establishing limits for change becomes fundamental for site analysis. Limits define the maximum changes that the urban form can support

without affecting the internal physical and social network. The basic information needed to establish these limits include spatial (physical) and non-spatial (social) variables.

Graphic 1: Compact homogeneous urban form.

3.2.- The physical network

The physical network is the way built elements connect through open space; therefore it constitutes the urban fabric of a settlement. Patterns of connection between individual buildings are usually analyzed through typological studies. In massive built forms, where buildings are difficult to individualize, studies should focus on group typologies.

Physical elements that perform a social role, such as pedestrian intersections where groups interact or signs that identify places linked to community history, can be difficult to perceive. Identifying these elements is basic to understanding the relationships of social groups to the built environment.

3.3.- The social network

Ties between groups constitute the social network, highly appreciated by barrio residents. Residents strongly oppose being separated from kin and friendship networks. To understand community relations, our first task is to define the boundaries of social groups. Each social group has a spatial domain; however, physical limits can be unclear.

In complex squatter developments, the only way to define community boundaries is through residents' participation. A territorial boundary is a knowledge that belongs to the community. Because boundaries are the main social constraints for change, improvement plans must identify and reinforce community boundaries.

4.- What do Sustainable Renewal Proposals require?

Sustainable proposals for squatter settlements require plans addressed not only to satisfy vital needs and organize chaos but to value social ties and aesthetics as a basic need for a healthy community. Preserving the existing referential system as a community resource

and developing projects that provide meaning to the urban vacuum, usually abandoned, unsafe and unhealthy, reinforce sustainable plans.

Community participation is required to identify social values and community ties. To guarantee sustainable solutions, the values and agendas of the squatter development's residents must be incorporated into the planning and policymaking process. Planning teams must assess community-based knowledge and perceptions to create sustainable development proposals.

At the start of the planning process, planning agencies and municipal councils usually identify and contact community leaders. Representatives of the planning agencies officially present the planning team to the community. After that, the technical group is on their own, organizing communities to involve them in the improvement process. Their main goal is to make sure that everyone living within that space will benefit from improvements.

At the urban scales leaders representing different community sectors communicate the needs and desires of large groups of population. Needs usually address problems related to environmental risks, infrastructure, accessibility and security. Some times these problems are not spatially located.

5.- Establishing a limit for urban interventions: A border line for sustainability.

Upgrading squatter development to increase life quality requires physical and social changes. The main question planners' face is how to remain sustainable when changing is inevitable. Where is the border line for improving life quality in a sustainable way? The border line even thou ambiguous is a condition within which the main guidelines of the underlying urban order continue to function.

In complex dense settlements, introducing radical modifications in the underlying order, affects sustainability. A review of the built form which provides a full understanding of how to change without exceeding the limits of sustainability is a mayor issue in Site Analysis. Therefore establishing a limit for interventions is a key planning problem.
Sustainability requires changing without disrupting the existing social structures and physical order. The changing process has two objectives dual and contradictory: preserving the social units and trying at least in a general way to maintain the built form. When establishing changing capacity, the existence of restrictions intimately related to urban form and to the subjacent order that guides life, must be considered.

5.1.- A friendly urban design.

In general, urban design proposals pursue integrating the informal settlement with the planned city by balancing the quality of life conditions in the barrio with the surrounding areas. When the guiding principles of improvement are rooted in urban form and community capacities, the physical and social values of the community will be preserved. Referential elements, natural features, vernacular building codes, and social subdivisions are some of the values that need protection.

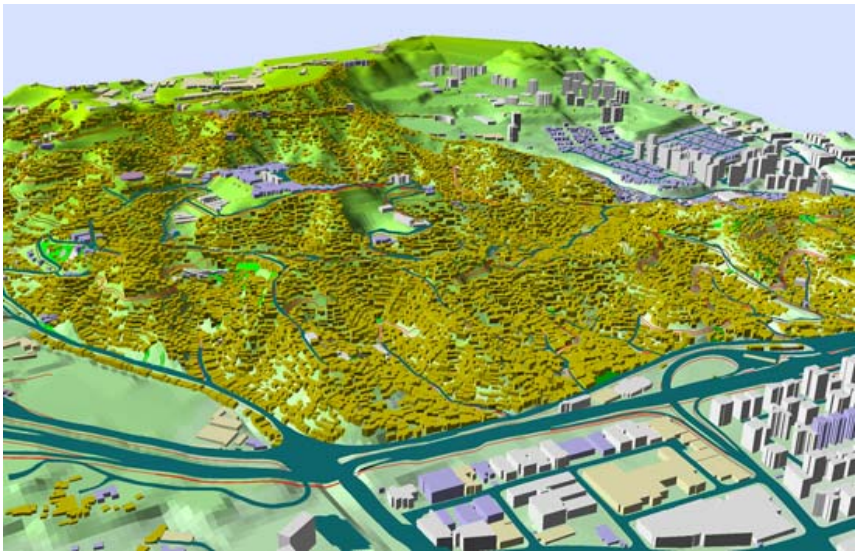
To preserve means making minimum interventions. We do not consider expropriation a just policy for obtaining land. We propose expropriation only for environmental protection when evident aggressions to the environment have occurred.

Making minimum interventions requires us to pinpoint urban improvement and build within the built. When land is scarce, building within the built is the best option. Recommended combinations for spatial change in high density settlements are vertical growth and insertions of buildings whenever vacant land is available. Building within the built is an urban intervention that preserves urban residents' memories (Graphic 2).

Graphic 2: Building within the built to preserve resident's memory.

6.- Petare Agricultura: a case study

Miles away in the city of Caracas, the settlement of Petare Agricultura appears as a solid built mass placed on the surrounding hillsides. Coming closer, an anarchic and discontinuous system of vehicular and pedestrian routes appears within this built mass.
The visual homogeneity is such that concepts of hierarchy are meaningless. A 3D view generated with ArcScene shows the homogeneity of the urban from and the sense of confusion generated by the absence of open space hierarchy (Graphic 3).



Graphic 3: 3D View of Petare, Agricultura.

6.1.- Petare: Physical and social characteristics.

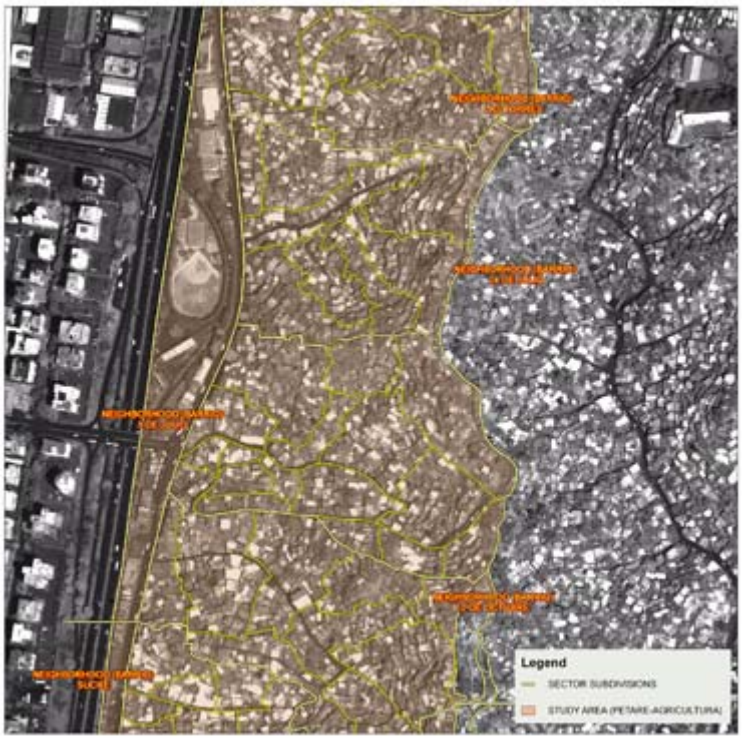
We chose Petare as a case study for its density and complexity. Developing a plan for this barrio required testing and evaluating different approaches before reaching a sustainable solution.

Petare Agricultura contains sixteen barrios, each with several sectors. Sectors represent the spatial unit within which residents develop a strong sense of belonging. Inside the sector everybody knows each other and residents can easily identify boundaries of their sectors and the dwelling units that belong to each of them.

The intricate built form and the way buildings within the same block can belong to different sectors give some idea of the difficulties in mapping spatial subdivisions. A fragment of an aerial photograph and a mapped subdivision show the interdependency that can exist between the physical belonging to a built group and the social belonging to a community group. Sectors limits constitute a threshold for change and must be protected as an indivisible territory.

A joint effort between the urban team and community residents carried out an exhaustive site and cartographic analysis to establish sector boundaries. The community identified 93 sectors within 82 hectares. The task of defining sector boundaries was one of the most difficult of the whole upgrading process.

To establish a relation between the social space and the built space, we overlaid the sector subdivision with the built form. Overlaying a sector subdivision and an aerial photograph evidenced the independency between both. Social subdivisions and variations in the urban fabric were impossible to detect (Graphic 4: Social Subdivisions).



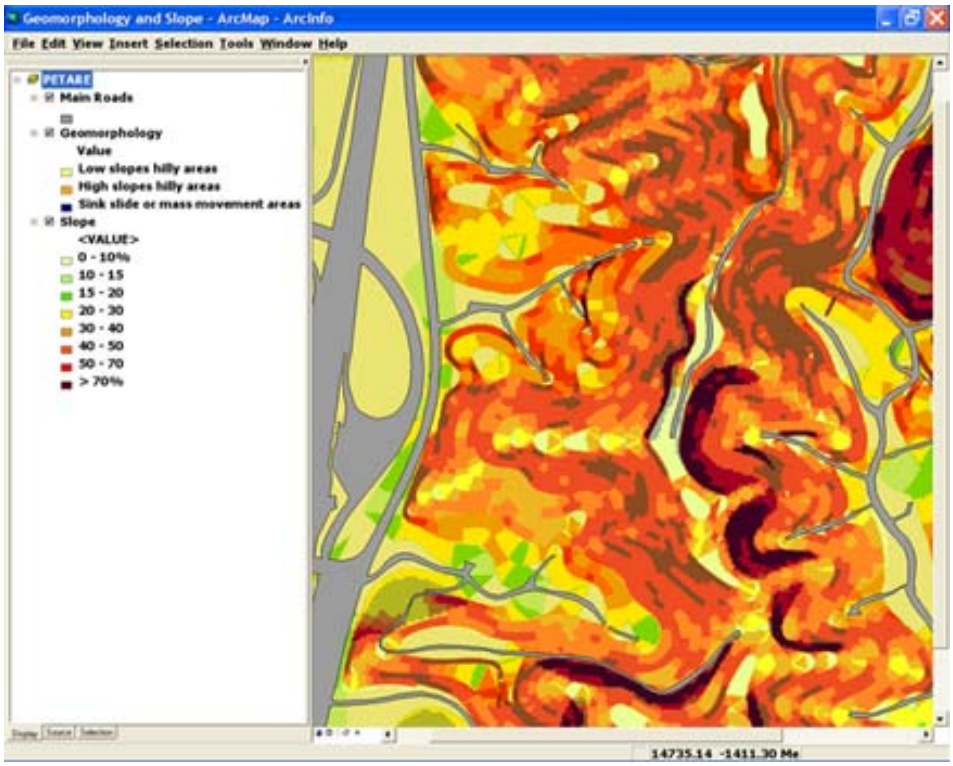
Graphic 4: Social Subdivisions.

6.2.- Site analysis in Barrio Petare.

We tested our approach to environmental studies in the barrio of Petare. Applying the threshold theory combined with GIS techniques for site analysis; we developed a set of maps and models. We produced a series of thematic maps in ArcGIS then manipulated and combined thematic maps to obtain two basic models: conservation and urbanization. A thematic map that gave a clear picture of the complex geography of the site was a combined geomorphology and slope map (Graphic 5).

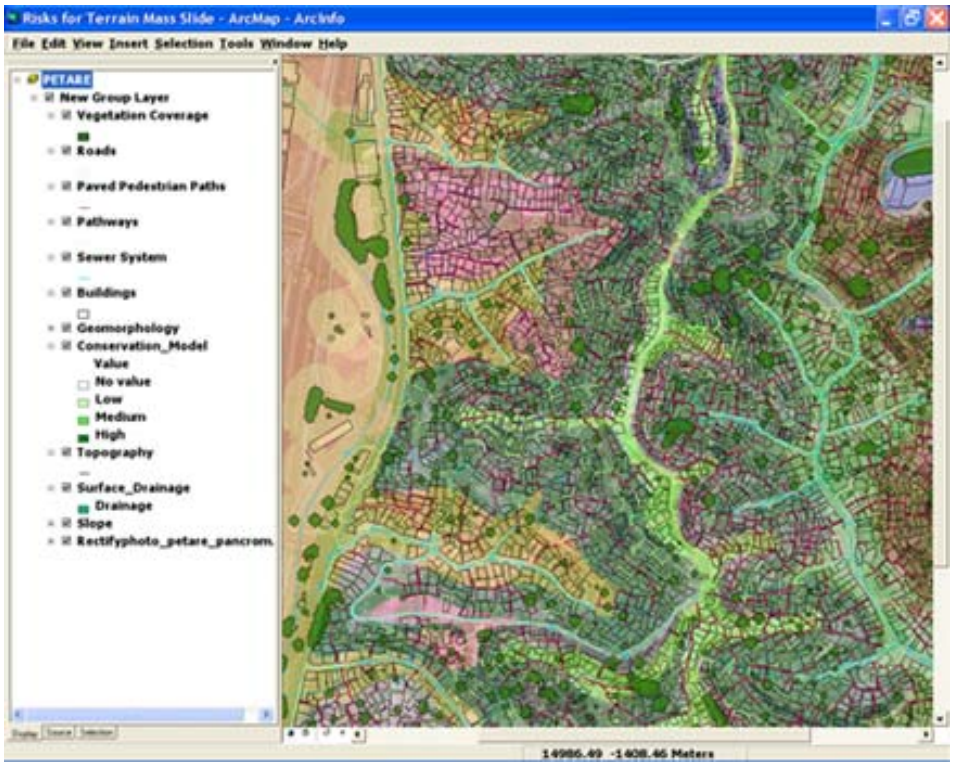
6.3.- Managing Environmental Limitations

Environmental limitations provide a frame work for change; however we usually observe occupation restrictions that reach up to 80% of the settlement. Can we remove thousands of inhabitants and relocate them somewhere else? Answering yes is a fantasy. Site analysis must identify critical areas, where environmental risks are severe. Those are the only areas to be preserved from urban occupation. The rest even though sensible to different environmental problems will need special urban interventions to palliate harmful effects.



Graphic 5: Geomorphology and Slope Map for Petare.

A combination of the Conservation Model with a transparent overlay of slopes allowed us to determine locations of higher risks of mass landslides. Special attention was given to these areas where building controls were proposed. Recommendations for avoiding vertical growth of existing buildings, was one of the few controls accepted by communities (Graphic 6).



Graphic 6: Risk of mass landslides for Petare.

6.4.- Proposals for organizing the Urban Scale.

Petare has a very dense urban occupation with little or no land for locating new facilities. The settlement has severe infrastructure problems. The network of water pipelines and sewers in the upper areas has been built by many different dwellers with low quality material, which has produced widespread leaking that affects the terrain stability. Pipeline tracing is not mapped and the pedestrian stairs also function as drainage channels. In general, accessibility is very difficult; however, the central interior areas are the most severely affected.

The primary improvements that the community requested are related to accessibility, urban facilities, and infrastructure. The community was also unsatisfied with drainage and solid waste disposal.

6.5.- Possibilities for changing the built

Possibilities for changing built groups can be graded from hard to soft, with intermediate categories. Hard defines areas that are difficult to change without disrupting the built environment. Soft describes easy-to-change areas that preserve the existing order.

For each building typology we can associate a minor or major possibility for change. For example detached buildings are easy y to change therefore are considered soft. Blocks of pilled buildings are considered hard to change. Usually moving a unit can produce the collapse of the whole.

Changing is also related to accessibility. Areas easier to access are more likely to improve in the short run. Very difficult access can freeze improvement. In Petare we measured

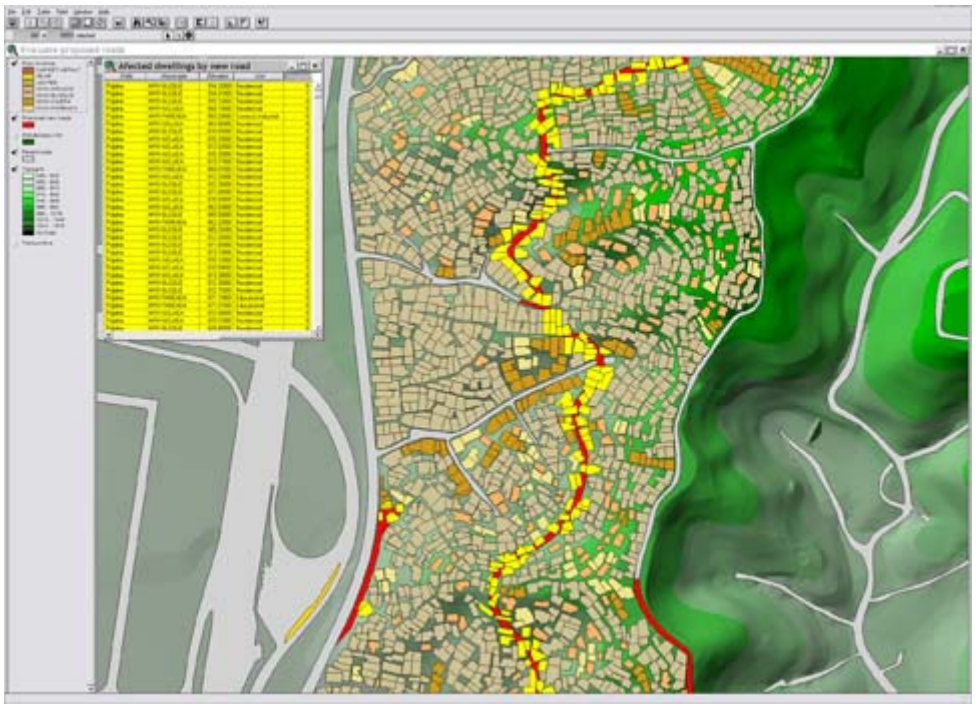
distance to roads to establish grades of accessibility. Adjacency to roads provides good accessibility. Areas located between 5 and 10 meters from roads have medium accessibility, areas located within 11 and 15 meters from roads have poor accessibility, and areas located more than 15 meters from roads have very poor accessibility.

To introduce changes in existing open space we identify types of public open space and their possibilities for locating new activities. Each type of open space holds different possibilities to be molded or expanded. Typology does not define minor or major possibilities for change; it simply points out what kind of change is adequate. Whether open space can be changed depends on its location and geometric characteristics.

6.6.- The urban design proposal

The urban design proposal includes a combined approach for horizontal extensions of very small dimensions, vertical growth of existing educational and health facilities, and substitution of selected pieces.

To provide access to the interior areas of the settlement, we proposed two network scenarios: a continuous north-south axis to connect interior areas or a succession of interior penetrations initiated in the north and south peripheral roads. Illustrating both scenarios, the feasibility map showed that the north-south settlement crossing had a big impact on areas classified as non-feasible for interventions (Graphic 7). Providing a continuous road to connect all barrios would require removing more than 500 dwellings.



Graphic 7: Proposal for a north-south axis.

Successions of inroad penetrations minimized the length of the trail, which reduced direct impacts on the built areas; however, this road system was not continuous and required a series of switchbacks. The urban design team chose to reinforce the existing branch-type road system proposing a succession of inroad penetrations based on small interventions that would have a minimal impact (Graphic 8).

Graphic 8: Proposed succession of inroad penetrations

Whenever possible, we made good use of multiple dead end roads, extending and including end returns or cul-de-sacs. We organized the space around a cul-de-sac to incorporate small community services such as health care centers, and turned return areas into local activity centers.

We organized residual space generated by improvement interventions and integrated it into the existing open space to develop plazas or widen roads and pathways. We used residual space larger than 50 square meters for new housing or community services. Another solution for adding community facilities was to reuse and grow existing buildings vertically.

The pedestrian system of stairs and sidewalks was improved and extended to include new elevated sidewalks that would allow pedestrians to circulate next to the adjacent highway (Petare-Guarenas), the main access to the neighborhood. Continuities within the pedestrian system were reinforced and linked to the cul-de-sac system.

Working together, technicians and a group of community members defined guidelines which were later submitted to the entire community for approval in an open assembly. Community members expressed what was important to them and what they wanted to preserve. Their desires were supported in the urban proposal. For example, buildings community wanted to preserve were renewed adding floors and refurbishing facades (Graphic 9).

Graphic 9: Refurbished Community Building.

6.7.- Proposals for organizing the neighborhood scale.

Once the proposal to organize the urban scale is approved by community leaders, a new process begins. The planning team starts working side-by-side with neighborhood groups to improve their living area. Neighborhoods were defined during the planning process. . For us, this process began simply when we asked residents for some information. It ended with the community participating in managing the improvement proposals.

With community leaders we schedule a series of general meetings to which we invite the entire community. Meetings take place in schools, open space, or sometimes in residents' homes. At these meetings, we interview residents to understand the real boundaries of the community (Graphic 10).

At the first meeting, we explore issues and ideas residents have about improving their community. We promote discussions with the goal of reaching agreements about priorities. As meetings continue, communities usually build a sense of ownership with the project and begin to participate more fully. By the end, participation leads to a joint decision-making process and, therefore, to a successful project.

Graphic 10: Community meeting at a resident's home.

We have found that it is impossible to define social information that is spatially-related without community participation. Residents' vernacular knowledge for their daily problems helps planners because professionals alone cannot provide all the answers. Likewise, communities need a full understanding of improvement proposals. It is not enough for a technical team to propose, solve, and apply solutions for a problem. For communities to support and be committed to development plans, they need to understand proposed solutions. Once residents understand proposals, their participation can modify the project agenda in terms of topics and timing.

7.- Neighborhood Scale in Petare: Case study.

In Venezuela, neighborhood associations have recognized legal rights; therefore, creating community associations is the initial step whenever planning urban development. Venezuelan agencies promote the creation of community associations that combine concepts of social domain and physical space. These groups, called *Estructuras Condominiales* and which translates as c*ondominium structures*, allow communities to benefit from common services (water supply, electricity, and access roads) and become responsible for shared facilities and urban space.

Even though residents in traditional condominiums and squatter development condominiums both share space and facilities, fundamental differences between them exist. In traditional condominiums, social relations between residents may not exist. In squatter development, those are required conditions. In squatter developments, a potential condominium is a shared residential area with strong identity elements where residents are attached to the place and have an informal neighborhood association. These characteristics provide a basis for beginning to organize community groups.

Planning agencies in Venezuela chose three small squatter development areas to promote community involvement and management of their improvement activities. For one of these areas, Condominium Doña Evangelista we developed an improvement project and guidelines for social behavior. We developed these in parallel, with continuous community participation. Approval of a final ruling document was achieved through meetings with community leaders.

At community meetings and workshops, residents were organized to do the following:

1. achieve agreements on priority needs
2. promote different groups to be responsible for tasks related to improvement projects
3. develop a strategy for achieving project goals
4. design development and behavioral rules for the condominium

We controlled and managed this planning process using GIS. GIS helped us keep track of multiple tasks related to regulating land ownership, community participation, agreements, and building permissions.

7.1.- Doña Evangelista: location and characteristics

The condominium structure of Doña Evangelista located in the barrio of Petare provides one example of designing a community-supported plan. Doña Evangelista is located in Petare's Barrio 24 de Julio, facing the Petare-Guarenas highway and easily identified by a retaining wall that limits the area (Graphic 11).

Doña Evangelista is a community of twenty buildings that lodge thirty-five families, with an average size of five persons per family. Nearly all the families were founders of the barrio. Sharing history has created strong community ties and united them in making requests for improvement.

Existing external and internal elements provide a clear understanding of the spatial unit. For example, the retaining wall provides access from the highway to a small public space and from there to surrounding dwellings. Direct access to dwellings and public transportation provides a higher quality of life than in the interior communities.

Graphic 11: Façade of Condominium Doña Evangelista.

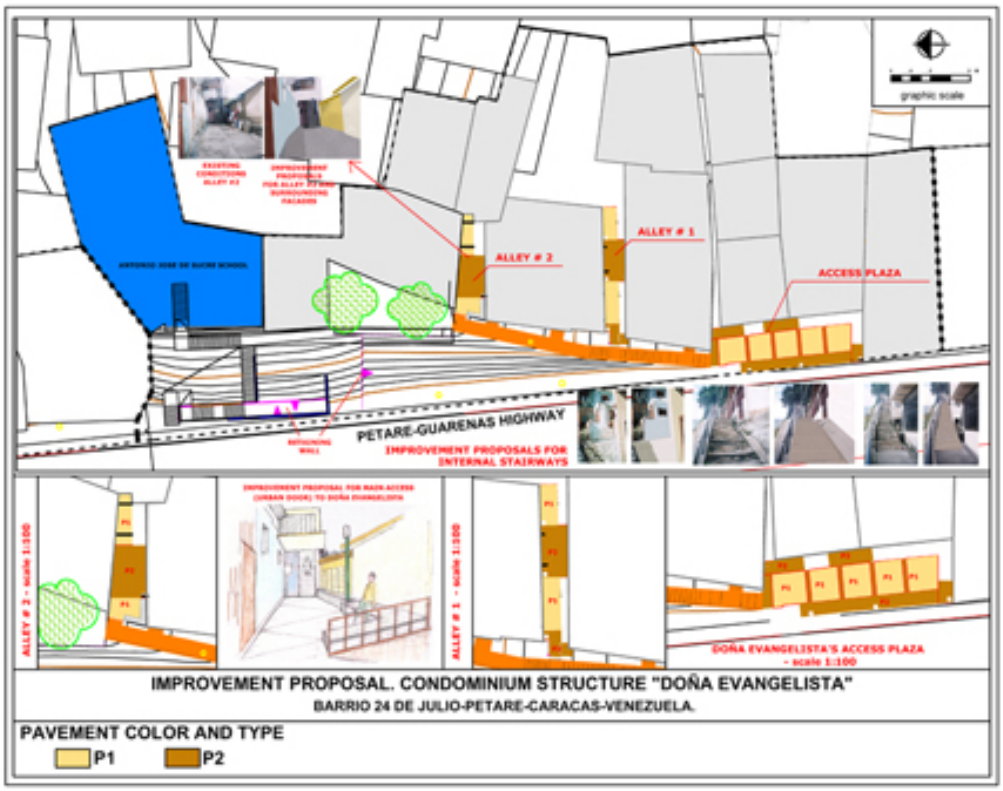
7.2.- A condominium plan for Doña Evangelista

The plan for Doña Evangelista pursued improving quality of life in the area and organizing the residents into a condominium structure association. Community members led the process of site analysis and residents participated in the evaluation of the area.

Planning agencies assumed that residents in the clustered buildings would work together in a unique neighbor association. A view from the highway gives an impression of wholeness

based on the façade continuity; however, in meetings with community members planners learned that residents had a clear sense of belonging to three different social groups.

Planners agreed to establish three sub-condominiums and develop a plan for the central sub-condominium. Once each sub-condominium was organized, the plan for the central sub-condominium became the example to follow and behavior rules were welcomed by all residents of the condominium (Graphics 12 and 13).

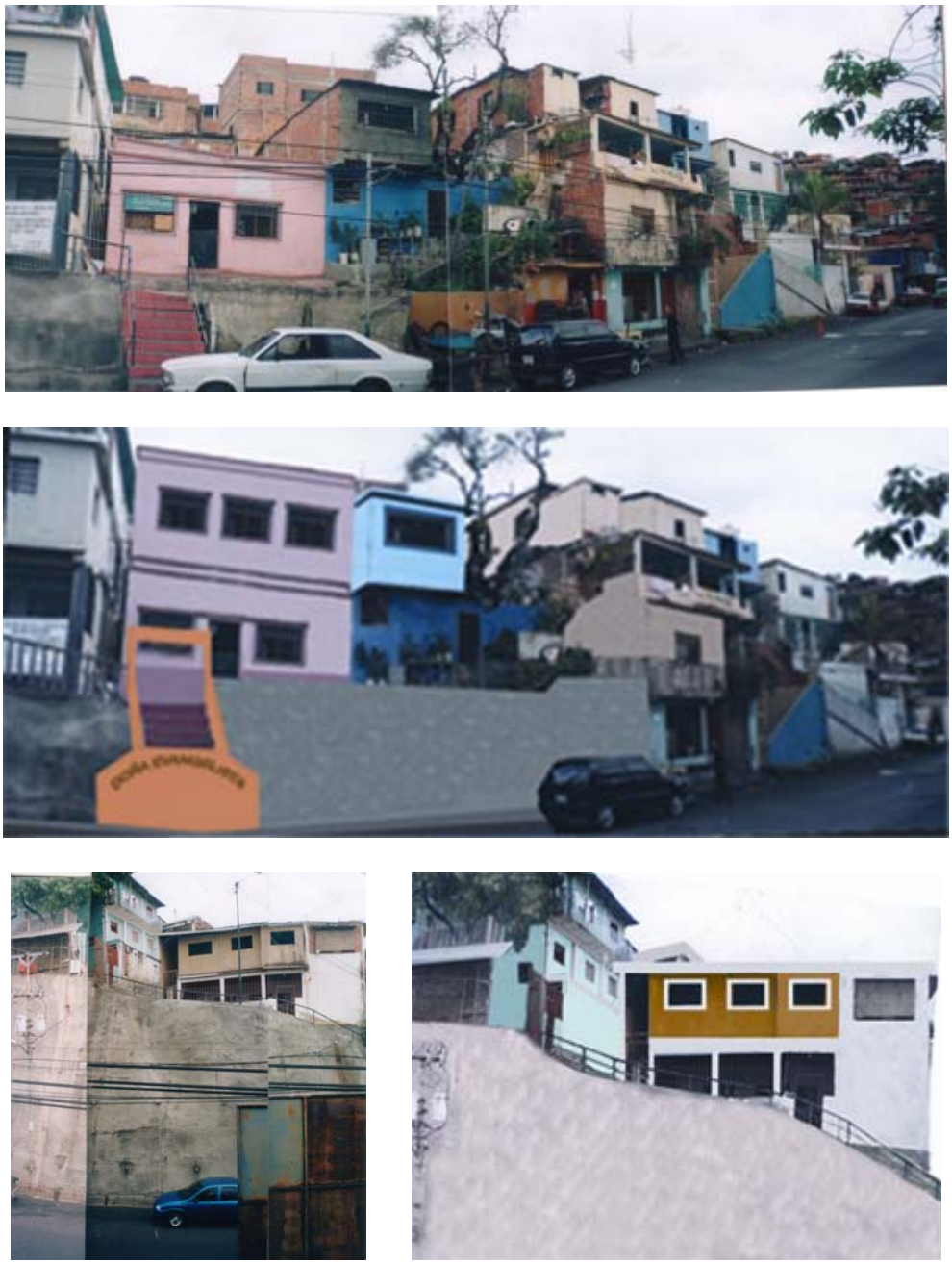


Graphic 12: General Improvement Plan.

7.3.- Community-expressed desires

In interviews, community members made the following list of requests:

1. provide channels to drain rain water
2. organize and refurbish open space so they could use it as recreational areas, mainly for children
3. provide handrails for the main access stairway to improve circulation security
4. provide public lighting because the lack of adequate light increases insecurity
5. make aesthetic improvements. This was the major demand expressed by community members, especially young people. They felt this would change their poverty image and make a difference with the rest of the settlement.



Graphic 13: Proposals for Façade Improvements.

7.4.- The Upgrading Plan.

Proposals for improvement included interventions to infrastructure and the functioning and appearance of the sub-condominium. Planners developed building specifications for each proposed public work. Proposals for physical appearance and functioning included:

1. Reinforcement and extension of the existing retaining wall, including landscape conditioning and a pedestrian connection with the existing school.
2. Refurbishment of public space that includes new public lighting, substitution of public space pavement, organization of surface levels, and relocation of access stairs to dwellings.

3. Façade improvements such as painting, roof gutters, and drain pipes Construction of a new access stair to the sub-condominium. This project includes a drainage channel parallel to the retaining wall and a special area for waste disposal (Graphic 14).

Graphic 14: Façade Improvement Project.

We developed proposals for infrastructure projects to:

1. Move the main water feeder underneath the main stairways and connect water supply to the city pipeline.
2. Substitute the bundle-type superficial water supply system with an underground branched feeder.
3. Promote agreements between the agency providing water and the community that would establish routes and fair service rates.
4. Design the sewer collector beneath the main access stair. Provide a secondary branch water system to connect dwellings.
5. Substitute the superficial pumping system with underground waste water disposal lines.
6. Design a drainage channel adjacent to the main access stair for rainwater discharge. (Water accumulates during the rainy season which makes access to the area difficult.)
7. Renew the drainage channel that runs along the highway.

7.5.- Rules for the social and physical functioning of condominiums

Though it was primary to control the way buildings are developed, squatter development residents completely rejected applying standard city development rules. To guarantee success, the planning team designed simple and easily understood rules for physical development and social behavior. To be successful, the residents needed to understand the guidelines and rules. The main source for rule design was site analysis and residents' information about their needs.

Social rules guide residents' behavior with other residents and with their living space. Communities themselves chose the word 'behavior' for the set of social rules. Simple responsibility rules support maintenance of public facilities. A condominium-ruling document includes general and specific rules. General rules include definitions to make the document easily understandable. Terms such as lot, façade, attachment, slab, cantilevers, etc., were described and explained at meetings with residents. Permitted and non-permitted land use was fully described.

The planning team and the neighborhood condominium association developed a document to guide residents' behavior. Rules included two types of controls, those related to living side-by-side with others and those related to the use, maintenance, and preservation of community spaces. To promote peace and solidarity between residents, the rules avoided sanctions.

7.6.- Physical rules.

Physical rules guide building and renewal interventions and serve to protect public space. Some of these guidelines include the following:

1. Enlargements adjacent to public space are not permitted.
2. Cantilevers and balconies over public space are not permitted.
3. Meters currently located on dwelling facades must be grouped and contained in specially built boxes.
4. Building heights cannot exceed four floors. Vertical extensions are permitted in dwellings that have not reached the maximum height. No vertical extensions are permitted in existing buildings that already exceed height limits.
5. To promote structural stability, floor and roof slabs must coincide whenever attached dwellings are renewed or enlarged.

8.- Guidelines for developing upgrading plans for squatter developments.

The following guide lines can be helpful when developing upgrading plans for squatter developments from the general urban scale to the neighborhood scale.

8.1.- The Urban Scale:

1. Urban design proposals must integrate the settlement with the larger city by balancing quality of life conditions with the surrounding environment.
2. Integration between squatter developments and their adjacent cities must preserve the existing spatial and social systems of relations within the settlement. Any urban intervention needs to promote social and physical cohesion.

3. The urban design proposal must benefit the physical, social, and economic conditions of the site.
4. Proposals should maintain key features of the urban scene since the features provide a singularity of appearance, which is highly meaningful to the communities.
5. Improvement interventions should provide a balanced fit between the built environment and proposed actions, avoiding scale aggressions or monumental solutions.
6. The proposed urban scene must integrate new elements with the collective memories of the residents.

8.2.- The Neighborhood scale.

1. Involving communities in improvement processes is fundamental to guarantee success. Residents need to be involved with the project so that both they and the planners understand it.
2. Community participation can help right mismatches between technical proposals and community requirements. The capacity of an organized community to dialogue with the institutions that provide electricity and water supply allows residents to request the infrastructure improvements they want.
3. To ensure community participation and harmony between residents, groups should be small.
4. Displaying information graphically helps planners communicate plans and projects to residents; however, residents' full understanding and participation depends on a community-based contribution of knowledge.
5. GIS promotes community contribution through an interactive process that allows residents to add relevant spatial information to the database and display its effect on improvement interventions.
6. Involving community groups with GIS enhances their capacity to generate, manage, and communicate valuable spatial information hidden in the complexity of poor settlements.
7. Planning for the poor succeeds when citizens participate and take direct action toward solving their problems.

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AUTHORS INFORMATION

Author: Rosario Giusti de Pérez. Msc. Architecture, Msc City Planning.

Title: General Manager (Gerente General).

Organization: Grupo ESRI de Venezuela.

Address: Centro Plaza, Torre C, Piso 19, Oficina 19B, Avenida Miranda, Los Palos Grandes, CARACAS

Telephones: 58-261-7927997, 58-416-6605960

Fax: 58-261-7923086

E-mail address: rosario@esriven.com, rosario_giusti@hotmail.com.

Co-Author: Ramón A. Pérez. Msc.Architecture, Msc City Planning.

Title: President.

Organization: Grupo ESRI de Venezuela.

Address: Centro Plaza, Torre C, Piso 19, Oficina 19B, Avenida Miranda, Los Palos Grandes, CARACAS

Telephones: 58-212-2859394, 58-212-2851134.

Fax: 58-212-2850714.

E-mail address: ramon@esriven.com, ramon_perez@cantv.net.