SUSTAINABLE DEVELOPMENT BY MEANS OF A COLLABORATIVE PLANNING FRAMEWORK. THE CASE OF MUNICIPAL HOUSING IN GUATEMALA CITY

JOSE ANDRES MORALES

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SUPERVISORS:

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SUPERVISORS:
Dr., J. F., Johannes Flacke
Dr., J. M., Javier Martinez

THESIS ASSESSMENT BOARD:
Prof. dr. ir. M.F.A.M. van Maarseveen (Chair)
Dipl.Ing. J. Lückenkötter (External Examiner, TU Dortmund)
Dr., J. F., Johannes Flacke
Dr., J. M., Javier Martinez

ABSTRACT

Urban areas are the core of social, economic and cultural advancements. However, past developing trends, characterized by fast growing rates, had lead cities to face serious challenges. The planning of future sustainable development is one of the core tasks and concerns for political and spatial planning agendas. In Latin American cities, previous low density growth trends and a top-down planning approach are now being shifted towards more intense use of urban land and inclusive planning practices.

In Guatemala City, larger expansion takes place in the peripheral areas in form of sprawl in the late 70' and 80' due to increase in the population natural growth rate and high migration rates to the capital city. Housing is identified as a component to address sustainable development by means of densification in central areas. Partnerships and inter institutional efforts are addressed in the attributions of the Municipal Housing Enterprise. However, structured frameworks and methods for collaborative planning are still not fully defined as a mean to face the city challenges by ways of coordinated efforts.

This research addresses the structure and implementation of a collaborative planning framework. The research approach conceptualizes sustainability in urban environments and its implications in planning for sustainable housing development by means of collaborative planning. Multi Criteria Evaluation methods are addressed as the core in the process of identifying and assessing sites for municipal housing projects. Emphasis is done in the flow and understanding of the information being produced by stakeholders involved.

Insights from stakeholders are investigated in order to account for a collective and multidimensional perspective of their concerns. Barriers and opportunities for the housing development and further collaborative approaches are identified.

Sites for housing projects are identified and assessed. Results show that different methodologies applied can offer an effective and transparent support to inform the planning process. Still, in addressing the sites assessment for municipal housing project from multi-dimensional perspective, strong discussions should be stimulated in order to strength the decision-making process in collaborative environments.

Keywords: Sustainability - Urban development – Densification - Sustainable housing development - Collaborative planning - Multi Criteria Evaluation - Geo-visualisation.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATIONS

1. INTRODUCTION

This chapter provide an introduction to the research starting in the first section with a background and justification that discuss the topic of sustainability in the context of urban expansion and the importance of improving the planning systems by means of collaborative planning. The case of Latin America cities and Guatemala City is briefly addressed. The second section presents the identified research problem. The third section introduce the objective and sub-objective that are met with this research, followed by the fourth section in where the objectives are decomposed into specific research questions. The fifth section explains the conceptual framework embraced in this research. The last section presents the structure that leads the presentation of this research.

1.1. Background and justification

Urban areas are the core of social, economic and cultural advancements as is remarked in the Habitat Agenda and Istanbul Declaration (Jenkins, 2007a; Milder, 2012). However, developing cities had been experiencing fast growing rates leading them to face serious challenges. Sprawl, congestion, housing affordability and loss of open space, are some of the side effects of urban expansion (Waddell, 2002). During the past decades, urban residential development had speed up extremely with massive population mobility in cities (Xu & Coors, 2012).

The planning of future spatial development, in line with the social, environmental and economic dimensions of sustainability is one of the core tasks of spatial planning (Steinebach, 2009). Within the social and economic dimensions of Agenda 21 to achieve sustainability, improving planning and management systems as well as decision-making processes by means of integrated multidisciplinary knowledge, collaborative/participatory environments and inclusion of data and information at all stages of the planning process is vital (Hall & Pfeiffer, 2000). Crossing professional boundaries to include non-professional, lay and especially tacit community-based knowledge is a clear requirement for sustainable development (UNCED, 1992).

Latin American countries show common roots on historical political, cultural and economic transformations regarding to understand their current issues on urban expansion. Jenkins (2007a), explain some of the common characteristics beginning with a strong colonial heritage reflected on capital cities primacy, top-down structures in housing provision and social spatial segregation together with the introduction of a land market and the penetration of capitalism. In the second half of the last century, high rates of population growth due to strong migrations and increased natural growth is reflected in the urban expansion of cities. Economic difficulties influence the increase in informal markets and informal human settlements. Weakness of public institutions derive in a strong private market oriented provision of housing, therefore accelerating the development in peripheral areas and stretching motorized mobility dependency. With this, Galafassi (2002) suggest that current social and ecological crisis is related to high population and territorial growth during the second half of 20th century.

The dynamics of the urban development of Guatemala are not far, but close to those mentioned previously. After years of a top-down and expert based planning tradition (Jenkins, 2007a), still, a strong market driven development had led to accelerated horizontal growth. In Guatemala city, larger expansion takes place in the peripheral areas in form of sprawl in the late 70' and 80' due to increase in the population natural growth rate and high migration rates to the capital city (Guatemala, 2010). According to the Office of Urban Mobility of Guatemala City Municipality, it is estimated that at least 50% of people working, studying and doing their daily activities within the city spend between 2.5 up to 3 hours in

average every day. Same as other Latin American cities, a background on economic and political instability had brought additional consequences, partially, reflected in a polarized society and uneven urban development (Galafassi, 2002; Jenkins, 2007b).

Guatemala City Municipality, in charge of the urban regulations within the municipal boundaries had reacted to this situation. Through its "Plan Guatemala 2020" (Municipalidad de Guatemala, 2005), states its vision aiming to an environmental, social and economic sustainable city. Based on this plan, policies like the new "Territorial Ordinance Plan" (in law since 2009), the public transportation plan "Trans-Metro" (urban project started in 2008, still in progress) and the housing program "Municipal Enterprise of Housing and Urban Development" (in law since 2012) were formulated and implemented. The Territorial Ordinance Plan (TOP), besides regulating the land use, intends to stimulate private investment towards more compact, varied and affordable housing within the municipal boundaries. Additionally, the Municipal Enterprise of Housing and Urban Development (MEHUD) is responsible in formulating financial and management mechanisms, and spatial strategies to develop municipal housing projects. Those oriented to low and middle income groups and strategically located to enforce inner city revitalization. Finally, it is stated a clear intention in enforce inter institutional alliances in order to build knowledge and facilitate sustainable development processes toward future (Municipalidad de Guatemala, 2012; URBANISTICA & CIFA, 2010, page 131). However these intentions are not currently materialized, and limitations and perspectives over a collaborative planning approach are unclear.

Based on the previous, research on collaborative planning frameworks to facilitate participation between multidisciplinary teams and stakeholders are important in improving the planning practice as a mean to favour sustainable development.

1.2. Research problem

In Latin American cities, previous low density growth trends and a top-down planning approach are now being shifted towards more intense use of urban land and inclusive planning practices. In Guatemala City, an accelerated peripheral growth and uneven development of central areas had shown to be unsustainable patterns. Social polarization, loos of valuable natural land, congestion and pollution are some of those effects (Guatemala, 2010). Redevelopment and a strong emphasis in housing projects in the central areas had been identified as one of the main components in addressing the negative impacts of sprawl (Guatemala, 2005, 2010; URBANISTICA & CIFA, 2010) . In this regard, the initial question where to locate municipal housing considering the existing limitations and opportunities for such projects in terms of social, economic and environmental aspects is critical in planning for sustainable development.

In planning for reaching sustainability, heritage of a top-down planning had shown to fail. The shift in the paradigm of the planning tradition and the role of the urban planner is moving towards a more participative and stakeholder-based knowledge. Together with the development of the Planning Support Systems and Decision Support Systems that enforce these approaches (Jankowski & Nyerges, 2001). However, for the case of Guatemala City, structured frameworks and methods for collaborative planning are still not fully defined as a mean to face the city challenges by ways of coordinated efforts. Research on the use of integrated planning and decision support systems and informative means need to be addressed to improve and facilitate collaborative approaches. Even though geo-information data and technologies like GIS software packages are available within the Municipal Institution, in most of the cases those are used in a merely descriptive manner. In most cases is used exclusively by municipal planners.

Therefore, the research problem is stated as *how to implement a collaborative planning framework in assessing municipal housing projects location to achieve sustainable development*.

1.3. Research objective and sub-objectives

The main objective was to develop and test a framework to identify and assess housing projects location in a collaborative planning approach in order to achieve sustainability. The framework is applied to the municipal housing projects of the MEHUD in Guatemala City. As part of the research, is carried out an exploration of the grounds in where no participatory practices are still fully implemented, but are intended according to the established attributions of the MEHUD (Municipalidad de Guatemala, 2012). Thus, this exploration had reviewed the pre-conditions (opportunities, barriers and willingness) for such participatory approach, investigating the insights from the different stakeholders that were identified.

Sub-objectives

1. To identify a methodology and process to support collaborative planning approaches for municipal housing projects.
2. To explore the perspectives by potential stakeholders regarding the housing development and the participatory planning approach.
3. To implement a collaborative planning framework to design and assess sites for municipal housing projects.
4. To critically reflect on the implemented collaborative framework.

1.4. Research questions

Based on the sub-objectives of this research, the following research questions were posed:

1. To identify a methodology and process to support collaborative planning approaches for municipal housing projects aiming to sustainable development.
    - What could be the process and methods to assess sites for municipal housing projects in a collaborative approach?
    - Who are the stakeholders involved in housing projects in Guatemala City?
    - How to capture the knowledge based on the insights from the different stakeholders regarding to site assessment for housing projects development?
    - What are the information requirements of stakeholders to support understanding and assessment of sites?
2. To explore the perspectives by potential stakeholders regarding the housing development and the collaborative planning approach.
    - How are related their interests and concerns to sustainable housing development?
    - What are the opportunities and limitations for the municipal housing development?
    - What interests do they have in collaborate in planning municipal housing projects?
    - What is their stake and what could be their degree of collaboration?
    - What are the main barriers and strengths for implementing a collaborative approach?
3. To implement a collaborative planning framework to design and assess sites for municipal housing projects.
    - What are the characteristics of a suitable site for housing and what is the priority of those?
    - How to do suitability analysis of urban land to do site search of suitable areas?
    - How to define site alternatives for housing development?
    - How to do assessment of sites options in a multi stakeholder environment?
4. To critically reflect on the implemented collaborative framework.
    - What are the benefits and difficulties of working in a collaborative approach in assessing location for the municipal housing projects?

- How relevant is the information being produced in the framework for the participants in order to improve understanding and support the decision-making process?
- How the designs of site options and the assessment of those incorporate the concerns of the stakeholders and the concepts of sustainable housing development?

1.5. Conceptual framework

The conceptual framework introduces the main concepts that are reviewed in this research and their interactions as flow of concepts. Sustainability, in its multidimensional character is reviewed focusing on two main aspects. First, a definition is given of urban sustainability, discussing the topics of density and the role of housing projects. Second, literature on collaborative planning concepts and methods is reviewed as a mean to achieve sustainability. The planning framework concepts and collaborative methods are reviewed in its convergence in the Spatial Planning Systems and Decision Support Systems. As an output it is conceptualized a collaborative planning framework to assess location for municipal housing projects aiming to the objective of sustainable re-densification.

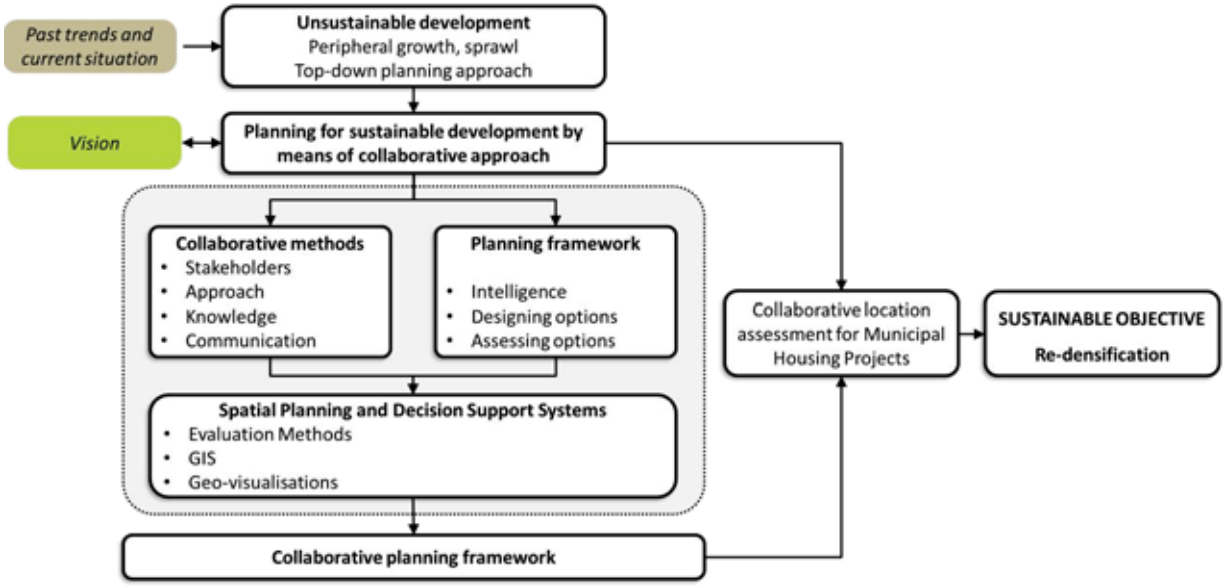

Figure 1.1. Conceptual framework. Own source

1.6. Thesis outline

This section describes the outline of this thesis

Chapter 1 introduces this research with background information and justification in addressing sustainable development by means of collaborative approaches. The research problem is identified and the research main objective is defined. Sub objectives and research questions are posed. A conceptual framework delimitate the discourse addressed in the research.

Chapter 2 synthetizes the literature review. Sustainability is conceptualized from a broad perspective and then its implications in urban environments, housing development and the collaborative planning approach as a mean to achieve sustainable development. A review is then given on collaborative approaches and the planning process and the Multi Criteria Approach as the evaluation method to be incorporated in this collaborative framework. Finally, a collaborative framework is proposed.

Chapter 3 describes the case study. An introduction is given to the city giving brief description on its past urban trends, the housing provision and the responses of the municipality. Finally, the study area is delimited geographically and briefly described in maps.

Chapter 4 constitute the operationalization description of the collaborative framework proposed in chapter 2. Five phases are defined in this operationalization with explicit description of the methods applied during the whole process. The first two phases correspond to the activities realized during the fieldwork. Stakeholders are identified and interviews and the workshop methods are implemented. Phase three and four consist in the implementation of a methodology and process to identify and assess sites for municipal housing projects.

Chapter 5 describes the outputs of the first two phases defined in chapter four. Insights from stakeholders are explored and criteria and weights are defined to be used in phase 3.

Chapter 6 describes the outputs obtained in phase 3 and four. A suitability model was implemented to design site options. Next, in a two-step framework, those sites are assessed and a rank is suggested.

Chapter 7 synthetizes the findings of this research addressing the research objectives. Final conclusions and recommendations for further research are given in this chapter.

2. SUSTAINABILITY AND COLLABORATIVE PLANNING

This chapter intends to introduce the frame of concepts on where this research relies. A literature review was done to conceptualize sustainability and its implication in the urban development. The model of compact city and densification is reviewed at the light of the debate found in literature. Following, the role and implications of sustainable housing development are reviewed, with emphasis in its role and other components. Then, collaborative planning concepts are reviewed as a mean to achieve sustainable development. Finally, Multi Criteria Evaluation methods are briefly discussed as the evaluation method incorporated in this research. The last section extracts some conclusions, and a collaborative planning framework is proposed.

2.1. Conceptualizing sustainability

Sustainability concept is broad and it can be related to several fields of human and environmental interactions. In reviewing the background of what it is known and discussed nowadays as sustainable development, Creech (2012) list the main historical events, documents and meetings that conform the timeline of sustainable development. Here are mentioned the most important ones in the scope of this research. From 1962, with an original focus on the effects of development in environment, through time other aspects come to the global concern about sustainability. In year 1969, the role of citizens in decision-making towards prevention of environmental degradation is introduced. In year 1971 are introduced concerns about ways to make economic progress without destroying the environmental resource base. Years 1974 and 1980, social dimensions of growth and equity are fist discussed in the context of Latin America (1974). Later (1980), in the World Conservation Strategy, poverty, population pressure, social inequity among others are identified as the main agents of habitat destruction. In year 1976, "Habitat" is the first meeting in linking the environment and human settlements. In 1987 "Our Common Future" brings together social, economic, cultural and environmental issues and global solutions. In 1992, agreements are reached in Agenda 21 at the "Earth Summit" UN conference. Years 1993-94 are characterized by special attention to enforce rationalization of intergovernmental decision-making capacity, give more decision-making power to developing countries. "World Summit on Sustainable Development" (2002) promotes partnerships as a non-negotiated approach to sustainability. Finally, in 2008 more than 50 per cent of the world's population live in towns and urban areas.

Primarily, the basic concept states that sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). Within the global political framework different discourses and definitions of sustainable development are given, also reflecting the way it is measured (Shen, Jorge Ochoa, Shah, & Zhang, 2011). From the timeline review and this definition some main words can be extracted (environment, economy, society, participation, partnerships and human settlements). It is understood that it is a multidimensional, multi-scale and dynamic concept.

However, Camagni (1998) presents a comprehensive review of the implications of sustainability arguing that a lot of ambiguity and vagueness prevails in applying this concept to urban environments. First he makes a distinction between the implications of the capital to be preserved at the global perspective (natural non-renewable resources) and within the urban artificial environment (overhead capital and wellbeing). A distinction is made between the approaches of decision-making process. It is stated that focus on the rationalization and continuous learning process in identifying choices with full account of uncertainty and incomplete information should prevail over the means-ends decisions

approach (assumption of complete knowledge and infinite capacity of computation). Under this scope, and debating the economic-environmental trade-offs within the urban environment, the time-span of sustainability should address needs of present generations and ensure capital flow in the long run for future ones.

Camagni (1998) concludes with defining "sustainable urban development as a process of synergetic integration and co-evolution among the great subsystems making a city (economic, social, physical and environmental), which guarantees the local population a non-decreasing level of wellbeing in the long term, without compromising the possibilities of development of surrounding areas and contributing by this towards reducing the harmful effects of development on the biosphere".

Addressing the implications of such definition from the normative point of view, measures in the short and long-term are discussed in the fields of technology, territory and urban form, and lifestyles and organization of social network (Camagni, 1998; Goodchild, 1994; Jenks & Jones, 2010a; Milder, 2012).

In measuring at what extent sustainability is being achieved, Shen et al. (2011) presents a comparison of indicators and its application in different cities, in reference to the International Urban Sustainability Indicators (IUSIL). IUSIL is a combined document of the indicators proposed by different international and regional organizations. Some few indicators are mentioned focusing on the scope of this research: number of inhabitants per Km^2 (density), restoration of urban land (renovation and redevelopment), travel time, transport modes, annual energy consumption, access to service infrastructure (water, drainage, waste management, telecommunications), number of daily trips and time taken per capita by type of trip and mode of transport, right to adequate housing, housing price and ret-to-income, land price –to-income, citizens participation, transparency and accountability.

In the light of these indicators, it is introduced a review on the compact city model and land use density, sustainable housing development, and collaborative planning as means to achieve sustainable urban development.

2.1.1. Compact city model and densification

Based on the implications suggested by Camagni (1998), a compact and dense city offer positive opportunities for the social, economic and environmental sustainability and liveability of it. Milder (2012) introduces a review of the typologies of urban forms. It is argued that positive aspects of the compact model are protection of rural land, quality of life and a maintained quality of services. Still the positive implications had not been fully demonstrated. Overall, when high densities are also associated with negative impacts in environment (congestion and pollution), and social (loss of privacy and crime) and economic aspects (higher land prices) (Goodchild, 1994).

Even though relationships between density and sustainable urban development are complex and not fully agreed, historically, cities which have higher population and development densities have proved the wealthiest, most dynamic, innovative, diverse and ecologically sustainable (Hall, 1998; cited by B. Roberts, 2007). More densely developed cities tend to have more highly developed social networks, higher levels of knowledge development, learning and innovation (Castells, 1989). Sustainable indicators on transport, economic viability, environment and social benefits are related to a balanced density in central city areas (Jenks & Jones, 2010a). Policies that integrate land uses and collective transport systems (Transit Oriented Development) support the ideal of densification (Jenks & Jones, 2010b). Milder (2012) describes that density is linked to scale economies (critical mass or agglomeration economies) that stimulate economic viability of other land uses (commerce and jobs) and makes economically viable the provision and maintenance of transportation and infrastructure services.

In contrast, sprawling, low density residential areas and spatial isolation from places of work and business with increased distances between travel origins and destinations can, in turn, give rise to vehicle-dependent populations, higher consumption of transport energy (Zussman, Srinivasan, & Dhakal, 2012) and a decrease in labour productivity (Milder, 2012). B. Roberts (2007) identify the main drivers of low

density as the automobile and low fuel prices; population and economic growth; rising living standards, competition for development between fringe municipalities; changes in household income and formation; housing preference, environmental and social problems associated with inner-city areas. However, these drivers are conducing to opposite desired effects. Additionally, issues related to agricultural and natural valuable land loss, land development, traffic management, pollution, costs of infrastructure expansion, between others (Jenks & Jones, 2010b; Jordán, Rehner, & Samaniego, 2012; Milder, 2012). These features of cities have given rise to concerns by governments in all states and territories that urban sprawl is not sustainable and should be prevented or slowed down (B. Roberts, 2007).

In the context of the debate of a compact development versus low density to achieve sustainable development and quality of life, researches point out the need to enforce the means aiming to compact developments and balanced densities to achieve sustainability. Roberts (2007) explain the conceptual relationships between housing density and different indicators of sustainability like ecological footprint, travel distances, energy demand, and micro climates and conclude with the need for a long-term approach to increase urban density as a mean to achieve sustainability. Patel (2011) explore the interactions between six urban design parameters (built-up area per capita, public ground area per capita, plot factor, floor space index, net density and gross density) that affect the quality and character of any urban layout and concludes that higher densities do not necessarily mean small accommodation and inadequate public space, meanwhile trade-offs take place. High densities imply a more compact development, and so less commuting time, which is an important factor that make up the quality of urban life (Patel, 2011).

Stabilizing urban population density and reducing the growth of urban footprints is one of the most important goals in the achievement of sustainable urban development (B. Roberts, 2007). Additionally the role of housing provision in an alliance-building mode together with shifted land use planning practices are fundamental in alleviating the outcomes of previous failed experiences and face the challenges of globalization (Jenkins, 2007a). Cities from different latitudes in Latin America are developing mechanisms and programs to develop affordable house together with new ways of land use planning approaches, transport infrastructure and revitalization plans.

The model of compact city is tightly related to densification. However, in adapting an existent city to this model, consideration on the local context and economic aspect should be addressed (Frey & Bagaeen, 2010). A collective vision and targets together with a contextualized set of indicators is suggested in order to measure the performance of existing neighbourhoods to then address the required actions. At this regard, preservation and construction of the local identity need to be considered. Density noes not have a fixed standard and vary from place to place, it needs to be identified in its specific context (Sivam & Karuppannan).

In the other hand, the urban form is the result of operations of the operation of real estate markets within the city's transport infrastructure and moderations by local planning policies (Milder, 2012). Therefore it is important to understand the dynamics of this markets and analyse the economic viability for different land uses (Jones, Leishman, MacDonald, Orr, & Watkins, 2010), in this case, housing. Still Jones et al. (2010) estates that major constraints to reshape local housing exists, and to overcome those will require substantial public expenditure cost to engineer a strategic restructuration of price structure. A contradiction in the model of compact city is found regarding to this topic. As densification can break down the land price (Sivam & Karuppannan), however improved accessibility to transportation and the economic effects of density may increase the land values and reduce economic viability for affordable housing.

Additionally, one dimension to achieve sustainability is critical. Different author emphasize that urban form and a balanced densification are just facilitators of sustainability in urban environments (Camagni, 1998; Milder, 2012; Sivam & Karuppannan). Probably equal or most important in determining sustainability are users attitudes toward trip behaviour and mobility modes, choices of housing and

domestic consumption patterns. Jones et al. (2010) deduces that demographic profiles and household characteristics (stage of life) are more important than the cost of trips, in choosing housing location.

2.1.2. Sustainable housing development

Discussing sustainability for housing development suppose a more punctual scale of the concept. Implications of density and sustainability are reviewed at the level of neighbourhood and housing development. What is referred in literature as high quality or sustainable housing is also related to impacts in the economic, environmental and social aspect.

Goodchild (1994) discuss from a historicist perspective about the extremes found in literature about low (countryside lifestyle) and high urban density. Each extreme is criticized based on the negative impacts of the first one, but also in ignoring the user's preferences in the second one. The author cites Marcus and Sarkissian (1986), that, in response, conceptualize an intermediate alternative as a "low rise/high density clustered housing". This intermediate status comprises the ideal of a balanced densification, but at the same time the preferences of the users for the countryside lifestyle. Those comprehends private entrance at the ground level, private open space, convenient car parking and pleasant open aspect from the windows, among others (Goodchild, 1991). The advantages of this model comprehend keeping the privacy, efficient domestic maintenances and possibility of communal facilities. While overcome disadvantages like distance from ground and feelings of anonymity.

The design phase also has significant contributions in the economic, social and environmental sustainability of housing. Design considerations should address materials, construction technology (including energy/water efficiency devices), height, optimal orientation to ventilation and natural light (Sivam & Karuppannan). The authors explain that these considerations could have an impact on the development costs and further maintenance. They also define high quality housing account for an adequate distribution of public areas, building design (aesthetic values), convenience efficiency and safety for pedestrian and public transport users, access to open space and social facilities. Figure 2.1 introduces the main components related to social and environmental sustainability in housing development according to the authors.

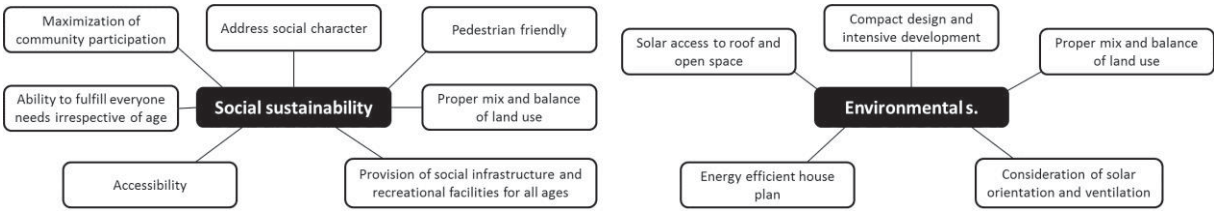

Figure 2.1. Components of residential sustainable development. Adapted from (Sivam & Karuppannan)

From a broad perspective so far it had been conceptualized sustainability at three levels, the global, urban environment and housing development scale. At the three levels, different implications are related to the three main concepts (social, environmental and economic). As figure 2.1 suggest, inclusive collaboration is also important in addressing sustainability at this level. This allows introducing the next theme of review of this research.

2.1.3. Collaborative planning to achieve sustainable development

Hall and Pfeiffer (2000) recall to the relevance of improving planning and management systems and the decision making processes in order to be able to reach the sustainability goal in the social and economic dimensions, as is stated in Agenda 21. Emphasis is done in the importance of multidisciplinary teams to enforce a transversal and local knowledge in facing the sustainability challenges. Also, collaborative approaches together with a more enforced used of data at all stages of the planning process is vital.

Shift in the city planning practice and city planners' role had resulted in a new perspective in how to face the city challenges. From a top-down to a more comprehensive and multidimensional approach "to help the planning profession abandon paternalistic models of planning for the public for new ideals of planning with the public, which involve the public more directly in the choices which help shape their communities" (Klosterman, 2006, page 81). Encouraging collaboration of actors with a stake in a specific problem, contributes in the search of local knowledge to solve local problems and stimulate participatory processes to promote local economic development (UN-HABITAT, 2005). Collaborative approaches contribute to build trust, strategic alliances, transparency and support of public projects by civil actors (Jankowski & Nyerges, 2001).

Strategic planning supported by local leadership in engaging community its key component in finding sustainable solutions in terms of economic viability, resources management, environmental concerns and social strength (B. Roberts, Kanaley, T. (Eds.), 2006). Steinebach (2009) present various approaches in planning sustainable living, arguing for the integration of knowledge in the 3 different aspects of the sustainability concept: economy, environment and social perspectives. Specifically for site search/selection spatial problems, various case studies with different nature in the planning task (parks, housing, waste disposals, among others) reflect and conclude on the importance of building knowledge in multidisciplinary stakeholder's teams to design and assess the site alternatives, ensuring a multidimensional approach in line with the objectives of sustainable solutions (Al-Shalabi, 2006; Ballis, 2003; Hersh, 2006; Mardin, 2009; Sharifi & Zucca, 2009; Zucca, Sharifi, & Fabbri, 2008).

2.2. Collaborative approaches and the planning process

The participatory design approach assumes that there is more than one designer, and that each has a concept about what the future design should be; is based upon the premise that de designers have a sufficient sense of place and time to provide a future oriented design (Steinitz, 2012). Participants might clarify their own perspectives and /or the perspectives of others in regards to values, goals, objectives, and beliefs (Jankowski & Nyerges, 2001). However, more participation doesn't necessarily mean better planning. As add complexity to the process, very often it can result in unfocused processes with non-fruitful outcomes, and even worse, damage in relationships between participants. Consequently, recognition of the different actors in terms of the stake, their type of participation and the knowledge they can offer is fundamental in addressing sustainable solutions, as well as a guiding framework in were adequate tools encourage participation and proper communication to support the decision-making process (Groenendijk & Dopheide, 2003; Souza Briggs, 2003).

Most of the discussion goes around of to what extent stakeholders should be empowered and how to guaranty a genuine participation rather than a mere manipulation. Dane and van den Brink (2007) compare different typologies of participation as presented in literature, see table 2.1. Across the table it is also possible to see according to other authors the possible interactions allowed according to the stakeholders' position in the ladder of participation proposed by Arnstein (1969).

Additionally, Woodhead (2000) describes in a different classification different types of participation from minor involvement to full empowerment in decision making process. Decision-influencers: People internal and/or external to the decision-making organization, contribute in a formal or informal way influencing the development of proposals. Decision-shapers: people in charge of developing high quality proposals to be approved or rejected by decision-takers and decision-approvers. Decision-takers: They ensure the quality of the proposals to be given to decision-approvers, in charge of meeting with decision-shapers. Decision-approvers: people who sanction decisions.

Ladder of citizen participation (Arnstein, 1969)	Participation ladder (Edelenbos et al., 1998)	Levels of participation (IEMA, 2002)	Degree of involvement (EC, 2002)	Kind of participation
Manipulation				Non-participation
Therapy				
Informing	Inform	Education and information provision	Co-knowing/ information supply	Non-interactive
Consultation	Consult	Information feedback	Co-thinking/ consultation	
Placation	Give advice	Involvement and consultation		
Partnership	Co-produce	Extended involvement	Co-operating/ active involvement	Interactive
Delegated power	Co-decide			
Citizen control				

Table 2.1 Typologies of participation. Source (Dane & van den Brink, 2007)

Frameworks to design the process of planning activities allow methodical selection of tools, methods and information requirements as well as to strength the relevance of inclusion. A conceptual process for urban design decision-making provide the instance to combine hard (quantitative data) with soft (qualitative information), adding an additional rich information (Boyko, 2008). Boyko (2008) argue that conceptual process facilitate inclusion of context-specific information, allowing creation of less prescriptive guide to urban design decision-making for urban development sites. Different models are presented in literature, ones emphasizing stakeholders participation (Boyko, 2008), others oriented to understand stakeholders involvement and human-computer-human interaction in planning activities (Jankowski & Nyerges, 2001) and more generic ones, but all of them with common roots based on the sequence of intelligence – design – choice steps. A framework is synthetized in figure 2.2 based on this approaches.

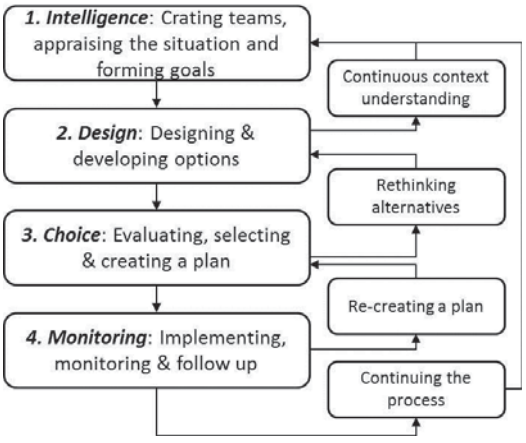

Figure 2.2. Planning Process. Adapted from (Boyko, 2008; Malczewski, 1999; Sharifi & Zucca, 2009)

2.2.1. Methods in collaborative planning, approaching to stakeholders

As collaboration is systematically embedded along the path of collaborative planning processes, different tools and techniques need to be addressed to favour such approach in different stages for different purposes. From collecting quantitative and qualitative data, processing it and giving it back to inform the process. As the main strength of effective collaboration is the communication, different techniques need to be addressed so stakeholders are able to understand and feel in control of the information being produced.

Different methods may serve for different purposes in approaching, collecting and communicating information (Groenendijk & Dopheide, 2003; van den Brink, van Lammeren, van de

Velde, & Dane, 2007). Some methods typically used in qualitative and quantitative surveys rank from paper based, phone or digital questionnaires, structured, semi-structured or non-structured interviews, group mapping exercises or focus groups. More contemporary techniques are based on the use of social networks to collect massive data from citizens. Other activities are more from an interactive nature like workshops and charrettes in where different group dynamics can be fit to reach different information flow purposes. More advance techniques are web-based like virtual discussion forums, geo-portals, geo discussion panel, and others. Activities like public meetings, presentations, temporal exhibitions and digital distribution of documentation can serve for the purpose of communicating to the public. Role playing games open further possibilities of interaction combined with geographical information to allow understanding on more complex dynamics involving stakeholder interests, behaviour and knowledge (Slager, Ligtenberg, Vries, & Waard, 2008; Washington-Ottombre et al., 2010).

2.2.2. Planning and Decision Support Systems in collaborative environments

Moving from a data-poor to data-rich environment, tools are needed to filter process and integrate data and information to support decision processes (Sharifi & Zucca, 2009). Different concepts are found in literature addressing this objective in spatial and non-spatial environments and stressing participatory approaches. Sharifi and Zucca (2009) explain the Decision Support Systems (DSS) and the Planning Support Systems as a class of information systems composed of data/information, models, and visualisations tools to support respectively task in decision (stressing the choice phase) and planning (stressing the design phase) processes, see figure 2.2. The combination of both results in an Integrated Planning and Decision Support System (IPDSS). Other systems stress the explicit use of geographical information for either decision, planning or both processes. Spatial decision support systems (SDSS) combine the use of geographical information, mathematical and logical formalisms to process it and human judgments to strength and better inform decisions processes in collaborative approaches (Andrienko et al., 2007). Others refer to the use of geographical information systems in collaborative approaches. Participatory geographic information systems (PGIS) information construct is the core of the "tool" perspective that provides a sense of what information capabilities are available to provide information insight into the decision situation (Jankowski & Nyerges, 2001).

2.2.3. The use of geo-visualisations in collaborative planning

As it was mentioned in previous sections, communication and the construction of a common understanding is fundamental in collaborative environments. Tools that allow and the previous and the use of available information are essential. The appeal of using geographic information systems (GIS) to support the participatory decision making process comes from the finding that on average, people can understand graphics more easily than tables for many types of problem (Jankowski & Nyerges, 2001). Efficient participatory urban-planning process should explicitly consider the stakeholder's skills in the understanding of geographical information (El Nabbout, Buchroithner, & Sliuzas, 2006) as space is implicit in the planning task (van den Brink et al., 2007). Referring to van den Brink et al. (2007), present a compilation of case studies in research and experimentation in geo-visualisation techniques showing the main concepts and the strengths in its use favouring information flows of simple or complex planning tasks.

The Participatory Spatial Planning in Europe (PSPE) project shows various case studies in where different approaches show the weaknesses, but also the evident potentials and advantages that the use of 3D models offer to enforce communication, understanding, learning, awareness and empowerment of participation by stakeholders and community groups in spatial planning activities (van den Brink et al., 2007). Conclusions around this cases argue that besides the communication, adequate geo-visualisation becomes a learning and educational tool for all parties involved (Lobera & Gonzlez, 2007). In general 3D visualisations are preferred as are closer representations of reality, and can improve the orientation,

dimensionality, participation, expression and the emotional involvement with the information being presented, especially through the interactive models. However, considerations about the detail of the information and the skills of stakeholders in managing these products should be considered, as previous training in using them may be required.

Discussions around geo-visualisation products go around the balance between the understanding of the user and the producer of such. Extensive literature is summarized by Mülder (2007) regarding the preparation, composition and presentation of geo-visualisations. Lammeren, R., A., Abreu, and Pleizer (2007) describe the "I" factors concerning the production of geo-visualisations being: information intensity, intelligence of objects, interaction, and immersion and augmentation. Each factor should be summited to considerations of user oriented requirements and producer understanding and skills.

2.3. Multi Criteria Approach as an evaluation method to indentify and assess location of land uses

The site selection problem within the frame of the spatial planning activities is usually supported by techniques like the land suitability analysis. Site search/selection is defined as the task involving the identification of elements or characteristics in the landscape that are best suited for a given specific purpose (Reynolds, 2012). Land suitability therefore is determined by the aggregated measure of performance in each of these characteristics using mathematical techniques. For decades, geographic information systems and multi criteria decision-making techniques had been used to perform this type of assessment (Al-Shalabi, 2006). Also extensive literature is found in the use of multi criteria approach in assessing sites in different case studies (Al-Shalabi, 2006; Ballis, 2003; Hersh, 2006; Mardin, 2009; Sharifi & Zucca, 2009; Zucca et al., 2008).

Multi Criteria Evaluation (MCE) techniques offer various advantages over other assessment methods. One of the main strengths is the possibility of incorporating qualitative and quantitative measurements. This can be particularly of huge advantage in doing MCE to design and assess alternatives (de Ridder, 2007; Malczewski, 1999; Voogd, 1983). Implementing these methods in earlier stages of the planning process (intelligence) can improve the understanding as it allows a multidimensional approach to the problem from distinct disciplines in a structured manner. Sharifi and Zucca (2009) explain that in the design stages, structured formulated values can be the base in designing the alternatives to be further assessed, like it could be the case of doing a site "search" and then "selection". This approach is also referred in literature as the value-focused approach (Malczewski, 1999) . The compensatory trade-offs and non-compensatory constraints within the set of factors formulated in the problem structure, together with the assign of weights by the stakeholders, allow a more integrated understanding of the assessment object.

2.3.1. Structuration of a Multi Criteria Evaluation

Malczewski (1999) and Voogd (1983) provide extensive literature over the concepts, structuration and a range of methods and techniques that support multi criteria and spatial multi criteria evaluations. Also reflected in the implementation of this approach in different case studies (Al-Shalabi, 2006; Mardin, 2009; Zucca et al., 2008). Figure 2.3 introduces a framework that describes the steps to implement a SMCE across three stages of the planning and decision-making process.

The intelligence phase it basically comprehends and makes emphasis on the identification of the decision making problem. Relevant data (spatial and non-spatial) is collected and explored in order to provide information to enforce understanding and construct knowledge regarding the problem. Following a value-based evaluation approach, criteria is formulated before in order to design the alternatives based on this judging values. Constraints are identified, which represents spatial restrictions within the analysis. In the design phase, a suitability analysis of the study area is the base in designing alternatives. In collaborative environments, stakeholders and decision maker also have an influence in formulating the evaluation criteria and establishing the priorities or ordinal values attached to each criterion.

Based on the alternatives and the evaluation criteria, a decision matrix or evaluation matrix can be produced. Alternatives are compared based on the measurements of the relevant attributes to be judged according to the evaluation criteria formulation. Decision-maker's preferences are also integrated within this matrix.

Decision rules refer to the aggregation function that integrates all the single measurements regarding each criterion and the decision maker's preferences for each alternative. The objective in this step is in assessing the performance of each alternative regarding each criterion and the overall performance of each alternative, the result is referred as the decision outcome space. Therefore a choice can be done based on the best outcome from a ranked set of alternatives.

Before reaching the last step, sensitivity analysis should be carried out in order to test the robustness of the outcome path. The objective is to observe whether if there are variations on the ranking of the outcomes based on variations on the inputs (geographical data and decision-maker's preferences).

In the final step, the best option out of the ranked set of options is recommended. Description of the option should be included as well as the information regarding the ranking and the sensitivity analysis in order to provide a transparent and justified result. Malczewski (1999) emphasise the use of visualisation techniques to present the results. Those should include the geographical dimension and the multi criteria analysis dimension.

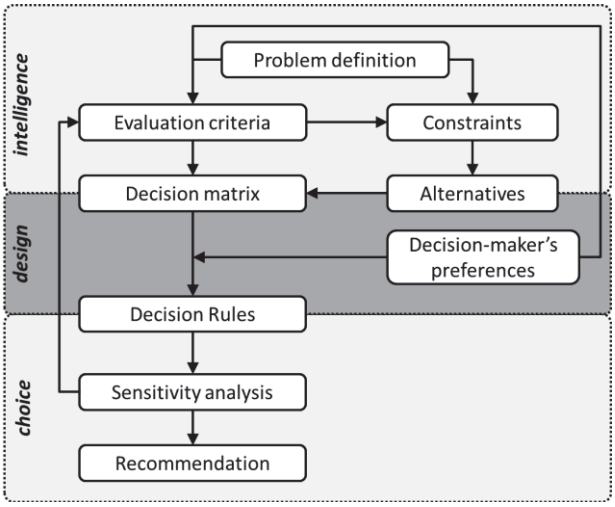

Figure 2.3. Spatial Multi Criteria Decision Analysis Framework. Adapted from Malczewski (1999)

2.3.2. Methods and techniques used in a Multi Criteria Evaluation Implementation

Different methods can be used within a MCE. The incorporation of the decision-maker's preferences implies the use of techniques to be able to incorporate values (weights) that reflect those. As different measurements units from different criteria are aggregated, standardization techniques are applied to make comparable and be able to aggregate those measurements to calculate the overall appraisal score. In order to test the robustness of the analysis, sensitivity tests are applied.

Ranking Methods

Different methods are available for assign weights to the criteria like the ranking methods, rating methods, pairwise comparison and trade-off analysis and the analytical hierarchy process (Benke, Pelizaro, & Lowell, 2009; Malczewski, 1999; Voogd, 1983). For the scope of this research, focus on the ranking method is described as the simplest method, repeatable, less time-consuming and easy to understand by stakeholders.

The ranking method consists in assign an ordinal value to the set of criteria. This means that the various criterions can be ordered from the most to the least important. There are two options to implement this method, the straight rank and the inverse rank. The difference is the logic whether if the

lower ranking value (1) correspond to the most important or vice-versa. The number of criteria to be ranked is important, Voogd (1983) refer that in applying this method effectively while shorter the amount of criteria more accurate will be the weighting. After giving priorities to the criterions, the ordinal values must be converted into cardinal values in order to be operated. Equation 2.2 is used in this conversion where w_j is the normalized weight for the jth criterion, n is the number of criteria under consideration, and rj is the rank position of the criterion.

$$w_j = \frac{n - rj + 1}{\sum (n - r_k + 1)}$$

Equation 2.1. Rank Sum (Malczewski, 1999)

Standardization methods

Standardization methods are applied in order to integrate and make comparable criterion measurements with different value ranges and scales. Two approaches are described by (Nyerges & Jankowski, 2009). Linear standardization (maximum) produces proportional transformations of raw measurements. Two equations can be applied depending on the nature of the criterion. Benefit criterion when higher values result in better performance (i.e. more number of beneficiaries is better). Then, equation 2.2 is used, where X'_{ij} is the standardized score, ranging from 0 to 1. X_{ij} is the raw criterion value, and X_j^{max} is the higher raw value. The other way around, when lower values are preferred (i.e. closer to transport system stops is better), then equation 2.3 is used.

$$X'_{ij} = \frac{X_{ij}}{X_j^{max}}$$

Equation 2.2. Benefit maximum standardization (Nyerges & Jankowski, 2009)

$$X'_{ij} = 1 - \frac{X_{ij}}{X_j^{max}}$$

Equation 2.3. Cost maximum standardization (Nyerges & Jankowski, 2009)

One of the disadvantages of the use of linear transformations is that sometimes the lowest standardized score is not equal to zero, causing difficulties of interpretation (Nyerges & Jankowski, 2009). An example is when standardizing raw values of number of inhabitants. When higher number of inhabitants is preferred (beneficiaries), the area with the lowest number of inhabitants will not account for a standardized value equal to 0. Therefore the second approach, the nonlinear standardization (interval), can be applied. Same as previous, different equations account for cost and benefit criterion, see equations 2.4 and 2.5.

$$X'_{ij} = \frac{X_{ij} - X_j^{min}}{X_j^{max} - X_j^{min}}$$

Equation 2.4. Benefit nonlinear standardization (Nyerges & Jankowski, 2009)

$$X'_{ij} = \frac{X_j^{max} - X_{ij}}{X_j^{max} - X_j^{min}}$$

Equation 2.5. Cost nonlinear standardization (Nyerges & Jankowski, 2009)

Uncertainty and sensitivity analysis

Uncertainty account for two considerations: unknown or know errors in the data being used in the multi criteria analysis or evaluation, or variations among judgments given by the decision makers by means of ranks or weights (Malczewski, 1999; Voogd, 1983). In order to assess the potential errors in a multi criteria model, Malczewski (1999) describes to approaches, the sensitivity analysis and the error propagation analysis. The first approach is used to assess how sensitive are the outputs of the model by introducing variations in the inputs, assuming that the source and magnitude of errors are unknown. The second approach account for variations in the outputs based on already known sources of error.

For the scope of this research, the focus is done in the sensitivity approach. This emphasizes the imprecise and subjective nature of value judgements by decision makers when establishing priorities or preferences of criteria being used. At this regard, exercising small variations in the input weights and examining the variation of the outputs (suitability of a given area or ranking of defined alternatives) is a common approach to test the robustness of the model (Malczewski, 1999).

Nyerges and Jankowski (2009) describes a similar method. However the exercise is repeated equal number of times as the number of variables involved. In each analysis full priority is given to one of the variables and assigning non priority to the others. This is useful in understanding the influence of each criterion in the ranking scores.

2.3.3. Implementing a Spatial Multi Criteria Evaluation model in a Spatial Decision Support System

To address the spatial component another type of MCE is used. Spatial Multicriteria Evaluation (SMCE) is the combination of multi-criteria evaluation methods and spatio-temporal analysis performed in a GIS environment (Sharifi & Zucca, 2009). Suitability models can be constructed in a GIS environment using a raster or vector approach using boolean, selection or overlay techniques (Mitchell, 2012). Although it is possible to design suitability models "manually" only using a GIS platform, ELWIS and CommunityViz include a module to carry out SMCE. In general the procedure follow a general frame of problem structuration (setting the objectives and the criteria), defining the utility functions (cost of benefit functions), standardizing the measurements (maximum, interval standardization), defining the weights (direct weight, ranking, pairwise comparison, analytical hierarchy process methods, among others).

2.4. Conclusion

Cities around the world and in the Latin America region are facing the challenges that the outcomes of the past growth trends had brought. Even though debate on whether densification can lead to a better quality of life or vice-versa, literature on redevelopment of inner cities describes the relationships between a balanced densification and indicators that conceptualize the goal of sustainable development. Efficiency of the existent infrastructure, reduction of the urban footprint, reduction in the energy demands by shorter travel distances and affordable high quality housing can be traduced to an improvement in the quality of life. However, in shaping the redevelopment of cities central areas, several challenges should be addressed in responding to economic and social dimensions of a sustainable development. Sustainability is a multi-scale concept with different implications at the different levels of discussion. When planning for sustainable housing development contradictions are found between low and high density models. An intermediate intensity of land use might balance and overweight the negative aspects of densification and gain the advantaged of a compact development.

Planning for a redensification by means of housing should be addressed in a multi-dimensional, transversal-knowledge and stake approach. Agenda 21 states the relevance of shifting the planning tradition to achieve sustainable development by means of changing the top-down approach for a community-based. In facing local challenges by means of collaborative-planning, enforcement on social and local economy dynamics can be reached. Spatial Planning and Decision Support Systems provides a

base logical framework that allows the integration and implementation of methods to carry out the planning task enforced by the use of data in different stages.

For the purposes of this research, emphasis is done in the importance of integrating stakeholder's knowledge to the Planning and Decision Support Systems. In assessing sites for locating a given land use in collaborative approaches, literature provides several case studies implementing a Multi Criteria Evaluation method as it allows a structured and multidimensional approach to the evaluation. It can also be implemented across different stages of the planning process. In the other hand, considering stakeholders multiple backgrounds and information requirements, the use of adequate techniques in communicating the results is important for the understanding, improvement and transparency across the process.

2.4.1. A framework of participatory planning

Based on the objectives of this research and the literature, the following collaborative-planning framework is proposed, see figure 2.4. The structure is explained as follows.

The outer rings [1]-[2] correspond to the intelligence phase of the planning process. [1] Correspond to identification of stakeholders and their role in the planning objective. [2] Represent the collaborative environment in where knowledge is built by participants. Objectives and criteria are built in this stage.

[3] The core represents the design stage in where evaluation methods and spatial analysis is carried out in a GIS environment based on inputs of stakeholders' knowledge. Sites options are designed primarily by the researcher based on stakeholder concerns. Then, geo-visualisations are constructed of the analysis conducted and the designed options in relation to their current characteristics (applied normative, current construction, etc.). A feedback is given to the stakeholders, and discussions take place in relation to the sites proposed. Followed, a framework of sites assessment takes place, in order to rank the designed sites based on selected criteria.

The last ring [4] represents the decision-making stage. Outputs of ring [3] are presented to stakeholders.

For the scope of this research and time constraints, the outputs of this research are limited to discussions of the outcomes of stage [3].

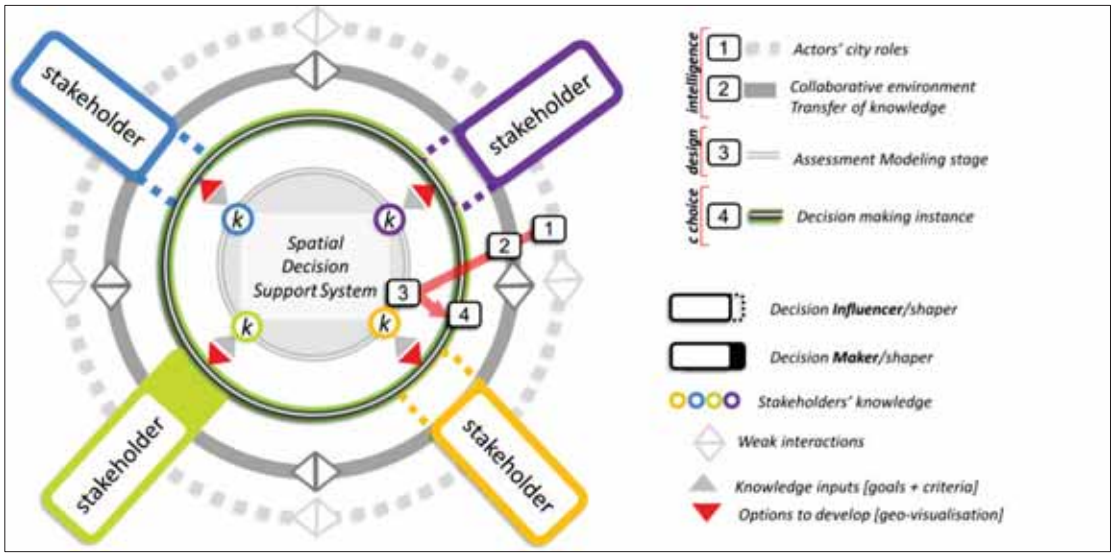

Figure 2.4. Collaborative Planning Framework. Own Source

3. CASE STUDY: GUATEMALA CITY

This chapter is dedicated to describe the case study of Guatemala City. Section one, to three introduces the case from a general overview to the background in the urban development in Guatemala City, followed by the trends in housing provision. Section four describes the latest municipal policies being implemented as a response to the past and current urban development trends and the vision of the sustainable development of the city. Section five introduces the Municipal Enterprise of Housing and Urban Development, as a key actor in promoting housing development within the city. Section ix and seven presents the justification of the study area and brief description of it.

3.1. Introduction

Guatemala City is the capital of Guatemala in Central America (CA). The country has an estimated population of 13 million, and 3.5 million live within the metropolitan area, according to the projections provided in the last census report in 2003. Twenty seven percent (27%) of the Gross Domestic Product (GDP) of CA is being produced in Guatemala country and seventy percent (70%) of the Guatemala' GDP is produced in the capital city (Guatemala, 2010). The geographical location converts it in a strategic point of intersection within the CA-1 and the "Dry Channel" that connects the Pacific with the Atlantic Ocean. See figure 3.1.

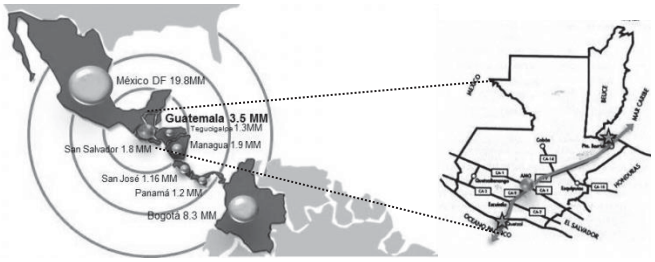

Figure 3.1. Guatemala country. Own Source

3.2. Urban development

Guatemala City had developed since its foundation until present following trends that nowadays are seen not sustainable. Similar to other Latin America cities during nineteen century, the city experiments a sudden population growth, reflected as well in a horizontal expansion that overcame the administrative boundaries, as the city construction density city remained the same. Figure 3.2 shows the patterns of the horizontal expansion until year 2000 and a projection for 2020. From year 1980 to 2000, maximum expansion is experienced and the city's peripheral areas start to develop at a rate higher than the city, see figure 3.3. Currently, more than 50% 'floating citizens' travel every day from the outside-boundaries to work, study, and access to services. Figure 3.4 shows what is termed by municipal planners as a "star behaviour", consisting of "tips" that represent the main access roads to the city by where thousands of vehicles travel from the surroundings municipalities to the city centre. Some of the results of these trends are deteriorated areas, heterogeneous low density, congestion, consumption of environmental areas, pollution, between others.

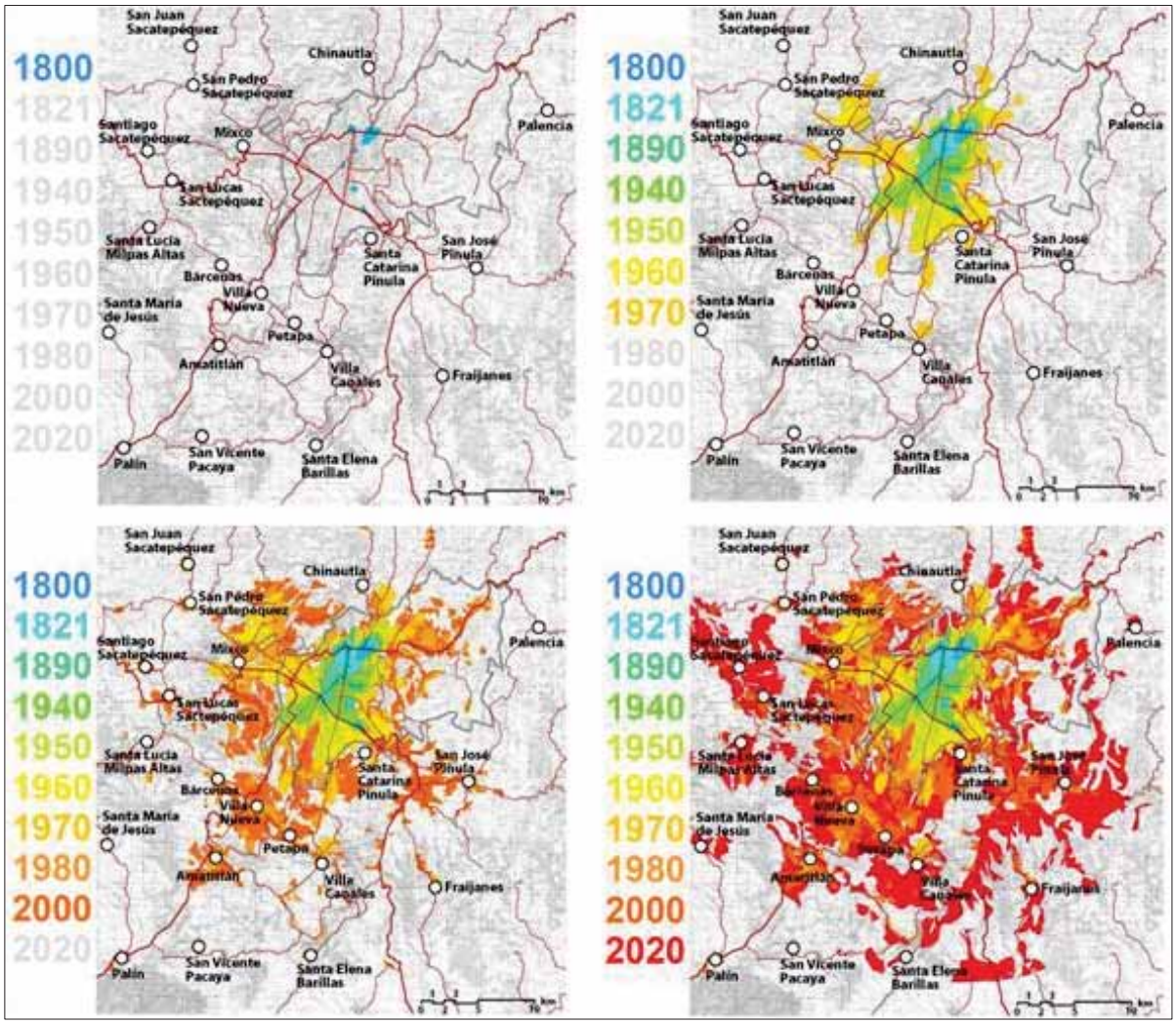

Figure 3.2 Guatemala City Urban Expansion. Source: Municipal Office of Urban Planning

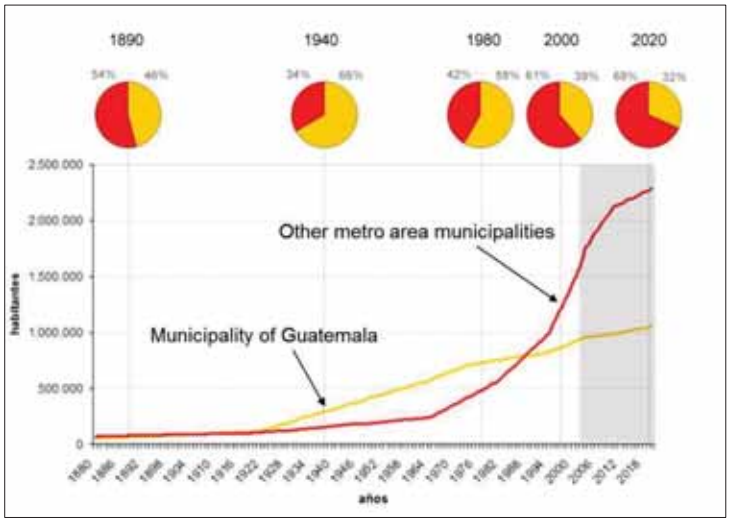

Figure 3.3. Rates of development Guatemala Municipality versus peripheral ones.
Source: Municipal Office of Urban Planning

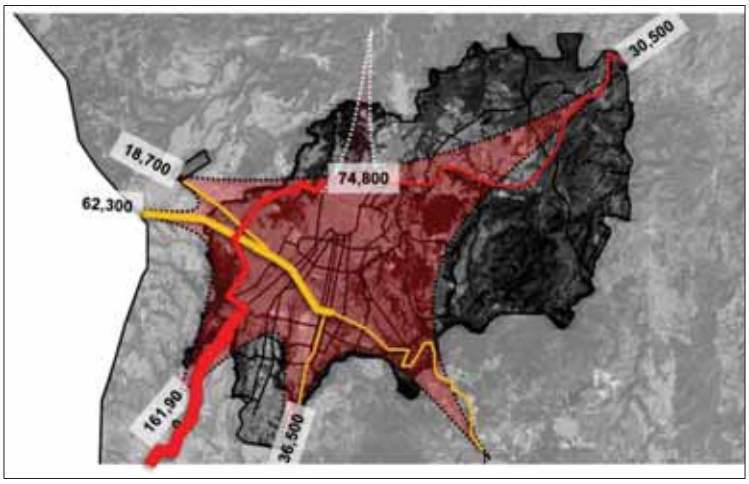

Figure 3.4. Daily mobilization from peripheral areas. Source: Municipal Office of Urban Planning

3.3. Housing provision

In the last three decades the provision of formal housing had been done by private developers, while previous experiences in housing development by public sector failed. From the public sector, in the decade of 1970 the, non-existing anymore, BANVI (National Bank of Housing) developed a model of compact house unit in middle dense buildings, however as an isolated remote project to where facilities and services arrived 10 years later. The result is a deprived neighbourhood with no access lack of public recreational spaces, devaluated properties, among others.

At the present time a model of support to housing developments from the public sector is the FHA (Fomento de Hipotecas Aseguradas) that provides subsidies through the financial systems in insured mortgages. In this model the planning and construction of projects is done by private developers, and is oriented to support families in the range of middle income groups with access to financial credits. Finally, FOGUAVI (Fomento Guatemalteco de Vivienda) is a governmental institution in charge of planning and constructing housing projects for low and very low income groups, including groups with no access to financial credits. This means less than four minimal salaries per month per family, equivalent to Q. 8,000.00 (€ 800.00). The housing solutions respond to uni-familiar houses in horizontal arrangements in rural or semi-rural contexts.

Private development oriented for middle income point out the trend of developing projects outside the municipal boundaries in form of horizontal condominiums. Whilst housing offers within the municipal boundaries and especially in the core areas are oriented for high income groups. Figure 3.5 shows in the right map the location of Guatemala and the south neighbours municipalities. The dots represent the location of housing private developments in horizontal and vertical solutions. The colour code ranges from A to C+ and C, being A the projects oriented to high income groups and C+ and C those considered as oriented to middle high and middle income groups respectively. The middle income group, defined as persons earning between 5 and 7 minimum salaries, equivalent to Q.10,000 to Q.16,000 (€ 800 - € 1,600). It is observed that most of the horizontal development oriented for middle income groups happens outside the municipal boundaries, while the vertical solutions, only happening within municipal boundaries in its majority, are oriented to higher income groups.

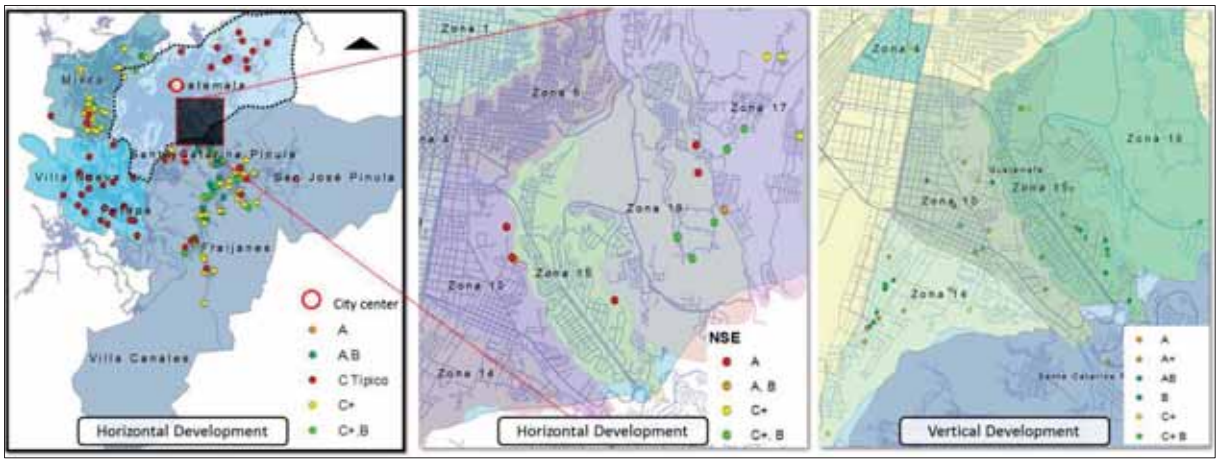

Figure 3.5. Horizontal housing projects. Source: Inspecciones Globales

3.4. Municipal policies

In 2009, after a participatory effort of diverse sectors (investors, citizen representatives and public institutions), as one of the policies raised in the "Guatemala 2020" Plan, the Territorial Ordinance Plan (TOP) became in force. The main aims are to promote a wider spectrum in housing offer by private developers in a mixed, compatible, and medium dense high quality environment, efficient use of existent infrastructure, shorter distances and protection of natural areas.

TOP constitute legal framework that regulate urban development based on a 'transect' concept, see also figure 3.6. A transit oriented development: land is categorized in six "General Zones" (from G0 to G5) according to its access to existent and projected mobility, hierarchical infrastructure (roads and public transport system). From type 'G0' where no develop is allowed, protecting valuable natural areas and human settlements in risky zones, to 'G5' where maximum density and height is permitted. 'TOP Map' displays this classification and constitutes an independent tool, allowing periodic update, see figure 3.7. Different types of general zone are subject to different regulations of construction intensity, height, plot partition, building alignments and land uses.

Figure 3.6. Transect and General Zones. Adapted from Municipalidad de Guatemala (2009)

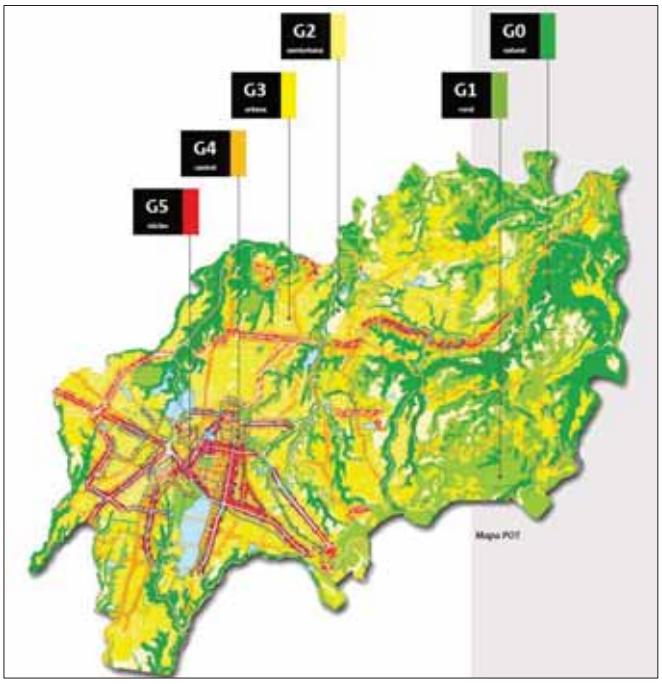

Figure 3.7. Territorial Ordinance Plan Map. Source: Municipalidad de Guatemala (2009)

3.5. The Municipal Enterprise of Housing and Urban Development (MEHUD)

In January 2012, the program of house development is formalized with the launch of the "Municipal Enterprise of Housing and Urban Development" (MEHUD). The objective is to provide public housing to middle income and low income groups to facilitate affordability as a mechanism to revert the trend of migration to the outskirts of the city, reducing home-work distances, improving access to already existent services an infrastructure, therefore making more efficient use of those. The enterprise is highly relevant in achieving the balanced density and even spatial development with mixed compatible uses. Under this scope, previous, current and future efforts are condensed in a delimitated area in the core of the city determined as the "Central Corridor" characterized by the central axis, see figure 3.8. Over this corridor a master plan of public space intervention and formulation of Local Territorial Ordinance Plans are in progress. This plan is named "Corredor Aurora Cañas".

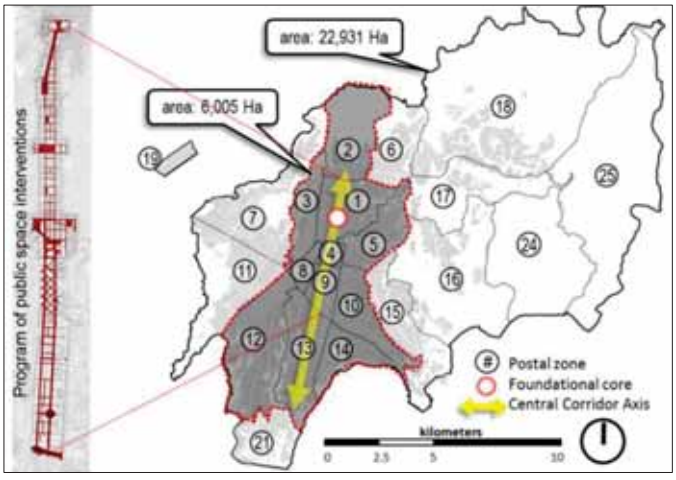

Figure 3.8. Central Corridor axis. Prepared based on Urban Planning Office information

3.6. Justification of the study area

In line with the preliminary knowledge on the objectives of the enterprise and the vision of the Municipality, a study area is defined within the area demarked with the central postal zones of the city, see figure 3.8. The study area polygon was delimited by URBANISTICA (Municipality office) as part of the formulation of the urban project "Corredor Aurora Cañas". This project is based on a series of public space interventions along a north-south axis of urban revitalization, see figure 3.9. The study area polygon was shaped based on the existing natural borders, the territorial ordinance plan, existing land uses and the intended incidence of the urban project. Therefore, is defined as an area of high priority by the Municipality. The polygon comprehends and area of 2,422 hectares. A total of 2,252 plots are within the study area with a surface of 1,481 hectares.

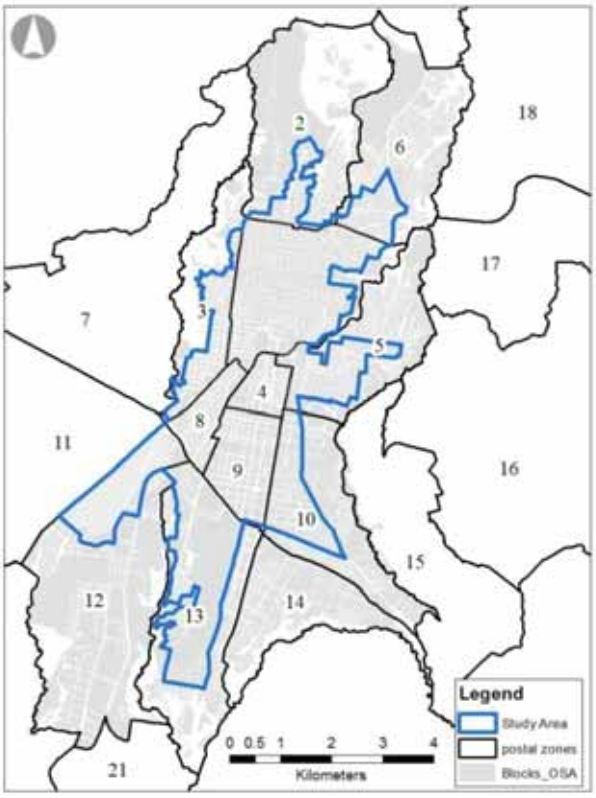

Figure 3.9. Study area delimitation.Prepared based on Municipal Cadastral Information.

3.7. Description of the study area

Based on information available in the Guatemala City Municipality website and information collected during fieldwork, see chapter four, different maps were produced to describe and understand the diverse dynamics within the study area. See figures 3.10-15.

Land prices tend to be more expensive along the central axis in the study area ranging from $ 600 to up to 1000 /m^2. Prices decrease proportionally when going to the edges. Still, in the south east some intermediate areas are homogeneous (orange) with prices ranging from $ 300 to 400 /m^2. Socio economic structures reflect a similar pattern. An important relation can be observed when comparing figure 3.10, 3.11 and 3.13. Higher populated areas are concentrated in the cheaper areas of the map, classified in the figure 3.11 as inhabitants of low and middle income.

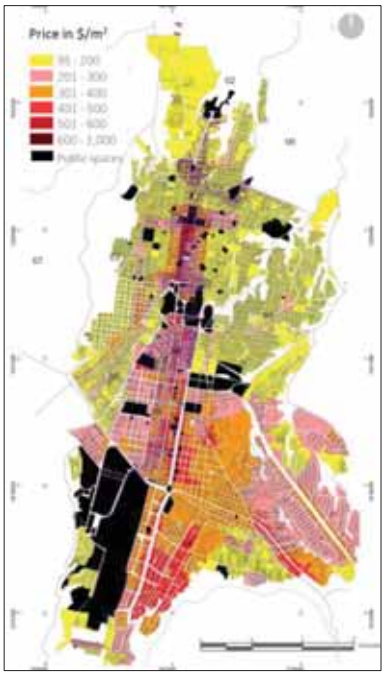

Figure 3.10. Land Price.
Source: URBANISTICA

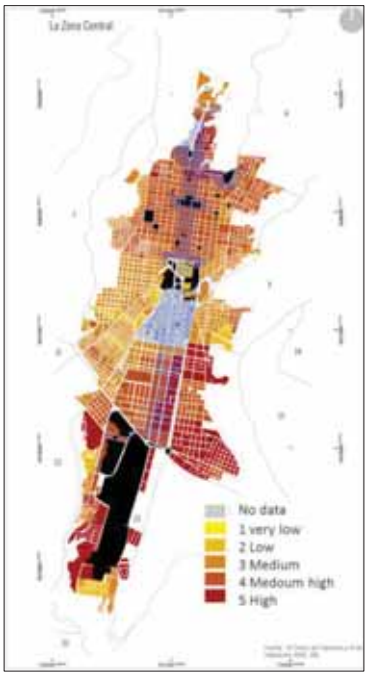

Figure 3.11. Socio economic structure
Source: URBANISTICA

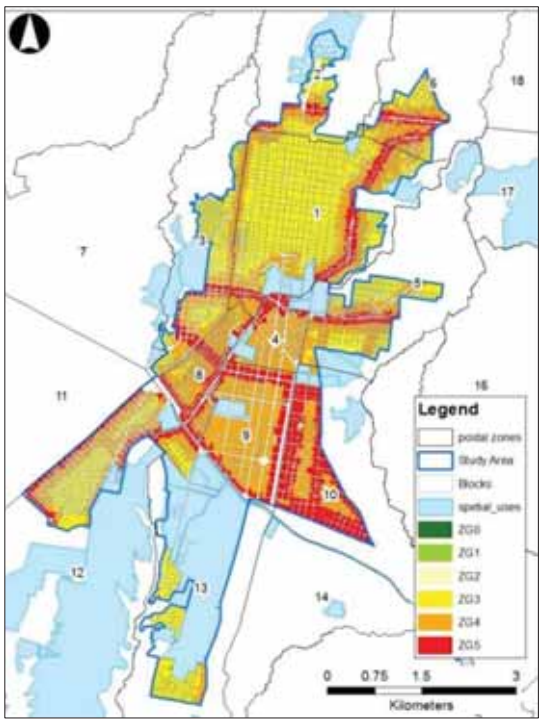

Figure 3.12. Territorial Ordinance Plan
Prepared based on Municipal Information

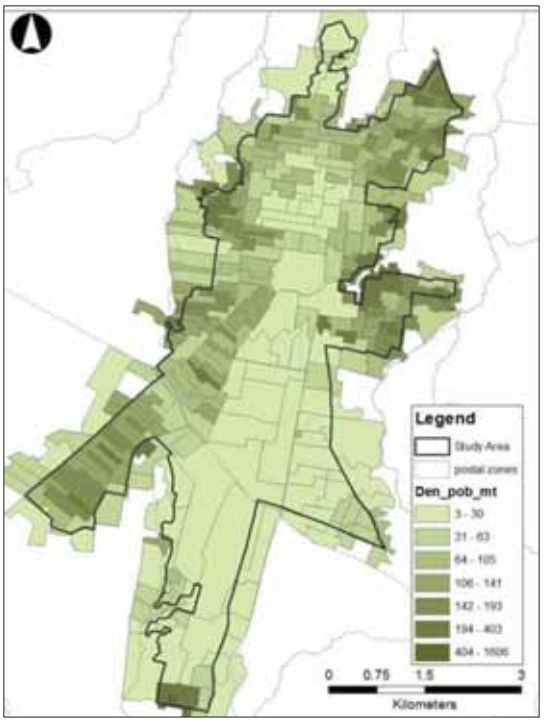

Figure 3.13. Population density. Source: National Institute of Statistics (INE)

Figure 3.12 can be directly linked with the figure 3.6 to give a preliminary understanding of the application of the TOP normative across the study area.

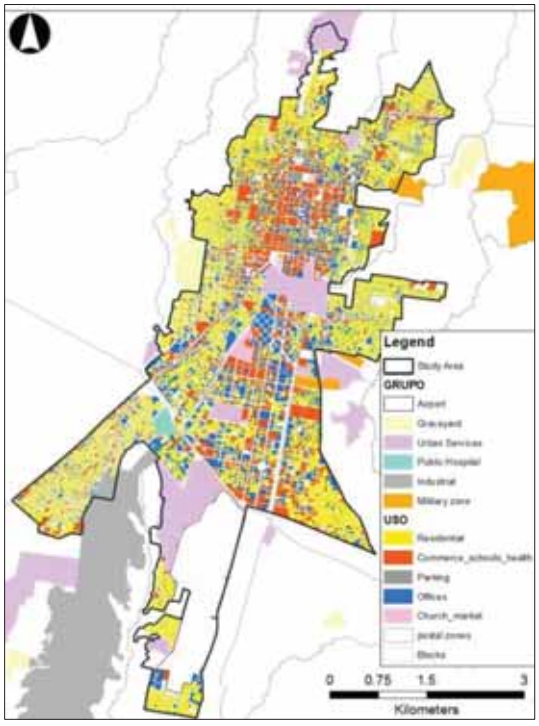

Figure 3.14. Land use.
Prepared based on Municipal Information

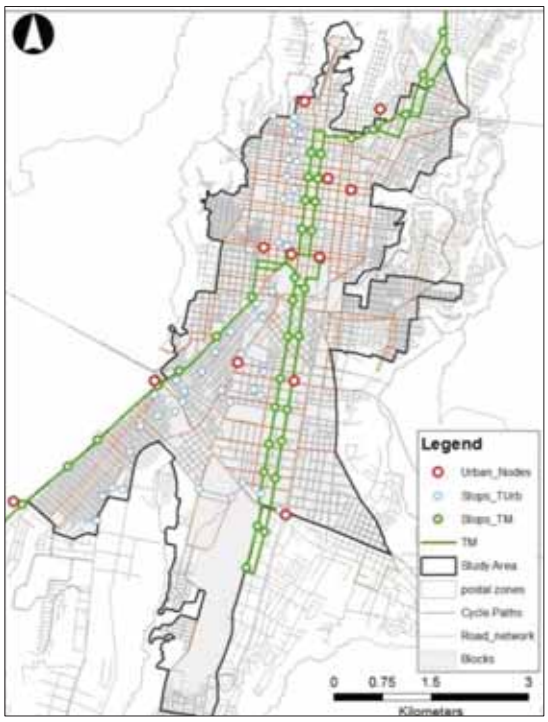

Figure 3.15. Urban mobility.
Prepared based on Municipal Information

Figure 3.14 shows a complex mix of land uses. Higher concentrations of offices and commerce are observed in the core central axis within the study area. Figure 3.15 shows the current implemented lines of the municipal transportation system (Transmetro), and the stops of the implemented routes of Trans Urbano. The last one is the transportation system provided by central government.

3.8. Previous experiences in collaborative approaches

Previous key projects like the design and implementation of TOP and Trans-Metro were funded in active stakeholders' involvement through multi-sectorial tables meetings. Other projects like the "Green public areas Network" exercises of collaborative mapping using paper-based maps in public external activities had been realized. Some advanced communicative technics had been put in practice like geo-visualisations in 2D and 3D shared through Google Earth compatible files (KLZ format) in the case of an urban green park project. Experiences in scenario development and 3D explorations are also accounted, but using loose-integrated software's and without using any explicit spatial analysis techniques.

Unfortunately, no documentation was produced regarding the methods and the process itself regarding the participatory approach. However, for the case of TOP and Trans-Metro, involvement of other actors were key in TOP approval and support by civil actors when the regulation became in force, as well as it had been crucial for the infrastructure implementation and acceptance of the public transportation system. For the other cases, explicitly the urban green park, the experience of using 3D models and sharing information via Google Earth with the participants had been a successful learning process for two main reasons. It allows putting into a recognizable context the different design proposals making easier to understand by the participants. Second, sharing the proposals in this way previous to meetings, allow to participants to review the content in advance before the meetings and make those more efficient with more productive discussions..

4. METHODOLOGY FOR IMPLEMENTING A COLLABORATIVE PLANNING PLANNING PROCESS

This chapter describes the methodology that was implemented in this research. The first section discusses the phases and methodology defined to address this research. The second section is dedicated to introduce the participants in this research as the stakeholders in the municipal housing projects. Section three describes the methods used as part of approaching and getting preliminary insights from the different stakeholder groups. The fourth section describes the collaborative approach workshop that was implemented with the participants. The fifth section describes the secondary data collected during fieldwork. The sixth section are described the methods and techniques used to design and assess the site options for municipal housing development in a multi-stakeholder environment.

4.1. Research methodology

The main objective of this research was to develop and test a framework to identify and assess housing projects location using a collaborative planning approach. A process was designed to carry out this research, see figure 4.1. This process respond to the researcher logistic of operationalization and it's explained in four phases. However, the first two phases respond to the intelligence stage, the third to the design phase and the fourth to the choice stage. This address the planning and decision making process reviewed in literature (Boyko, 2008), see figure 2.2, 2.3 and the collaborating framework proposed, see figure 2.4. Different methods are discussed and implemented across the process. Notice in the figure 4.1, that graphical coding in the legend makes explicit reference to the collaborative framework of figure 2.4.

The first phase *[P1]* regards with the identification of specific stakeholders based on literature on published information related to the Municipal Enterprise of Housing and Urban Development (MEHUD) and also on the local knowledge. Other methods are reviewed in literature like the stakeholder analysis (Groenendijk & Dopheide, 2003). However, in this case the identification of those was limited to those that are primarily addressed in legal published material like Municipalidad de Guatemala (2012).

During the second phase *[P2]* two methods where implemented. Semi-structured face to face interviews was the selected method to explore the insights of stakeholders. Other methods like telephone interviews, digital surveys or other impersonal approaches could be used. However in order to catch attention and interest for the second exercise a personal discussion was preferred. A workshop was implemented to formulate and prioritize criteria to characterize suitable land for municipal housing development. Other methods to do this are individual interviews or digital surveys, however the workshop method was preferred in order to stimulate face to face discussions and emphasize the nature of a collaborative approach. During this phase geographical information was collected in order to be able to implement it in the next phases.

Phase three *[P3]* and phase four *[P4]* consist in implementing a land suitability model to design site options for housing development and assess those options respectively. Both phases are based on the stakeholders' information produced in phase *[P2]*. Literature offers different methods to implement the suitability analysis (raster overlay in GIS, ILWIS Multicriteria module, CommunityViz). In order to make as transparent and understandable the process to stakeholders as possible, and suppose a further easy use of it, CommunityViz was selected.

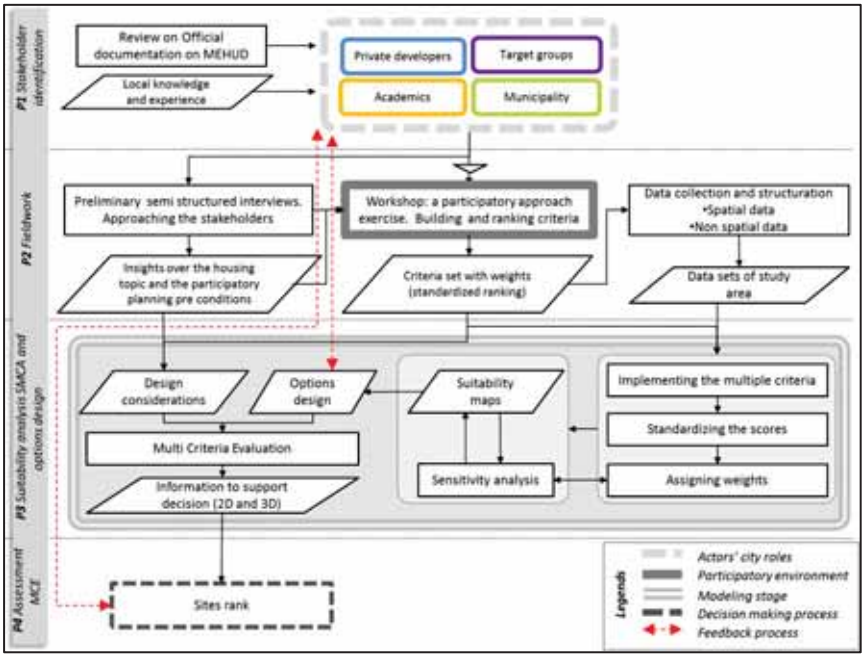

Figure 4.1. Methodology flowchart. Own source

4.2. Identifying the stakeholders

Even though is established that one of the attributions of the MEHUD is to implement instances of inter-institutional collaboration in aiming to strategic alliances (Municipalidad de Guatemala, 2012), such approaches are not jet designed and neither implemented. Based on the MEHUD established regulations, four main categories of stakeholders were considered for this research: Municipality planners, private developers, academics and target group. Based on the classification of stakeholders by Woodhead (2000), the four groups are described and classified according to their current type of participation in the current planning practices of municipal housing project, see table 4.1.

stakeholder	description	decision maker role
municipality	Oriented by city vision of sustainable development and redensification - in charge of land use regulations, transport projects, service infrastructure. The new unit of housing development aim to provide affordable houses in city's central areas	Decision-approvers Decision-takers Decision-shapers
private developers	Market and revenue oriented knowledge - investors in real estate development, could participate in public private projects in infrastructure provision	No current role, but possible decision-influencers
target group	Personal preferences oriented - middle and low income groups, either new forming households or already existing households without access to adequate housing in the city	
academics	Scientific principles oriented - researchers, acknowledged professors in related area.	Decision influencers / consultancy

Table 4.1. Stakeholders description. Own source

Based on this classification and using the criteria below fourteen participants are included in the research representing the four groups of stakeholders.

- Municipality Planners: Role and responsibility within the institution and their relation with the Municipal Enterprise of Housing.
- Private Developers: Experience in developing different types of housing projects, being an active developer and their current or potential interest in the study area.
- Academics: Their academic knowledge and research activities related local urban development and their role within an academic institution.

- Target group: The participants embracing this group were selected based on the characteristics related to the middle income groups that were defined during the interviews carried out with the municipal planners and the private developers. These characteristics are further explained in the next sub-section

Additionally, own local knowledge and consultation with the sub-director of the Municipal Urban Planning Office (MUPO) based the selection of the participants. The reason of consultation with the municipal planner was due to his role within the institution. As director of the Technical Team of Territorial Ordinance, he is involved in reviewing and assessing the development projects of private developers that are being approved or rejected. For this reason he had the knowledge about the type of projects that the main developers are carrying out, which was one of the criteria for selecting the participants within this group of stakeholders.

The objective of the planning task in the implementation of this collaborative framework is to assess the location of the municipal housing projects. This means looking for suitable sites, design those sites and assess the options. Land owners of the assessed sites become important stakeholders in the later stages of the planning process. However this goes out of the scope of this research.

The description of the profiles of the participants is given in the first section of the next chapter.

4.3. Approaching the stakeholders

Based on the research questions and the strategy adopted for the operationalization of the conceptual framework, this research explores the existing preconditions for a participatory planning approach for the municipal housing projects development. Table 4.1, shows that up to date only the municipality planners are involved as stakeholders. In the case of the other participants, the interview methodology allowed to establish a first contact to introduce them to the municipal housing projects and the intended participatory planning approaches, as well as the objectives of this research. In total, a round of fourteen preliminary interviews was carried out with the participants identified.

4.3.1. Surveying the insights from the stakeholder's knowledge and perspective

Semi-structured interviews methodology was used to survey the stakeholders. Fourteen persons were contacted and interviewed face to face between September 26 and October 12. The method facilitated to orient the questions asked to the stakeholders without limiting their answers and allowing the researcher to ask additional questions in order to get more insights from their answers. All the interviews were digitally recorded with the permission of the participants.

The interviews were designed based on the research questions corresponding to the second sub-objective of this research and accomplishing two main objectives, see the interviews in appendix A. The first one was to explore the discourse of each stakeholder regarding to housing. This allowed identifying what is their vision and concerns about the topic and be able to link those with the concepts reviewed in literature about sustainable housing development. The municipal planners, academics and the private developers were asked questions about the definition of the middle income groups, towards to whom the projects are oriented, this was used as base criteria to select participants to be included in the research interviews and workshop.

The second objective was to explore the preconditions for implementing a participatory approach within the stakeholders. They were asked questions about the barriers, strengths, opportunities, their stakes and interests regarding to participatory planning approaches for municipal housing projects.

In order to extract information and make interpretations based on the semi –structured interviews, the records were fully transcribed into digital text files. Then, a Thematic Analysis Framework based was used to analyse the transcripts. Even though the methodology had not been fully developed, it allows a less time consuming qualitative analysis of the answers (Bryman, 2012). Texts addressing the

topics in research were coded and classified into categories and themes. The outputs of this analysis are discussed in chapter five.

In general, all the participants showed a clear interest in the research. They were easy to reach and showed an accessible attitude toward the interviews, providing the information required. Being that this was the first approach of the researcher with the participants, these meetings were helpful in sharing with them the theme and the purposes of the research and getting them interested in order to be willing to participate in the workshop. As researcher and ex-municipality collaborator, previous acknowledgment and the reference of the sub-director of the MUPO facilitated the approachability and communication with the participants.

4.4. A workshop: Implementing a collaborative approach exercise

Ten participants, out of the fourteen interviewed, were invited to a workshop activity named *Where to locate Housing Projects?* see figure 4.2. Municipal planners were selected based on their role within the municipality and with the MEHUD, the rest of participants were selected in order to ensure a certain degree of heterogeneity within the groups of stakeholders and also considering their availability of time.

In general, the preliminary approach through the interviews was very helpful in arise interests in participating in this activity. In the case of the target group participants, permissions were managed so they were able to attend the activity without disruption of their work. Still, extra invitations were sent two days before due to participants that cancelled in the last moment.

Figure 4.2. Workshop participants. Own source

4.4.1. Group discussion and criteria formulation

The workshop was designed in order to promote a common understanding of the study area and then formulate the criteria that characterize the suitability of a site to develop municipal housing projects. This approach responds to the further implementation of a Multi Criteria Evaluation approach. This method was selected as it allows the inclusion of criteria with scores in different units (quantitative, qualitative) as was reviewed in literature. Additionally, the method provides and evaluation structure that is used during the suitability assessment stage for designing the site options, and also to assess those options.

The activity was realized on October 12 from 9:30am to 1:00pm (three and a half hours). For the location the facilities of "Inspecciones Globales", specialized company in doing market research, were facilitated. The whole activity was carried in a spaciousness living room to ensure the comfort of the participants and stimulate a natural, open and fluid conversation between them. The conduction of the activity was carried by the researcher, supported by the use of a power point presentation displayed in a wide screen TV. A copy of the slides presented is included in appendix B. The activity was video and voice-recorded for further analysis of the content, unfortunately due to technical disruption the records are not available. Therefore discussion of the outputs of this activity, presented in the next chapter, is based on notes made by the researcher.

The description of the activity goes as follow:

- (15 min.). The participants introduced themselves to each other. Then a presentation was given introducing the participants to background and justification of the research and the objectives of the activity.
- (60 min.). This time was used to introduce and explore the study area. The following information was presented: background of the city development with statistical charts; two-dimensional maps showing demographical information in the study area (socio-economical distribution, population density), physical characterization (index of housing building quality, land price), municipal information (territorial ordinance policy, master plan of biking routes, public transportation routes) and a 3D model of the study area showing the current volume of construction coding colours of the constructions based on number of floors, and the resulting volume of construction based on the current urban regulations. Several discussions took place during this time regarding the understanding of the study area, the information and the opinion of each group of stakeholders.
- (10 min.). Break
- (10 min.). Participants were introduced to the participatory framework approach oriented to criteria formulation for finding suitable sites using a multi-criteria approach.
- (30 min.). Participants are requested to formulate carefully one criterion per person they consider most important and that should be used to find suitable sites for municipal housing development. Cards with four different colours are proportionated, each colour corresponding to each stakeholder group.
- (40 min.). The criterion presented is posted individually on a board and explained by the moderator. Is discussed how it can be assessed with the available information. During this process, similar criteria is detected and reduced to five. Participants are requested to think if under their consideration any additional criteria are needed, then two criteria are added to the set, making a total of 7 criterions.
- (30min.). Three dots were proportionated to each participant with the same colour code as the cards. The participants are requested to allocate the dots in the criterions they consider most important, being able to allocate more than one dot in one criterion. A ranked criteria was obtained, discussed and agreed by the participants.
- (10 min.) A questionnaire was proportionated to be answered by the stakeholders. The objective was to get insights about the experience of the participants regarding the information presented (maps and 3D visualisations) and their perspectives on the participatory approach during the activity. See the questionnaire in appendix C.

In introducing the study area, the objective of using 3D models, is what is defined in literature as the "training process (van den Brink, 2007) in recognizing and understanding modelled urban contexts to support the planning activity. As the models are used in later stages of the planning process to assess the sites, this first approach in using the 3D models was important. Originally it was intended to construct the visualisations using the 360 and the Scenario 3D viewer. However, didn't facilitate the labour due to the amount of information being modelled. Instead, ArcScenario was used with relatively easiness and less time-consuming manner.

The ranking method was chosen to assign priorities to the criteria. Even though other methods are available, this one is more easily understandable for participants not familiarized with multi-criteria approaches. Additionally, it gives an ordinal value to the criteria. This is an attribution that, according to Voogd (1983), is the most reliable value even if the method chosen assign a quantitative cardinal value to the criteria. An addition to the method is the colour code, which allows keeping track of the inputs

provided by each group of stakeholders in terms of criteria and preferences in assigning priorities, at the same time that the criteria and the priorities are agreed within all the stakeholders.

The workshop was carried with success in a friendly and cooperative environment. All the participants showed interests in the different stages of it and got involved in fruitful discussions that helped in understanding and elaborating over the topics that lead to the criteria formulation. Due the criteria was formulated in a collective manner, the importance of sharing the available information required to perform this type of analysis became evident. The previous, could be seen as one of the advantages in implementing participatory approaches, as it helps in creating a platforms of data sharing for a broad collective purpose.

4.5. Secondary data collection

A dataset of various shapes (road network, land use, municipal public transportation network, public spaces, blocks, plots, construction, territorial ordinance plan, demographic information, administrative structure and topography) was obtained from the Municipal cadaster database, the Urban Planning and the Urban Mobility offices see table 4.2. The information was given under strict conditions of confidentiality, with exclusive use of it for the purposes of the research.

Layer	type	update year	source
Administrative subdivision (postal zones)	polygons	2008	Cadastre Office
Blocks	polygons	2010	
Construction	polygons	2010	
Land use	polygons	2010	
Plots	polygons	2009	
Topography	polylines	2008	
Municipal transportation network	polylines	2012	Urban Mobility Office
Municipal transportation stops	polylines	2012	
Traffic analysis zones (TAZ)	polygons	2005	
Demographic information (INE)	polygons	2002	Urban Planning Office
Planning neighborhoods (Delegations)	polygons	2008	
Primary roads classified by TOP	polylines	2008	
Territorial Ordinance Plan (TOP)	polygons	2012	
Land price	points	2009	URBANISTICA

Table 4.2. Secondary spatial data collected. Own source

Two documents were acquired as part of getting insights of the municipality vision and methodology used until now to locate suitable sites for housing development. The first one consists in an analysis of the vacant land in the "Central Zone" and elaborates on criteria and methods that were used to understand the possibilities of development of housing projects within the study area (URBANISTICA & CIFA, 2010). The second one is not official and it's in process of corrections, but presents an update of the Municipality Vision for the city development for the next 30 years (Guatemala, 2012). It elaborates on a city structure of urban components in where the housing projects are important for the focused interventions for the urban rehabilitation for the city central zones as well for a sustainable development.

4.6. Implementing a methodology to identify and assess sites for municipal housing projects

This section describes the implementation of an Integrated Decision Support System (IDSS) to support the planning and decision making process, see section 2.2.2. A combination of methods were implemented to analyse the land suitability within the study area based on the stakeholder's interests, design sites options and assess those to develop municipal housing projects. A SMCA was implemented in a GIS environment to produce a suitability map. CommunityViz was selected to implement the analysis due to its easiness in customize the analysis based on the user's needs. It also provides a more user friendly interface though the use of sliders to manipulate the criteria and visualize the effects on the analysis. This is also useful when it comes to implement the sensitivity analysis.

4.6.1. Suitability analysis

In this section are explained the main steps that were followed to set up the suitability model, further details of the data used and the information produced are given in section 6.1.

a. Weights are recalculated based on the stakeholders ranks given to the criteria in the collective approach and per group of stakeholders, see table 6.2.
b. Different layers of data obtained from the Municipal Cadastre were prepared and used to make the regarding measurements for the different criteria. Some criteria scores are based on one single measurement while others results from a combination of more than one.
c. The measurements were standardized using linear and non-linear conversions, see formulas 2.2, 2.3, 2.4 and 2.5.
d. Criteria in where more than one measurement is combined, a preliminary score was calculated using a weighted summation method. The total weight equal to 1 divided by the number of measurements being combined. See figure 6.1.
e. A layer of Uniform Analysis Areas (UAS) with cells of 25m x 25m was produced using a "fishnet" with the extent of the study area. This allows protection of the plot layer due to confidentiality restrictions of the data.
f. Spatial constraints are defined and extracted from the UAS's
g. After calculating the scores for each criterion, those are attached as attributes the UAS cells.
h. Criteria preliminary scores were then combined using the tool of suitability analysis of CommunityViz. Scores range from 0 to 100, being 100 equal to highest suitability.
i. In total five suitability maps were produced and compared. The first reflects the results following the collective approach. Additionally one map per group of stakeholder was produced based on their own priorities identified in step a. The suitability maps are classified using equal intervals of 10%.
j. A sensitivity analysis was applied to assess the outputs of the model.

4.6.2. Designing site alternatives for housing development

Using the suitability map, cadastre data, overlay techniques and visual interpretation sixty three sites were designed. New criteria are introduced to make the selection. This allows incorporating specific concerns addressed by stakeholders during the interviews and the workshop (plot size, current construction and land use, surrounding residential land use). A virtual meeting was arranged with four stakeholders representing each group and power point slides were presented. Information regarding to the methods and the combined data was shown to the meeting participants as well as the suitability maps and the site options in order to receive feedback, see appendix D. Three Google Earth files (*.KMZ) were made available to the municipal planner participant to facilitate the visualisation and exploration of the suitability map and the sites options. Further details are given in section 6.2.

4.6.3. Assessing site options for housing development in a collaborative environment

Based on the options designed in the previous step, new information is produced based on the stakeholders information requirements identified in the interviews and discussions of the workshop. Also, considerations regarding the literature review on sustainable housing development are incorporated. Two steps are implemented in order to do the assessment after selecting 8 sites out of the 63 sites designed. The first comprehends the implementation of a dynamic model in CommunityViz due to its easiness in working with dynamic variables. Three development scenarios were explored under the assumption of different intensities of land use. By comparing the 3 scenarios, one scenario is suggested by the researcher and information is extracted for further analysis. The second step consists in the implementation of a Multi Criteria Evaluation. The step incorporates additional criteria related to the location of the sites. As a result, a rank is suggested in order to give priority to the sites. Further details are given in section 6.3.

5. INSIGHTS FROM THE STAKEHOLDERS AND CHARACTERIZING LAND SUITABILITY

The first section introduces the profile of participants that were interviewed as the groups of stakeholders. The second and third sections explore the insights of the stakeholders regarding to the housing development for middle income groups in the study area and their perspectives on the participatory planning approach. The fourth section describes the characterization of the suitable sites that should be considered to develop the municipal housing projects, concluding with the criteria and its weights that will be used to implement a suitability model. The fifth section defines the information requirements to be considered in order to make a site-assessment by stakeholders. And last section describes the perceptions from the different stakeholders regarding the collaborative approach exercise carried out during the fieldwork.

5.1. Profile of the stakeholders

Table 5.1, list the participants involved as groups of stakeholders and their profiles. Those are referred as interviewees coded by number.

Stakeholder group	Subject	Profile
Municipality	1	Urban analisis and research at MHEUD
	2	Design of municipal housing prototypes at MHEUD
	3	Urban development normatives and urban projects at MUPO
Private developers	4	Real state projects designer
	5	Private multi-familiar developer and land owner
	6	Designer and private housing (mix) developer
	7	Private developer and MHEUD consultant
	8	Private unifamiliar housing developer
Market (private-targets)	9	Market researcher and property appraiser
Academy	10	Urban researcher at public university
	11	Urban researcher and proffesor at public university
Target groups	12	Young single professional renting within study area
	13	Young professional with family living in peripheral area
	14	Professional with family renting within the city, but within study area

Table 5.1. Stakeholder participants. Own source

Municipal planners

Interviewee 1 works for the Municipal Housing Projects. It had been involved in various urban studies and analysis like (URBANISTICA & CIFA, 2010). It was part of the technical team that conceptualized and currently operates the MHEUD. It has a deep knowledge and understanding of the background of the city, as well as the strategies being discussed for the development of the housing projects. Interviewee 2 also works for MHEUD. It is involved in the municipal housing prototype design and planning. It had been involved in the formulation and design of the different public space interventions distributed along the central corridor. Its role is more embedded with the architectural and planning aspect, providing useful information regarding the typology and specifications about the types of development expected for the housing projects. Interviewee 3 works for the Municipal Urban Planning Office. It is collaborator in the normative formulation and operation. Currently, it is part of the team updating the document *Plan Guatemala 2020* (Guatemala, 2005), now named *Plan Guatemala 2040*. It describes the Guatemala City vision conceptualized for the next 30 years. It is aimed to lead the municipal interventions linked to a structure of the city looking for *coherent* and *sustainable* development.

Private developers

Between the similarities of the group participants are that all of them had been involved in housing projects with a significant scale and within the municipal boundary. Several of their housing projects had been oriented to the range of middle income groups (middle low to middle high). All of them are active developers with on-going projects. Between the differences, the typology of housing that they develop goes from uni-familiar to multi-familiar and in different locations within the city. One of them is at the same time land owner within the study area. Only one person, had already knowledge about the Municipal Housing Projects, as currently collaborates in the consultancy board of the MHEUD. Additionally one person was interviewed; he is an expert market researcher with experience in real estate properties appraisal.

Academics

Subject 10, is researcher and planner at the urban research unit in the public university. It is also is involved in the cooperation between the Municipality and the university in research and the university projects. Subject 11 is involved in developing research activities in the field of urban form and structure in the public university.

Target group

This group was defined based on the outputs of the interviews with the other participants. It was preliminarily defined as persons with a monthly income within € 1,000 and € 2,000. Young professionals single or forming a young family (with or without kids). Based on this criteria, three persons were selected from the municipality, this because it was easy to get a permission for them to be able to attend the workshop during the next phase of the fieldwork. The three of them come from units that are not linked to the MHEUD. One of them is a young single professional currently renting an apartment within the study area. The second one is a professional with a young family renting a uni-familiar house within the municipality but distant to the central area. The third one is a professional with a young family, owning a house but living outside the municipal boundary. All of them are potentially interested in owning a residential unit (in a multi-familiar project) within the study area.

5.2. Stakeholders perspective and sustainable housing development

Two themes were defined to analyse the outputs for the first objective of the interviews. First the theme *Sustainable Housing* categorizes the stakeholders' concerns and ideals of housing development, see table 5.2. The three categories are economic, environment and social. Considerations of the implications of these three dimensions are done at the level of sustainable housing development reviewed in literature. The second theme is *Housing Development in Central Areas*, and address four categories. This are tightly related to the housing projects oriented for middle income groups within the study area, see table 5.3. The analysis presents a definition of a middle income group by the municipal planners, private developers and academy. From a private investment point of view, the economic viability is defined by the average expected revenue in developing housing projects. Barriers and opportunities for such projects are identified.

SUSTAINABLE HOUSING DEVELOPMENT				
	ID	Economic	Environment	Social
Municipality	1	*AHOUS + FUNHOUS + favour local economic context + construction and maintenance efficiency	*BDMLU + *OG access + energy efficiency	job access + *AS + avoid displacement + social character + enforce community + *LO involvement
	2	*AHOUS + construction and maintenance efficiency	*BDMLU + *OG access + energy efficiency	*AS + avoid displacement + social character + enforce community + *LO involvement
	3	*AHOUS	*DMLU + *OG access	*AS (housing is articulated to the transport system, but not next to it) + enforce community
Private developers	4	maintenance efficiency + one life-time investment + user investment recovery	*OG access via high density	*AS + more family time + parking space + possibility to raise a family + family asset + enforce community
	5	*FUNHOUS + construction and maintenance efficiency + user investment recovery	=	*AS + parking space + enforce community + quiet environment + *LO involvement
	6	economic viability +*FUNHOUS + construction efficiency	*OG + *BDMLU	*AS + enforce community + possibility to raise a family
	7	*AHOUS	*DMLU	*AS + enforce community + avoid displacement + *LO involvement + family asset
	8	user investment recovery	*OG + natural light + air quality	*AS + quiet environment + visuals + possibility to raise a family + enforce community
Market res.	9	economic viability+ *FUNHOUS	*OG	*AS + social character
Academy	10	economic viability + *AHOUS + favour local economic context	*BDMLU + *OG access + energy efficiency	job access + *AS + avoid displacement + social character + enforce community + enforce education
	11	*AHOUS + investment recovery	*BDMLU + *OG access	job access + *AS + social character + spaciousness
Target group	12	*AHOUS	=	job access + *AS + neighbourhood characteristics
	13	*AHOUS + FUNHOUS	*OG access	job access + *AS + secure and safe + 2 parking space + spaciousness + close to relatives + possibility to raise a family + neighbourhood characteristics
	14	*AHOUS + FUNHOUS	*OG access + air quality	job access + *AS + secure and safe + family time + possibility to raise a family + close to relatives + neighbourhood characteristics

*AHOUS = affordable housing *AS= accessibility to services (infrastructure + health + culture +mobility +education)
*BDMLU = balanced dense and mixed land use *DMLU = dense and mixed land use
*FUNHOUS = fundable housing *OG =open and green areas *LO=land owners

Table 5.2. Stakeholders' perspective. Own source

Sustainable Housing

Different implications of sustainable development are within the discourse of the four groups of stakeholders. Municipal planners aim to promote affordable and fundable housing by means of a balanced densification and mixes land uses (4 high floors and possibility of a ground floor with commercial activities). They foresee a potential of improving economic dynamics in the immediate context of their projects. The quality of those should address characteristics of efficiency in their construction and maintenance in the long term. Design should consider low energy consumption by users (energy efficiency plans or devices). Proportions between the buildable and not buildable surface should guarantee access to open and green areas by the users. Housing interventions intends to avoid displacement of current residents and enforce community between users and neighbourhood residents. At this regards, involvement of land owners residents is key important. "People have tradition of living in these areas" (interviewed 2). Housing projects intend to strength social structures by a more permeable and inclusive society. Accessibility to services and jobs is main criteria for their location. "Is natural that

areas in where Trans Metro pass along side will be under economic commercial pressures, therefore locating housing projects there is more difficult due to land prices. This implies that housing should be articulated to the transport system, but not next to it" (interviewed 3).

Private developers address more or less same implications but in different perspective. They aim to a maximum possible densification. Projects need to be fundable to ensure a cash flow for the development. Economic sustainability depends on an efficient management of the construction. Maintenance efficiency will avoid degradation in the long term and ensure the investment recovery of their users. Environmental and social concerns are viewed in terms of what makes housing projects attractive for buyers. This also addresses reasons why users also prefer peripheral areas (security, private gardens, and recreational areas). The social structures respond to the preference of living nearby relatives and similar social groups. Enforcement of community is seen as the awareness of developers of organized users to ensure good coexistence and good long term maintenance of physical structures. Involvement of land owners in this case is more a strategy to negotiate affordable land in exchange of one or more of the resulting built flats equivalent to the arranged land price. Parking space is included in the social dimension. "Middle income groups own a car, and if not, still they aspire to have one" (interviewed 4). "I define commodity as having 2 parking spaces" (interviewed 13). In the social context of Guatemala City, owning a car is not just a necessity, it also addresses important perspectives of the *image of success*.

The academic perspective is very similar to the municipality. Still an additional point was addressed. "This model of compact dense development implies a trade-off of spaciousness of the housing units versus the location; however, sometimes minimum spaces are such that housing becomes temporal rather than permanent" (interviewed 11). Even though projects are oriented to young professionals and families, possibilities of raise a family should be considered (interviewed 11).

Target group views are based on what they value most from their current location and what do they evaluate in looking for housing options. They emphasize that characteristics of the surrounding neighbourhood are important. For them, affordability and access to finance is a main concern. "I was looking for housing options within the city, but I couldn't access to finance so I decided to go out of the city" (interviewed 13). Additionally to the economic constraints, the characteristics they value in their current location overweight at some extent the time and costs of daily trips. "One gets used to it, still I would like to reduce the time and the money I spend in coming to my work every day" (interviewee 14).

Even though mobility and facilities of transportation concerns are not included in the table, those are referred by the four groups. Municipal planners and academy address this point from the environmental (pollution mitigation) and economic dimension (costs of mobility). Interview 4 address a social dimension and estates "current generations, born around 80's want to spend more time with their families, they are able to sacrifice space but reduce time in their trips".

HOUSING DEVELOPMENT IN CENTRAL AREAS					
	ID	Definition of *MI	Expected profitability	barriers	opportunities
Municipality	1	*MI earn = >$ 1	□	limited municipal land source and budget + *LES + plot sizes + better locations are more expensive + non acknowledgment of market dynamics + *PersIC	modify urban conditions + normative and management tools + *LO and PRIV association + sub used land + organized demand
	2	*MI earn = $ 1 - 4	□	limited municipal land source and budget + cultural barrier + *LES	modify urban conditions to increase value of limited municipal land source + *LO and PRIV association
	3	□	□	Locations with higher fluxes of mobility (Trans Metro lines) have a higher commercial pressure + bureaucratic procedures + *PersIC + *LES	normative and management tools
Private developers	4	*MI affordability = $ 0.25-0.55 monthly	Profit > 30% + market research (known demand)	HHPref + *PersIC + bureaucratic procedures + plot size + unknown urban impact expenses + land price, *LES	cultural shift (60% acceptance of vertical & compact housing) + zones 1,2,4,11,12,7 + cheap land but not very close to main mobility lines
	5	*MI retail price = $.0.5-0.6 / m^2	Profit > 20% + market research	plot size + construction costs (underground parking) land price, *LES + bureaucratic procedures + *PersIC	cultural shift + zone 4 + existent market niche
	6	*IM earn = $ 2.4, affordability instalments = $ 0.8-0.9, retail price = $ 47 - 65 unit +	Profit = 12-15%	bureaucratic procedures + plot size + unknown urban impact expenses + POT normative + construction costs (in higher buildings) + land price + imply a new model of development	use of land classified as G0 (no economic value)
	7	□	Profit = 15-25%	bureaucratic procedures + plot size + unknown urban impact expenses + *PersIC + *LES + imply a new model of development	zone 4 (*LO with investment capacity) + sub used land + increase in mobility costs
	8	*MI retail price = $ 50-60	Profit = 20-25% + market research	new tax system + *LES + *PersIC + bureaucratic procedures	existent market niche
Market res.	9	*IM earn = $ 1.6 - 1.9	Profit > 20% + market research	bureaucratic procedures + plot size + unknown urban impact expenses + *LES + conservationism of architectural assets + non acknowledgement of municipality future plans + polarized society + neighbourhood resistance	zone 5, 6, 7, 11, 12, 19 (highly populated), zone 8 (views), zone 9 (best but very low populated), zone 4 (everybody see it), zone 18 (sales leaders)
Academy	10	classified by income	□	plot size + tenancy model ("large areas in few hands") + *LES (atrophied real state market due money laundering) + uncoordinated institutional efforts	*LO and PRIV association
	11	classified by income	□	limited municipal land source and budget + plot size + land price + *LES + better locations are more expensive	national level normative and management tools
Target group	12	□	□	□	existent *AS within the city
	13	□	□	imply a new model of development	sub used land
	14	□	□	*PersIC	□

*HHPref = household preferences (private garden, privacy, parking space) *LES = land speculation *LO=land owners
*MI = middle income definition times 1000 PersIC = perceptions of inner city (security, pollution, noise) *PRIV= medium private investment

Table 5.3. Stakeholders and developments in central areas. Own source

Housing Development in Central Areas

Middle income target group is defined in different way by almost all the stakeholders (municipality, private developers and academy). Municipality and academy classify those based on their income (earned amount per household). Private developers introduce other variables like affordability capacity (monthly instalments or retail affordable price of the housing units). The ranges vary among those, still one similarity is found between the housing retail price given by interviewed six and eight.

One of the main concerns of private developers is the economic viability of the projects. This is defined as the expected revenue after covering all the costs that development implies. The ranges go from 12% to 30%. However, as expressed by interviewed 5, the guild, in average, defines viable when a 20% of the total sale is left as profit. In pre-development studies, higher expectations might be done when development is risky (unexpected costs may arise, uncertainty in development). Those might also decrease or increase depending on the scale of the project. This dimension is important when planning for municipal housing projects in collaboration with private developers or investors. And, even for the municipality alone, economic viability plays an important role if they intend to finance other projects (low income housing) by means of housing for middle income.

Stakeholders identify the barriers that by the moment need to be overcome in order to develop housing for middle income in central areas. Current urban structures, high land price, land price speculation and bureaucratic procedures to get construction permissions are identified as main barriers.

Private developers adduce that land price speculation had been observed in the areas along municipal interventions. "It could be different if the municipality could anticipate developers about their interventions so investment can take place in synchrony with those, not later when after municipal millionaire investment it's impossible to manage with land owners for long time" (interviewed 9). Additionally, private developers state that development operations within the city are risky. "It might be that when one is already in the construction process, municipality will ask to pay for urban impact rates" (interviewed 4). "These additional surprising expenses might even stop the construction process" (interviewed 9). "Private investors are aware of investing in improving services infrastructure in the city, but it is needed to be clear from the mere beginning what and how much are those, otherwise this situation just bring uncertainty to development" (interviewed 6). Finally "the Territorial Ordinance Plan is blocking possibilities of development, it do not adapt to current urban structure" (interviewed 6). He explains that due to the set-backs parameters established in the norm, it is practically impossible to develop in small plots.

Stakeholders also identify a cultural and perceptual barrier. The first addressed models of ownership between horizontal and vertical housing. Interviewed 4 estates that this is changing and, in turn, it represents an opportunity for these projects. Interviewee 7 visualize that a generalized increase in mobility costs (fuels) will enforce this cultural shift. Perceptions of noise, pollution and insecurity play a negative role in promoting inner city housing.

"Private developers invest a lot of money in learning" (interviewed 6). This might be interpreted as pragmatism. They already have a market, a development structure and methods. Developing housing projects in central areas is seen as a challenge in where new manners of ensure successful projects should be researched and this represent investment of time and money.

Municipality is limited in its budget and land source. Therefore, as a first step, managers of associations between land owners and private developers are the most viable short-term opportunity as well as improving and enforcing current normative. However, "our limited knowledge of market dynamics is a weakness in negotiations with private investment" (interviewed 1).

In conclusion, opportunities are seen from to points of view. It is recognized that very good locations exists within the city due to their current populations and access to infrastructure. "There is a group reaching a mature age getting ready to leave home" (interviewed 9), in other words, there is a potential market niche currently living within the study area. Public-private (investment and land owners) associations are key important in facing the challenges due to current constraints.

5.3. Stakeholders and the participatory planning

Two themes are defined to address the second objective of the interviews, see table 5.4 and 5.5. The first is *Assuming a Collaborative Planning Approach*. Outputs are coded and classified in three categories. Based on the perspective of the participants, strengths and difficulties are identified assuming collaboration in the planning process for municipal housing projects. The second one is *Personal Perspective on Collaborative Planning Approach*. Four categories are defined: stake, willingness, participation degree and collaboration of others.

ASSUMING A COLLABORATIVE PLANNING APPROACH				
	ID	Strengths	Difficulties	barriers
Municipality	1	organize demand (buyers) for housing projects + study their preferences + enforce a scenario for investment + value the public management	non compatible interests	non acknowledgement of market dynamics
	2	¤	¤	¤
	3	¤	¤	¤
Private developers	4	trust backing for housing projects (experience and brand) + overcome of bureaucratic processes + enforce a scenario for investment	unfocussed discussions	lack of trust + political stress + financial uncertainty
	5	knowledge construction + certainty in development investment + overcome bureaucratic processes + enforce a scenario for investment	once identified certain areas of interests, this could favour to speculation by *LO + unfocussed discussions	lack of trust
	6	certainty in development investment + overcome bureaucratic processes	non acknowledgement of market dynamics by municipality (TOP do not adapt to current urban structure) + not compatible interests + communication among stakeholders + unfocussed discussions	imply a new model of development (learning process is an investment) + personal time limitations + political stress + lack of trust
	7	certainty in development process + synchronize municipality interventions with private investment + enforce a scenario for investment + overcome of bureaucratic processes + collective vision	perceptions of stakeholders about the others and the project itself + negotiations with *LO + development pragmatism	lack of trust + political stress
	8	enforce a scenario for investment + certainty in development investment + overcome bureaucratic processes + time saving in looking for land + focus in a disregarded niche + alliances with *LO + loyal competiveness between developers + academics could favour cultural shifting and community by means of education	unfocussed discussions	¤
Market res.	9	access to information + certainty in development investment + overcome bureaucratic processes + synchronize municipality interventions with private investment + identify compatible interests among participants + knowledge construction	non compatible interests + unfocussed discussions	previous experiences (lack of communication instances with municipality) + lack trust
Academy	#	reach society and strength human development +multidisciplinary approach to urban phenomena + knowledge construction	non compatible interests	bureaucracy
	11	multidisciplinary approach to urban phenomena + knowledge construction	¤	personal time limitations
Target group	#	knowledge construction	¤	political stress (lack of continuity)
	#	user preferences consideration	unfocussed discussions	¤
	#	synchronize municipality interventions with private investment	non compatible interests	personal uncertainty if my opinions are going to be addressed
*LO = land owners				

Table 5.4. Assuming a collaborative approach. Own source

Assuming a Collaborative Planning Approach

Stakeholders identify several advantages in collaborative planning approach. Mainly those addresses the possibility of overcome the identified barriers for development. New knowledge can be built on collaborative planning practices. Research on new construction methods, enforcement of current normative and paths to overcome the market challenges, between others are mentioned. Municipal planners foresee a possibility of organize the demand (potential buyers) for housing projects. Also it represents a mean to value their role, acknowledging third parties perspectives and strength their administrative management (normative tools). Private developers preview a possibility to build a scenario for development and local economic strength. It could provide a first step in further approaches with land owners to facilitate availability of land for development. They visualize the labour of academics in promoting new lifestyles and community coexistence (addressing cultural barriers). Such approaches could also enforce trust and an environment of information sharing, parallel to synchronize municipal and

private investment interventions. Academics point out that municipal housing could also be the gate to share knowledge and enforce human development making use of current telecommunication technologies.

Difficulties are also identified. There is uncertainty in the real progress in collaborating approaches due to non-compatible interests. "Private developers want to sell at the best price and reducing the costs as much as possible (construction costs, construction permissions), and have tight agendas; users want to buy the best product at the lower price; municipality want to charge more for construction permissions and political image is more important, for them time is not that important; academics want to give a discourse" (interviewed 9). "When too many chefs are in the kitchen, no cake can be cooked" (interviewed 8). "Collaboration has nuances, what people consider is good might be that is not the best" (interviewed 1). Variety of interests and mind sets could lead to unfocussed discussions, with no benefit at all. Land owners still provide uncertainty and risk for the housing projects. "After identifying the optimal sites for development, it might happen that in the same minute the land owners are contacted, the land price duplicates" (interviewed 5).

Stakeholders mention some barriers that may avoid the implementation of such approach, some of those from a personal dimension (time limitations). Municipality is aware that their limited knowledge of the market dynamics could be a limitation in the negotiations with private investors. Private developers express a generalized lack of trust toward public entities and political stress. Academy adds that bureaucratic procedures to articulate inter institutional collaborations are not always viable. Target group estate that uncertainty in the seriousness of addressing their collaboration.

Personal perspective on Collaborative Planning Approach

Stake category expresses their potential contribution to the planning process. Willingness define in a scale from 1 to 5 their interest in collaborate (being 1 less interested and 5 very interested). Decision level indicates and collaboration of others categories indicate, under each perspective, what should be their own empowerment and the other's. These are based on the classification of types of involvement given by (Woodhead, 2000).

Municipal planners describe their role as managers between the associations that can arise from the planning approach (land owners and private investment). They also emphasize their role in being the only one capable to modify and improve certain urban conditions by means of public space interventions. They estate that municipality, in its role of lead sustainable development, should be the decision maker and approver. Other stake holders are source of knowledge inputs.

Private developers emphasize their experience and knowledge to be added in the planning process (design, planning, construction, etc.), as well as knowledge on how to operate in the market and deeper understanding of the users' preferences. Three of them express that their empowerment it is conditioned. If they are funding the project, they should be the only agents of approval. While others stakeholders only provide inputs to be considered. "What really matters is a market research, not the opinion of someone else" (interviewed 4). If they are not funding the project they could offer consultancy and be decision shapers. They don't consider proper that municipality proceed alone with housing projects. "Private developers should be the natural partners of Municipality; if the private developers were not able develop in central areas, why the municipal planners are going to be able to do so?" (interviewed 9).

Academy stresses their contribution in the knowledge building process and multidimensional approaches to the urban phenomena. Also, they make reference of skills in designing and adapting these projects to their urban contexts addressing dimensions of urban image and social character. Alike the perspective of other stakeholders on their type of involvement, they see themselves as contributors to the process but not as decision makers.

Target group express their contributions as indicating their preferences. "Housing offer usually disregard user preferences, I can contribute in this sense even though my participation do determines that

I will live in those projects" (interviewed 13). They see themselves with high empowerment together with others.

Most of the participants are willing to collaboration. Sometimes moderated by personal limitations (available time). In the case of interviewee 4, its willingness depends upon the overcome of the barriers it identify in the previous theme.

PERSONAL PERSPECTIVE ON COLLABORATIVE PLANNING APPROACH					
	ID	stake	Willingness	Decision level	Collaboration of others
Municipality	1	managers between *LO and PRIV investment + further promoters of new housing in diff. modalities + interventions of public space	5	Decision approver	Consultancy / decision influencers / shapers
	2	managers between *LO and PRIV investment	¤	¤	¤
	3	¤	¤	¤	¤
Private developers	4	development management knowledge (design, construction and finance) + brand	1	Making decision in selecting / approving	Consultancy
	5	development management (design, construction and finance) knowledge	5	Making decision in selecting / approving	Consultancy
	6	development management (design, construction and finance) knowledge + market knowledge + target group knowledge	4	Making decision in selecting / approving	Consultancy
	7	market knowledge + entrepreneurial vision (economic revenue)	5	Consultancy	Decision shapers + decision in selecting / approving
	8	development management (design, construction and finance) knowledge + market knowledge + target group knowledge	5	Making decision in selecting	Decision shapers + decision in selecting / approving
Market res.	9	knowledge of the market + sustainable and economically viable models of development + identify opportunities for development	4	Consultancy	Making decision in selecting / approving
Academy	10	lead to common wellbeing + share knowledge	5	Decision influencer /shaper	Making decision in selecting / approving
	11	knowledge on adapting new intervention to local contexts + urban analysis	3	Decision influencer /shaper	Making decision in selecting / approving
Target group	12	indicating users preferences	5	Decision influencer / making decision in selection	Making decision in selecting / approving
	13	indicating users preferences	5	Decision shaper / making decision in selecting	making decision in approving
	14	indicating users preferences + knowledge on infrastructure planning	5	Making decision in selecting / approving	Consultancy / making decision in approving
*LO = land owners			Willigness = 1(not willing to) - 5 (highly willing to)		

Table 5.5. Personal perspective on collaborative planning approach. Own source

5.4. The workshop: Characterization of suitable land for municipal housing development

The following sections describe the outputs of the workshop. First, a review of the main discussions is given. Next, the criteria formulated by stakeholders to do a suitability analysis are described. Finally, their priorities are analysed.

5.4.1. Discussions on municipal housing development

Several discussions took place during the presentation of the slides regarding the understanding of the study area. Those lead to three main preliminary definitions. One it is discussed the role of the Municipality trough MEHUD in promoting and developing housing projects oriented for middle income. Second, is recognized the need for specific definition of a target group. Third, it is the possibility of

looking for and assessing the sites for developing the municipal housing projects based on the possible definitions of housing products for different type of users.

In addressing a public-private intervention for municipal housing projects, the role of the MEHUD as public managers to facilitate availability of land is important in overcoming the actual barriers for development. As one of the main limitations of the MEHUD is the availability of public land, the success in developing and promoting housing projects strongly depends on managing to acquire land or stimulate development in private plots. Different policy tools and mechanisms could be the base to either afford to acquire the land by mean of a sale-purchase transaction in a market based land price, or involve the land owners that for different reasons, besides land price speculation, don't want to sell their land (old residents, land owners without economic capacity to develop, groups of residents that own small plots within a block or residents that don't want to move from the sector). The scheme of "new housing by associated management" in where the interests of the municipality, the land owners and private investors are synchronized is seen as one of the major and more feasible mechanism to materialize housing projects. Here it is made evident the importance of identifying areas to prioritize such management efforts.

Recalling the current demographic dynamics within the study area and some of the barriers identified to develop housing projects is clarified that the first potential buyers for the municipal housing projects oriented for middle income are already within the study area. The definition of the target group should be more precise in terms of income, level of education, family status and range of ages. In the task of reverse the trend of depopulation towards peripheral area, a "mature" population that fit in the "target group" definition should be attended either by the private sector or by the municipal housing projects. The precise description of the target group is stated as young professionals single or married, with or without kids, earning a total salary between Q. 12,000 and Q. 18,000 (€ 1,200 – € 1,800).

"The whole territory has a potential for something" (interviewee 9). Assessing the adequacy of a site to develop any housing project should be directly linked to the users to who is oriented and be as explicitly as possible. In considering the definition above, it is possible already to define more than one specific type of user for whom the affordability capacity and concerns may vary. For example is not the same a young professional earning Q.15,000 without no kids, than a couple of young professionals earning the same amount of money together still without kids, and different for the same case but with kids. At this regard, in considering the possible variety of housing products for different households will also be reflected in the opportunities that a specific site offer to develop a housing project. Based on experiences of private developers, target group preferences expressed on market researches and the current market trends a range of parameters can be defined. It is assumed to develop housing units within a range of size of 50-75m^2, with selling prices estimated between \$800-\$1000/m^2 and assuming an average construction cost around \$600/mt^2. This supposes the definition of a type of product that corresponds in part to the prototype of housing that the municipality is interested in develop, and the market niche that is still unexplored by private investments.

5.4.2. Definition of criteria and priorities

The criteria state the characteristics of a suitable site to develop the municipal housing projects oriented to middle income groups as defined during the workshop discussions.

As can be noticed, the land price is excluded of these criteria. This responds to two main considerations. First it is emphasized that one of the main roles of the Municipality, due it's attributions in the public context, should be one of land source manager. The development of different strategies that allow involving land owners, acquiring land by a normal sell-purchase market operation by means of public funding, operationalization of financial mechanisms or incentive tools, between others are important in ensuring the availability of land, overcoming one of the main barriers which is the land price speculation. Second, including the variable of land price in part redundant as the land with some of the most valued characteristics for locating housing projects (access to high quality public transportation and

mobility) it is also submitted to strong pressure to be developed with commercial land uses, meanwhile the cheapest available land within the study area is located in areas that do not fulfil the desired characteristics for municipal housing development. At this regards, a contradiction in using land price as a variable can be also observed based on the experiences shared by the stakeholders. In some cases land price increases are detected when a municipal intervention is done in the proximities (i.e. parks, Trans-Metro) due to land price speculation, however such price do not responds to other desired spatial qualities that should account for the location of housing (i.e. access to services or education).

Therefore, the methodology agreed during the workshop was to assess the land using the variables that correspond to desirable location characteristics, then, once the suitability maps are produced and the sites are designed, the assessment should incorporate financial specific parameters to analyse whether the sites offer an economical viable opportunity to develop such project or not based on its land price.

a. Proximity to municipal transportation system Trans-Metro (the closer the better): the Municipal Transportation System had gained high acceptance as is considered as the most efficient and secure alternative of public transportation. This characteristic is very important in discouraging the use of private vehicles for daily activities; therefore is strongly linked to the potentiality of reducing CO_2 emissions. It is also important as justifies the possibility of reducing parking space for these housing projects and consequentially the construction costs.
b. Proximity to nodes of commercial and services land uses (the closer the better): this is highly relevant in order to reduce travel times in daily activities and make more attractive the housing options regarding the preferences of future residents to access to a wide range of daily supply options, commercial activities, health services, education. Other characteristics are assumed to give additional value favouring the quality of life like proximity to recreational, cultural and green areas.
c. Proximity to semi/qualified job sources (the closer the better): as the first criterion, this characteristic is more oriented in reducing travel distances between home-work locations. Qualified and semi-qualified refers to all those jobs that can be accessed by skilled or professionals persons.
d. Proximity to higher populated areas (the closer the better): This criterion responds to the need of attending the already settled population within the study area as they also represent a potential market of buyers. Following a specification of the target group discussed during the workshop, it also comprehends to focus on those areas whit higher inhabitants with ages between 25-40 years old. From social point of view, the strategy of targeting the higher populated areas responds to the objective of avoiding displacement and improvement of current living conditions of already existent residents. It is stated that there exist a group of the population already settled in the study area that is reaching "maturity" and that will be interested in looking for house opportunities. At a more specific level, different ranges of age can lead to different sub-specification of the target group and therefore to get insights in the diversity of housing products that could be developed in the area, according to the market researcher.
e. Distance to municipal interventions (the closer the worse): this criterion responds to the land market dynamics that had been observed by private developers referring to the land prices increases after the implementation of a municipal intervention, and even with the mere public knowledge of the municipal plans like "Aurora Cañas". As it is mentioned before, land price speculation represents one of the barriers for developers, and especially for this type of projects. This criterion suppose a trade-off between the desired characteristic of being close to a municipal intervention like it is the municipal transportation system in terms of accessibility, but at the same the negative aspect of incidence of land price speculation. Both criteria do not auto-eliminate each other as each one have a differentiated weight, as it is seen further.

Together with this criteria, it was agreed that all plots that are located directly facing municipal interventions (Trans-Metro, public space interventions) should be considered as a spatial constraint for the analysis, this will allow to concentrate the effort in all those plots which values are less affected by speculation. "It is not said explicitly, but is natural that the municipal projects that generate more fluxes in the open street will influence in the commercial pressure and vocation of the immediate land. Therefore residential projects for middle and low incomes are intended to be indirectly connected but not directly facing the public transport axes" (Arch. M. Catalan).

f. Sites with less construction (less construction the better): This constitutes a constraint for the plots that are considered in the design phase. Two indicators are considered. First, the number of built floors, for this analysis it is assumed that plots with more than three built floors (ground floor, first and second floor) are less probable to be redeveloped than plots with one two or three built floors. Second, the current built squared meters per plot was compared against the total squared meters that could be built according the TOP regulations per plot, see formula 4.1. This gives an indicator of sub-utilization versus the amount of square meters that is possible to build in such plot(s). While smaller the percentage of current built area against the possible buildable area, the better. Following this logic, empty plots are preferred as well as plots being used as open-air parking. Is worth to mention, that according to the experience of the market researcher, empty plots have a high probability to be less viable for development. This, due that in most of the cases, the reasons why those are empty are either land price speculation, or some other legal conflicts usually related to heritages or between more than one land owner.

g. Access to mobility network (closer the better): this criterion refers to the proximity to other means of mobility, either by accessing to other types of public transportation rather than Trans-Metro, or accessing to the main roads by private vehicle. Even though this criterion point out the preference for good access, it is also stated by the target group that housing projects should not face directly these main roads due to safety, noise and air pollution issues.

Figure 5.1 shows the ranking ordinal values that resulted in the group process, being 1 the most important and 5 the less important.

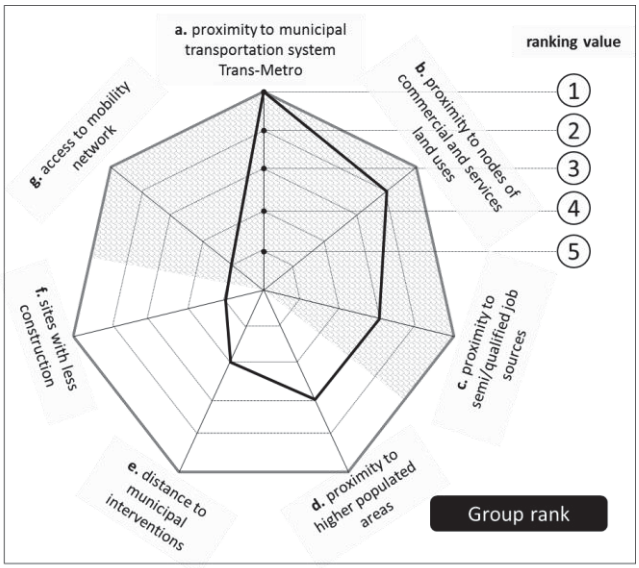

Figure 5.1. Group ranking. Own source.

The main characteristics of suitable land for municipal housing development are related to issues of accessibility to transportation and desired land uses. The access to the municipal transportation system

(Trans-Metro) is the characteristic with the highest priority, followed by the access to nodes of commercial activity and services like health, education, recreation and green areas. Third the access to qualified or semi qualified jobs. At the same level of importance is the proximity to already populated areas. Fourth is the distance to municipal interventions, and fifth is the characteristic of low construction intensity and access to other means of transportation. In reference to the trade-off mentioned between criteria "a" and "e", it is observed that due to the priorities established by the stakeholders, criterion "e" lightly punish criterion "a", avoiding auto-elimination.

5.4.3. Analysing priorities regarding stakeholders perspectives

Due that each participant was given a limited amount of dots to distribute over the criteria, those criteria that were not given any dot by any participant of one group of stakeholders were assumed to be at the same level in the last ordinal position. Table 5.6 shows the criteria ranks obtained in the workshop exercise, the weighted rank and the normalized rank (higher the value = higher the relevance) as a group as well as the values deduced for each group of stakeholders. The criteria rank values were normalized multiplying the result given by the formula times 10. The Figure 5.2, shows the overlapped weights from the different stakeholder and the group preferences converted into weights, showing the differentiated priorities regarding each stakeholder group perspective.

	CRITERIA	Group rank			Target Group			Municipal Planners			Private Developers			Academy		
		Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**
a	transportation system Trans-Metro	1	7	2.12	1	7	2.06	1	=	1.43	1	7	1.89	2	6	1.46
b	proximity to nodes of commercial and services land uses	2	6	1.82	2	6	1.76	1	=	1.43	1	7	1.89	1	7	1.71
c	Proximity to semi/qualified job sources	3	5	1.52	2	6	1.76	1	=	1.43	4	4	1.08	1	7	1.71
d	Proximity to higher populated areas	3	5	1.52	4	4	1.18	1	=	1.43	2	6	1.62	2	6	1.46
e	Distance to municipal interventions	4	4	1.21	5	3	0.88	1	=	1.43	3	5	1.35	3	5	1.22
f	Sites with less construction	5	3	0.91	5	3	0.88	1	=	1.43	4	4	1.08	3	5	1.22
g	Access to mobility network	5	3	0.91	3	5	1.47	1	=	1.43	4	4	1.08	3	5	1.22
	TOTAL		33	10		34	10	7		10		37	10		41	10

*n − rj + 1 **[(n − rj + 1) / ∑(n−rj+1)] n=number of criteria rj=ordinal position among the rank

Table 5.6. Stakeholders' preferences. Own source

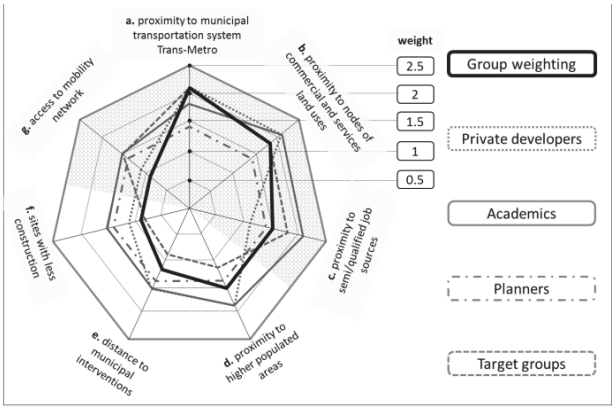

Figure 5.2. Stakeholders' overlapped preferences. Own source

Based on the table 5.6 and figure 5.2 can be observed that for the private developers and target group the two most important criteria are the proximity to municipal transportation and proximity to commercial and services land uses. For the target group the access to semi/qualified job sources is equally important as the proximity to commercial and services land uses, followed by the access to other means of transportation, then proximity to higher populated areas and in the last order of relevance the distance to municipal interventions and sites with less construction. Meanwhile for the private developers the

proximity to populated areas falls in third order of priority, followed by the distance to municipal interventions and last are the criteria of proximity to job sources, other means of mobility and the construction within the site. For the academy, the two most important criteria are proximity to commercial and services land uses and proximity to job sources, followed by the proximity to the municipal transportation system and proximity to populated areas. At last, access to other means of mobility, distance to municipal interventions and the construction within the site. For the municipal planners the priority was defined as equal among the criteria, similar approach is observed in the methodology followed in URBANISTICA and CIFA (2010) an analysis done to identify vacant land within the study area having accessibility to certain land uses.

5.5. Stakeholder information requirements

Based on the literature review, the interviews, discussions with stakeholders and previous experiences working with stakeholders with different background, considerations on what information is needed and how is presented are important. The "what to present" aspect deals with the specific quantitative or qualitative information that is being used and produced during each stage of the planning process and presented to the stakeholders. For the case of planning for Municipal Housing Projects, after identifying and extracting information from the different stakeholder individually and in a collaborative exercise, two more stages are identified in the collaborative framework proposed: sites options design and sites assessment, see figure 2.4. During the design process information on the data and the techniques to produce the suitability map was presented as well as the procedure to design the site options and the characteristics of those (surface area, current built area, buildable area, current land use, location, etc.). In assessing the suitable sites that could be developed, the stakeholders concerns are more related to aspects of benefits in terms of number of possible beneficiaries, and the financial opportunity that exists for developing each site. More detail regarding to design and assessment of options is given in chapter six.

The "how to present" aspect deals more with the information and techniques pertaining to facilitate communication with the participants and to enforce their understanding on the process of identifying and assessing sites for municipal housing development. At this point, the natural flow of information of what is received from the stakeholders, what is given back to them after the analysis and the easiness to recognize their own inputs and how it affect the analysis is vital in making more transparent the technical and analytical procedures being implemented during the planning process, as well as generating certainty on the quality of the outputs by stakeholders. Within this aspect, the methods used to share and visualize geographical and non-geographical information were paid consideration regarding stakeholder's skills and available software.

5.6. Experiences by stakeholders about the workshop

Based on a questionnaire carried out at the end of the workshop, see appendix C, some remarks are done. In general stakeholders agree that 3D visualisations enforce understanding by territorializing the information to be analysed within a public that is not very familiarized in using geographic information. The level of detail used was adequate due to the scale of the area, however higher levels of detail could bring new information and better understanding. Almost all the stakeholder emphasizes the richness of the discussions by acknowledging different opinions and perspectives respect the same topic. Still, they all agree on the need of a moderate participation by all stakeholders to avoid unfocussed discussions.

6. IDENTIFYING AND ASSESSING SUITABLE SITES FOR HOUSING PROJECTS

The first section describes the implementation of a Spatial Multi Criteria Analysis using stakeholder's criteria and combining different layers of data. Section two describes the site design process and results. Section three describes the implementation of a framework in order to assess the sites proposed. In this section, a rank is given to a selected group of sites in order to prioritize planning efforts.

6.1. Analyzing the urban land suitability

6.1.1. Implementation of a Spatial Multi Criteria Analysis in a GIS environment

Based on the conceptual description of the criteria, see section 5.4.2 the available data there was also discussed with the stakeholders the way each criteria was going to be measured . Figure 6.1 synthetize in a diagram the methodological structure that was used to implement the SMCA model. In the left are listed the different layers of data. Negative sign indicates cost standardization and positive indicates benefit standardization. Second column from left to right indicates the weight assigned in order to produce preliminary suitability scores (one per each criterion). The fourth column indicates the weights coming from the priorities analysis, see table 6.2.

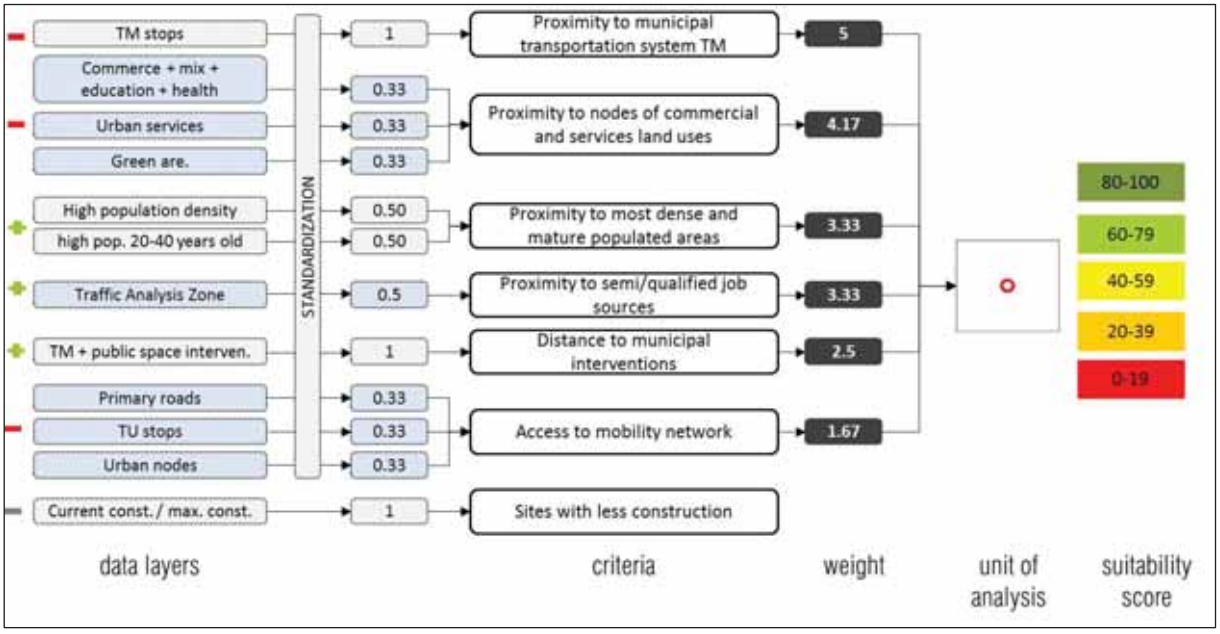

Figure 6.1. SMCA implementation. Own source

As it can be noticed, the last criterion named "sites with less construction" was not incorporated in the suitability analysis. As it was mention before, it was the only criterion which data is directly linked to each specific plot. The exclusion is justified as an alternative to facilitate working with a different unit of

analysis rather than the plot, this as a measure protect the confidentiality of the plots. This criterion is then incorporated in a further step when it comes to assess the sites, see section 6.3.

6.1.2. Description of the data used in each criterion

Table 6.1 briefly describes the type, nature and source of the data contained in each layer, as well as the relevant measure extracted. In the source of the layers is indicated the last update year to which the information corresponds. The layers of demographic information and the traffic analysis zones are the older layers; however it is assumed that even though there were natural changes (increases) in the values, the ordinal spatial arrangement had not changed. This means that even though the population had growth, the areas with higher concentrations of residents are spatially located in the same areas. It happen the same with the number of attracted trips for the layer of traffic analysis zones.

Criteria	Layer	Type	Content / selection criteria
Proximity to municipal transportation system	TM stops	Point	Euclidian distance to stops of the municipal transport system Trans_Metro
Proximity to nodes of commercial and services land uses	Commerce + mix + health + Schools	Polygons	Euclidian distance to commercial, mixed, public/private health facilities and school land use "high cathegory"
	Urban services	Polygons	Euclidian distance to dedicated uses to recreational, sport, culture and universitary education
	Green areas	Point	Euclidian distance to green areas
Proximity to most dense and mature populated areas	High population density	Polygons	Value of the density in hab/Ha
	High pop. 20-40	Polygons	Value of the number of inhabitants with ages ranging from 20 to 40
Proximity to semi/qualified job sources	Traffic Analysis Zone	Polygons	Value of the number of attracted vehicles per track during day, during working days.
Distance to municipal interventions	TM+public space intervention	Polylines	Euclidian distance to the municipal intervention
Access to mobility network	Primary roads	Polylines	Euclidian distance to the primary roads
	Trans Urbano stops	Point	Euclidian distance to the stops of the public transport system Trans_Urbano
	Urban nodes	Point	Euclidian distance to the urban nodes of intermodal exchange

Table 6.1. Criteria data combination. Own Source

6.1.3. Implementation of the Uniform Unit of Analysis (UAS) and spatial constraints

The implementation of the UAS reduces the computational demand when carrying out the multi criteria analysis, as due to the irregularity of the plots geometry and the range of sizes, the same extension (study area) is analysed with one third of the amount of polygons than if the plot layers would had been used.

The spatial constraints where defined using the TOP regulation data, specifically the areas defined as “special land uses”, defined as various dedicated land uses (military areas, industrial clusters, graveyard, urban infrastructure, public health, archaeological sites and urban services) but not meant for residential uses. Additionally, based on stakeholder’s discussions, it was agreed to exclude all those plots that directly face a municipal urban intervention, refer to criteria “e” in section 5.4.2. See figure 6.2.

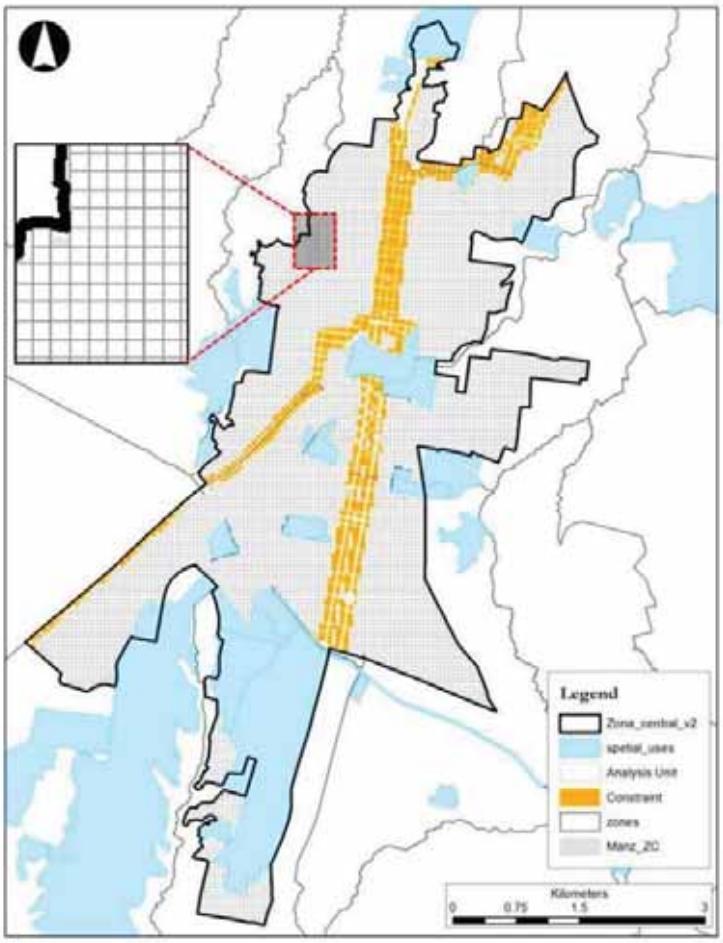

Figure 6.2. Uniform analysis area and spatial constraints. Own source

6.1.4. Characterization of suitable land and stakeholder's preferences

As the criterion of "less construction the better" is not included for the suitability analysis, the weights for each criterion are calculated again. Table 6.2 shows the new weights. In comparing table 5.6 and 6.2 it can be noticed that the nature of the relevance of each criteria for each stakeholder remains the same after excluding the criterion, as it was prioritized as least important among the four groups of stakeholders. The colours ranging from green to yellow in the column of normalized weight indicates the order of their preferences, being green the most important criteria and yellow the least.

CRITERIA	Group rank			Target Group			Municipal Planners			Private Developers			Academy		
	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**	Straight Rank	Weighted rank*	Normalized rank**
proximity to municipal transportation system Trans-Metro	1	6	2.50	1	6	2.61	1	=	1.67	1	6	2.22	2	5	1.67
proximity to nodes of commercial and services land uses	2	5	2.08	2	5	2.17	1	=	1.67	1	6	2.22	1	6	2.00
Proximity to semiqualified job sources	3	4	1.67	2	5	2.17	1	=	1.67	4	3	1.11	1	6	2.00
Proximity to higher populated areas	3	4	1.67	4	3	1.30	1	=	1.67	2	5	1.85	2	5	1.67
Distance to municipal interventions	4	3	1.25	5	2	0.87	1	=	1.67	3	4	1.48	3	4	1.33
Access to mobility network	5	2	0.83	5	2	0.87	1	=	1.67	4	3	1.11	3	4	1.33
TOTAL		24	10		23	10	6		10		27	10		30	10

* n – rj + 1 **[(n – rj + 1) / Σ(n–rj+1)] *n=number of criteria rj=ordinal position among the rank*

Table 6.2. Suitability criteria and weights. Own source

6.1.5. Suitability of urban land within the study area per criterion

Several maps were elaborated as the criteria were implemented for the analysis using the available information. Raster images were produced for the distance measurements. Even though the distance measurements could had been done automatically where implementing the criteria in CommunityViz with no need of raster layers, the raster maps were useful in explaining to stakeholders the process of implementation of the model and be able to make a clear relationship between the suitability patters and the data used for that criteria. Below are presented the suitability maps corresponding to each criterion and the layer or layers that were combined to produce the suitability score.

Criterion: Proximity to municipal transportation system Transmetro

Figure 6.3 shows the raster map produced with the euclidian distance analysis and the suitability score. The values of the measurement (distances) were standardized using a goal standardization method. According to the Urban Mobility Office, the expected distance of direct benefit is 500m away from each Transmetro stop, therefore all those UAS with a measurement below or equal to 500m will have a suitability score of 100, and as it increase the distance, the score gradually decrease down to 0 for the UAS with the higher distance value. This standardization was applied by the researcher before implementing the criteria in CommunityViz, as the suitability tool does not allow this type of standardization.

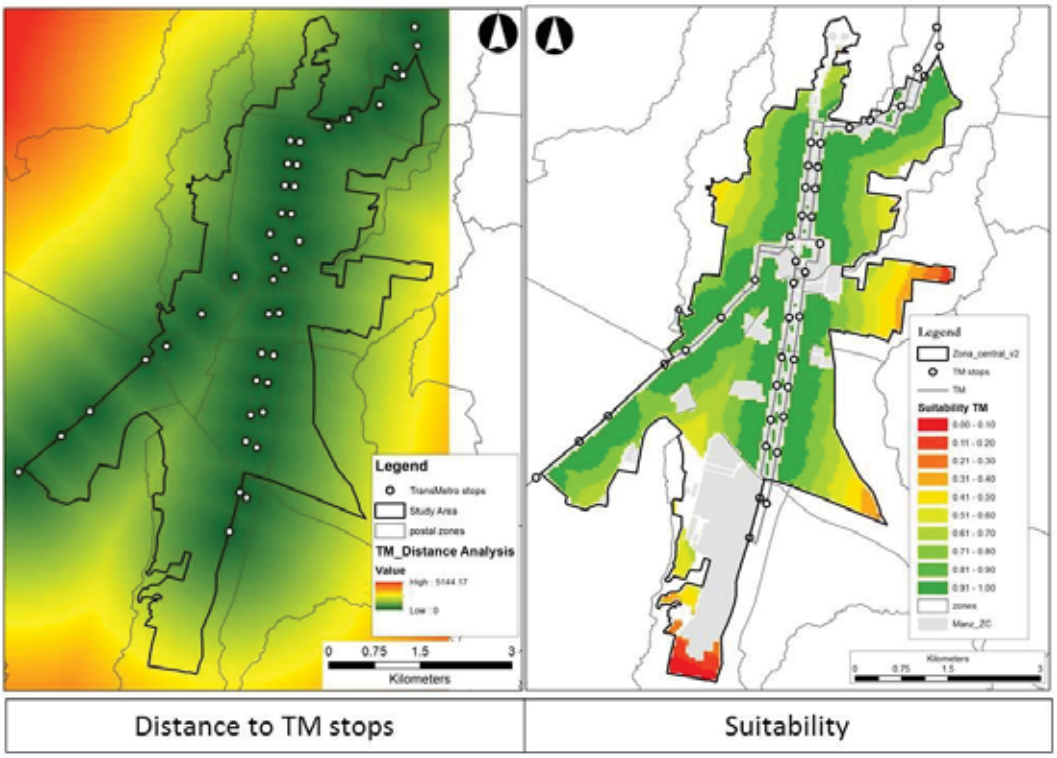

Figure 6.3. Proximity to Trans Metro stops. Own source

Criterion: Proximity to nodes of commercial and services land uses

For this criterion, measurements from three different layers were combined, see figure 6.4. The top left map contains polygons extracted from the land use layer, specifically commercial (shops, daily supplies, banks), schools, public and private facilities. The commercial polygons were selected based on the criteria of being larger than 300m and classified under the "high quality" category. This allows including exclusively those commercial facilities that ensure certain quality and avoid including others that might be less permanent on time. In the top right, the polygons that corresponds to sport, cultural, recreational and superior education facilities. In the inferior left, the green areas were digitized based on

the “Guatemala City Plan 2040”, including only the already existent areas. A maximum standardization method was applied to the distance measurements of the three layers and then combined using a weighted summation method that assigns equal weight to each measurement.

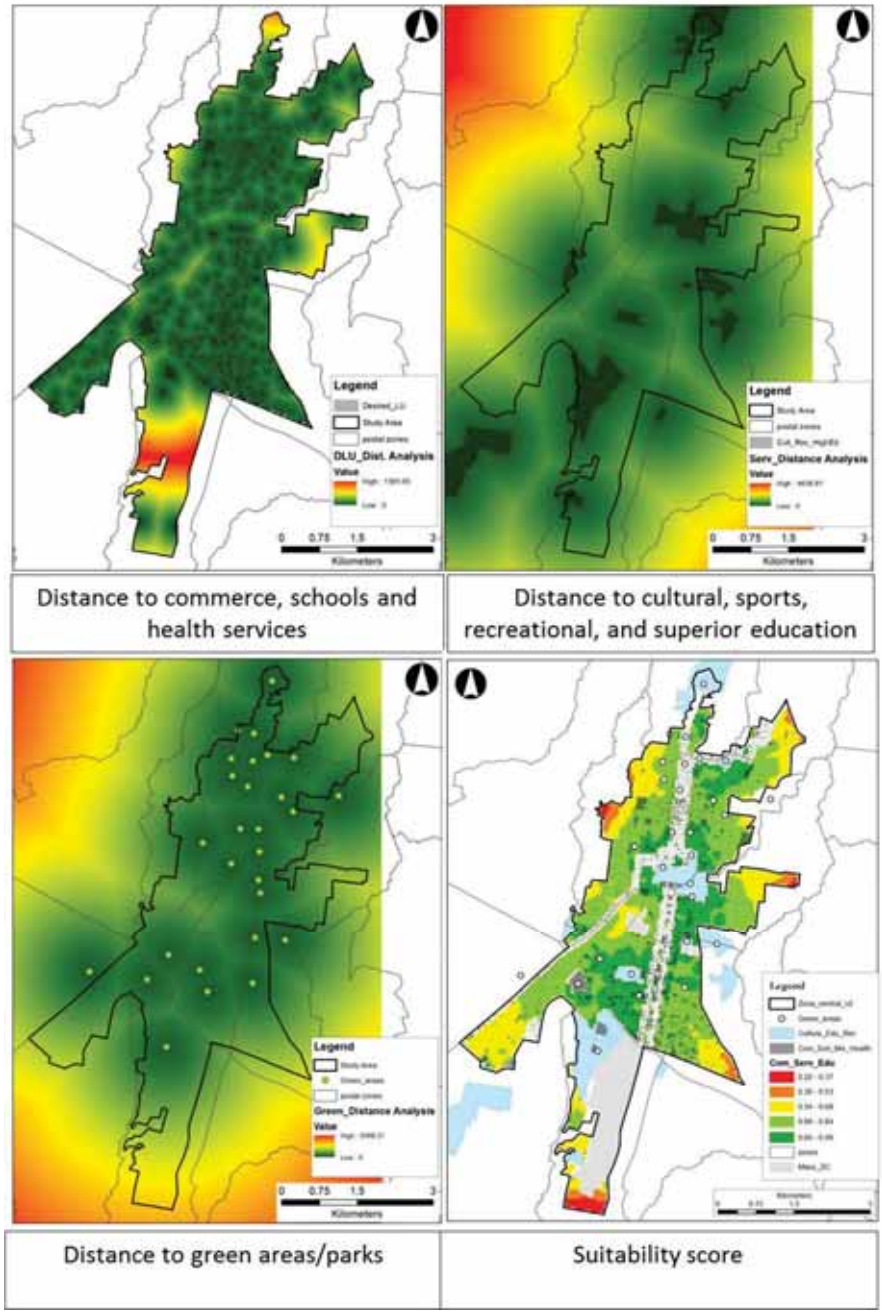

Figure 6.4. Proximity to nodes of commercial and services land uses

Criterion: Proximity to dense and mature populated areas

Two measurements are done based on the census tracks layer containing demographic information corresponding to the census done in year 2002. The first measurement is the population density and the second one is the population with ages in the range of 24-40 years old. Figure 6.5 shows the spatial distribution according to population density and the targeted population, as well as the suitability score resulting from the combination of both.

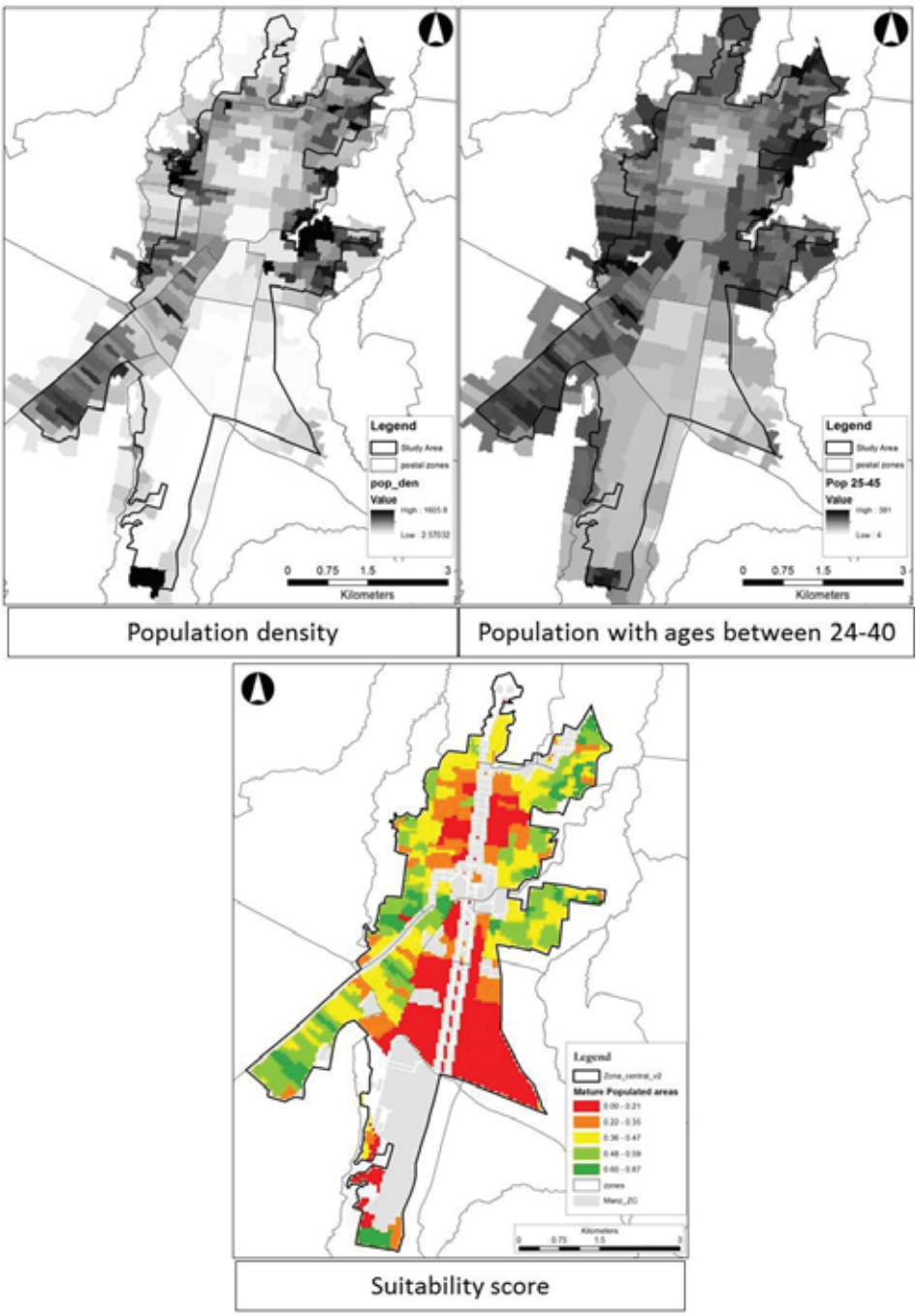

Figure 6.5. Proximity to dense and mature populated areas. Own source

Criterion: Proximity to semi/qualified job sources

In order to measure the performance over this criterion, data extracted from the layer of "traffic analysis zones" (TAZ) was used. The layer contains a subdivision of the territory similar to the census tracks. Based on the report JICA (1992), updated in 2005 by the Office of Urban Mobility, for each polygon it was calculated the number of private and public trips attracted during a regular work day, coming from the whole metropolitan area (this includes the peripheral municipalities). This is assumed to show those areas in where most of the jobs are located. This assumption was validated using SPSS to analyse the correlations between the number of trips being attracted and the amount of built square meters per land use within each TAZ polygon. Table 6.3 shows a significant correlation of 0.59 at the 0.01

level between the number of trips being attracted and the built area in squared meters dedicated to commerce, as well as a significant correlation of 0.57 at the same level with the office land use. While naturally it is observed a negative correlation of -0.519 at the same level where residential land uses are predominant. Figure 6.6 shows the study area and the TAZ subdivision, as well as the proportional distribution of land uses in relation to the built area within the study area.

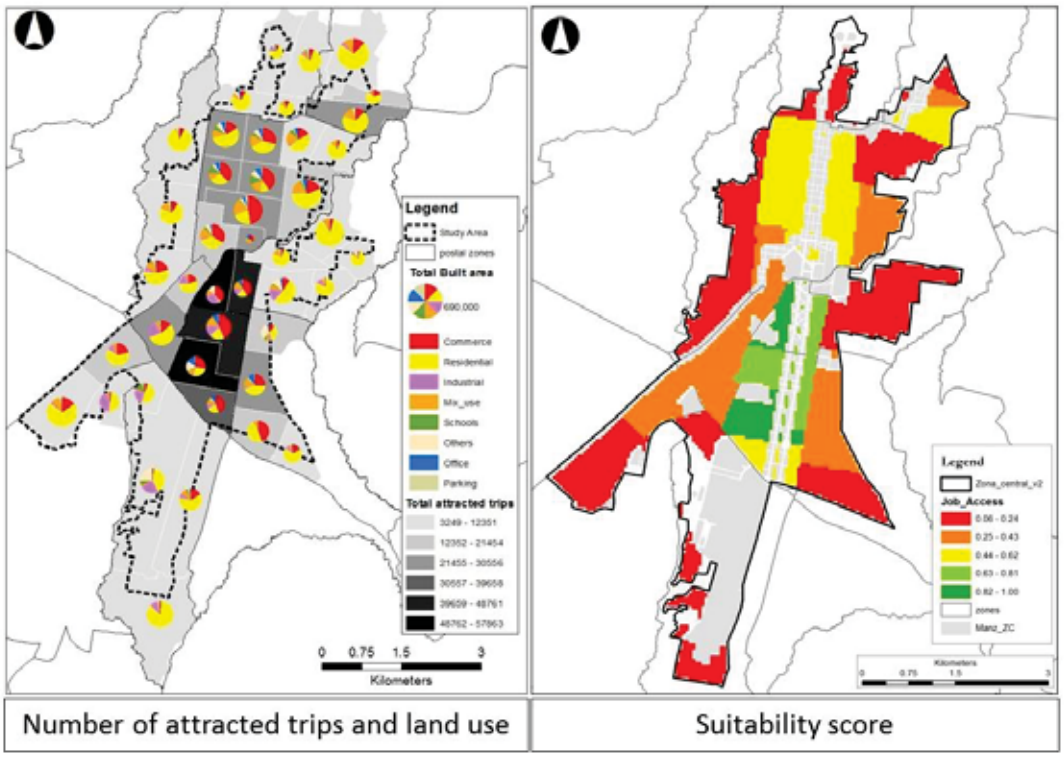

Figure 6.6. Proximity to semi/qualified job sources

Correlations

		Sum_DM	Commerce	Office	Industrial	Mix	Schools	Residential
Sum_DM	Pearson Correlation	1	.591**	.570**	.108	.371*	.096	-.519**
	Sig. (2-tailed)		.000	.000	.491	.014	.541	.000
	N	43	43	43	43	43	43	43

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6.3. Trips attracted and land use correlations. Own source

Criterion: Distance to municipal interventions

Figure 6.7 shows the euclidian distance analysis to the municipal interventions, that basically are embraced by the axis of the existing municipal transportation system and interventions in the public urban space. The measurements were standardized using a maximum standardization method.

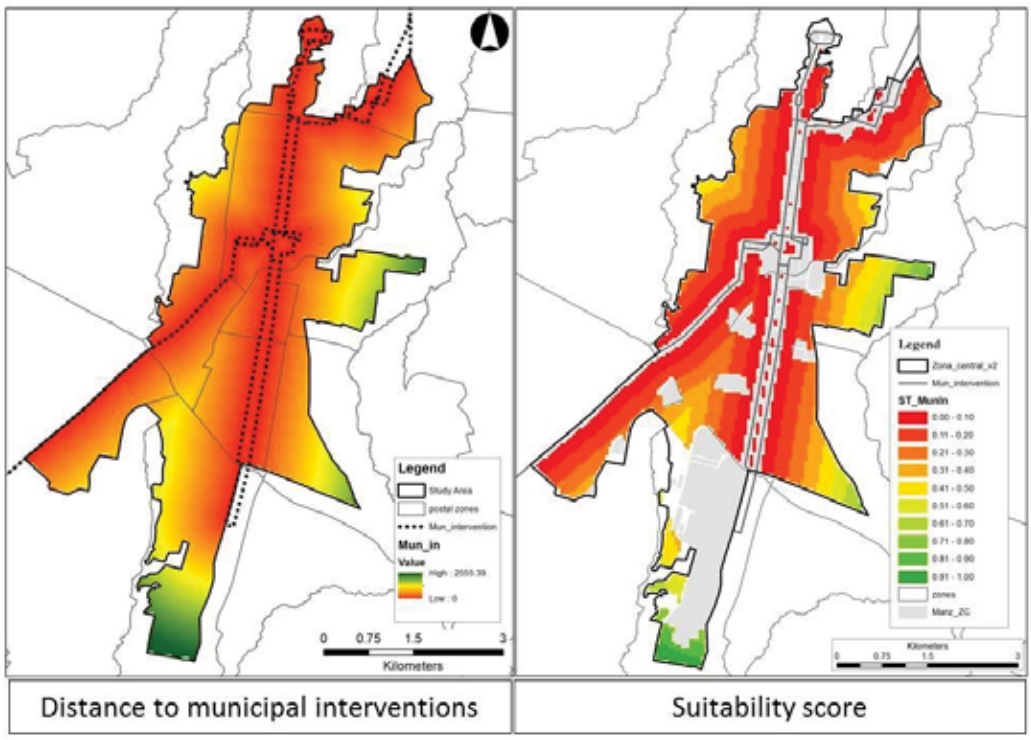

Figure 6.7. Distance to municipal interventions

Criterion: Proximity to other means of mobility

For this criterion measurements based in euclidian distance analyses were done in three different layers. Figure 6.8 shows in the top left corner the analysis in the layer of Trans-Urbano stops, which is the most recent implementation of public bus transportation system by the central government. The standardization for these measurements was done similar to the one in the first criterion, assigning the highest suitability score for the values minor and equal to 500m. In the top right the distance analysis based on primary roads, as classified by the TOP regulation. In the bottom left corner, the urban nodes of intermodal change were digitized based on the "Plan Director 2040" (Guatemala, 2012).

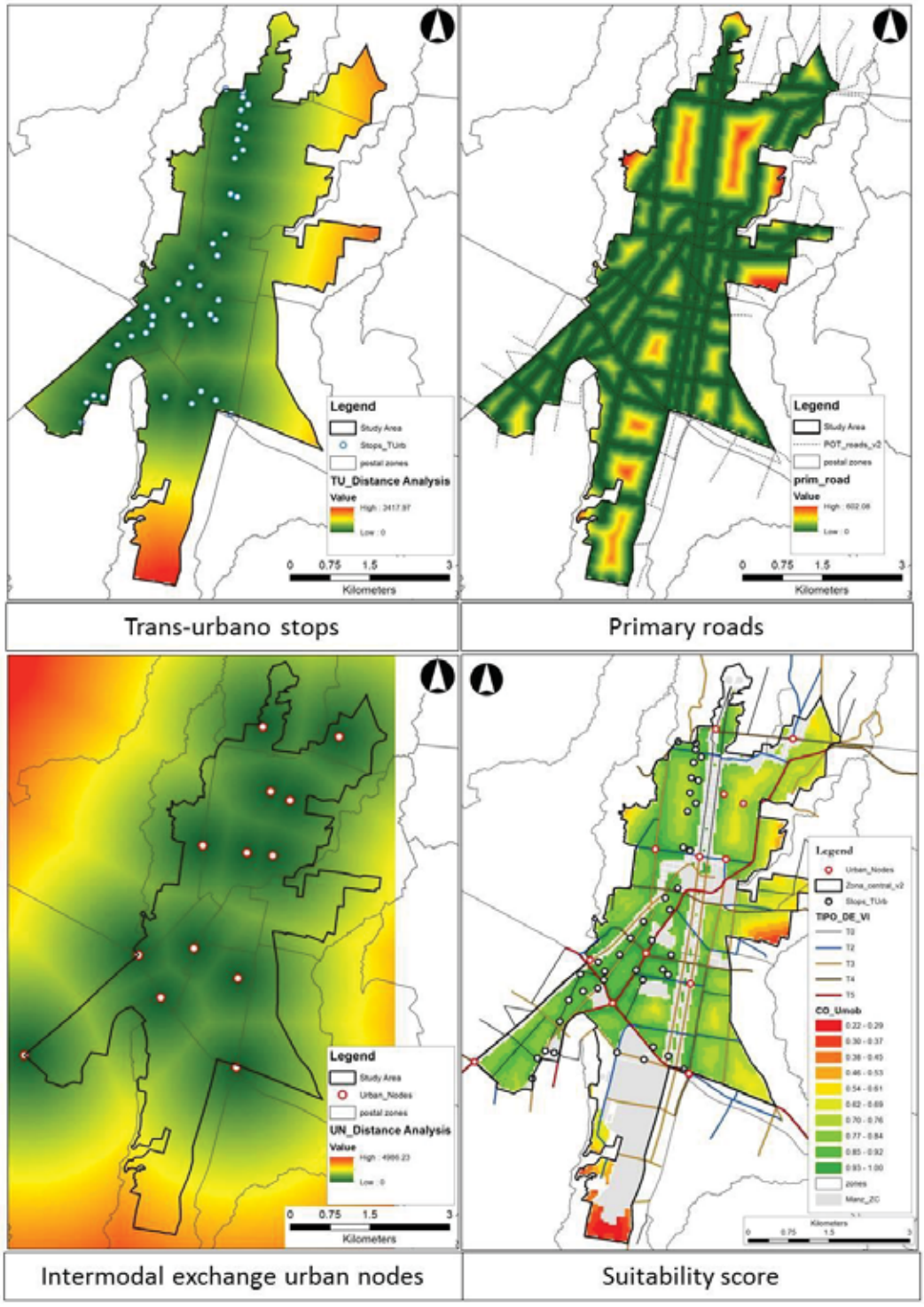

Figure 6.8. Access to other means of mobility

6.1.6. Suitability maps

Five suitability maps are produced. The objective was to compare the outputs of the variations of the different ranks by the stakeholder over the suitability in the study area. Figure 6.9 shows the group suitability map and figure 6.10 shows the four suitability maps that represents the four groups of stakeholders.

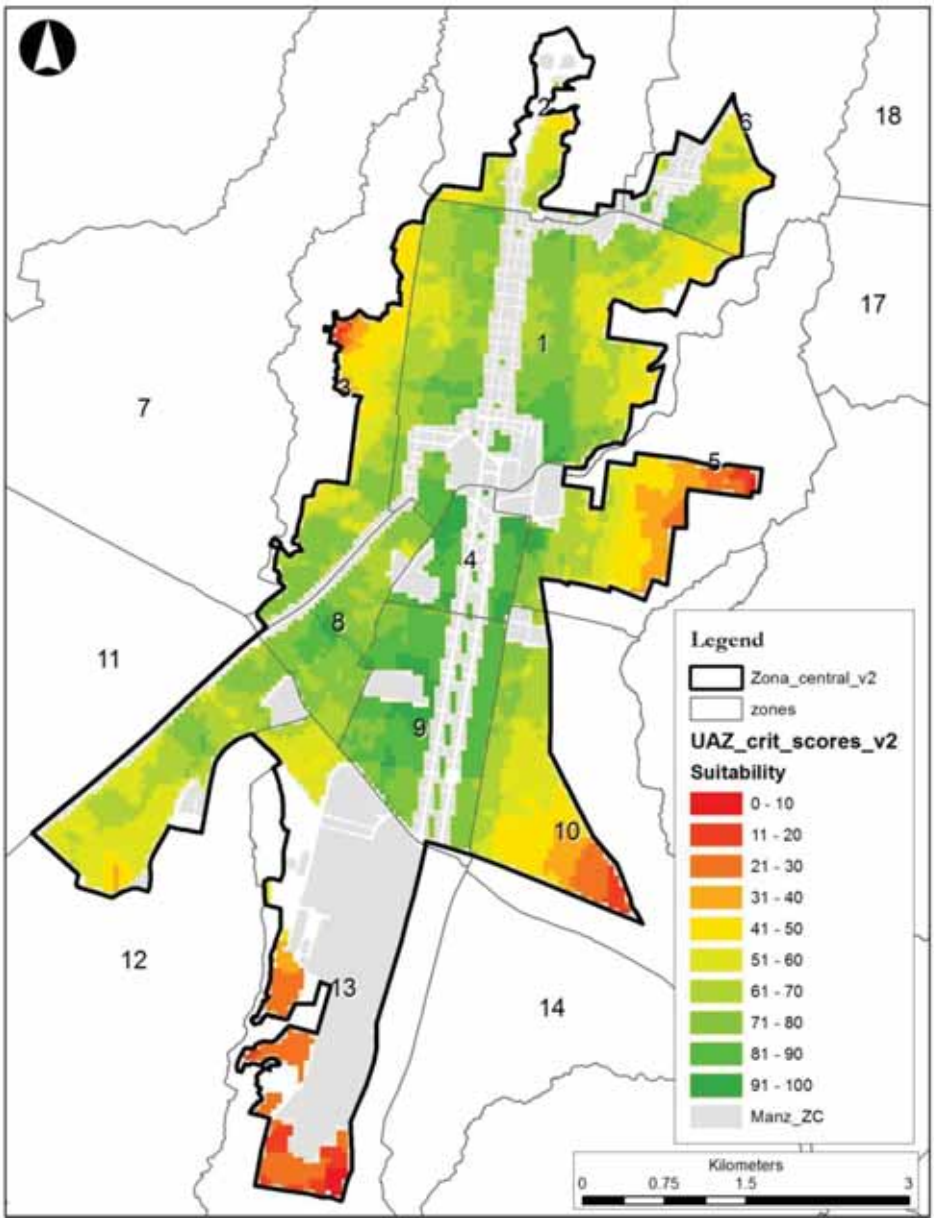

Figure 6.9. Group suitability map. Own source

When observing figure 6.9 a large extension of suitable areas can be identified along the central corridor. This can be explained by the concentration of commercial and services land uses as appreciated in figure 6.4, together with the lines of the municipal transportation system, see figure 6.3. As these two variables account for high priority in the group ranking, those are dominant in this area. Additional contribution to high suitability is expected due that the core of the area is characterized by good performance on access to jobs, see figure 6.6. Proximity to mobility network also contribute, however is not that significant due its weight. Distance to municipal interventions does not affect the suitability for

the same reason. Performance in north core area seems to be over weighted by low performance in the criterion of proximity to dense and mature populated areas, see figure 6.5 and the distribution of the primary roads, see figure 6.8. In general this output is naturally expected.

However, some interesting suitable spots are demarked in other areas in the north east, mid-west and south west areas. Those can be explained due that other combination of criteria improve their suitability. Proximity to dense and mature populated areas, municipal (Trans Metro) and public transportation system (Trans Urbano), see figure 6.5 and 6.8, are main contributors. Additionally, proximity to nodes of commercial and services land uses still add significant performance.

Low performance areas are explained by their low performance in most of the criteria, except in the criterion of distance to municipal interventions. However this criterion is not as important as others. Even though there are some low-suitable areas that account high performance in their proximity to dense and mature populated areas, the contribution of this criterion is not enough to result in a higher suitability.

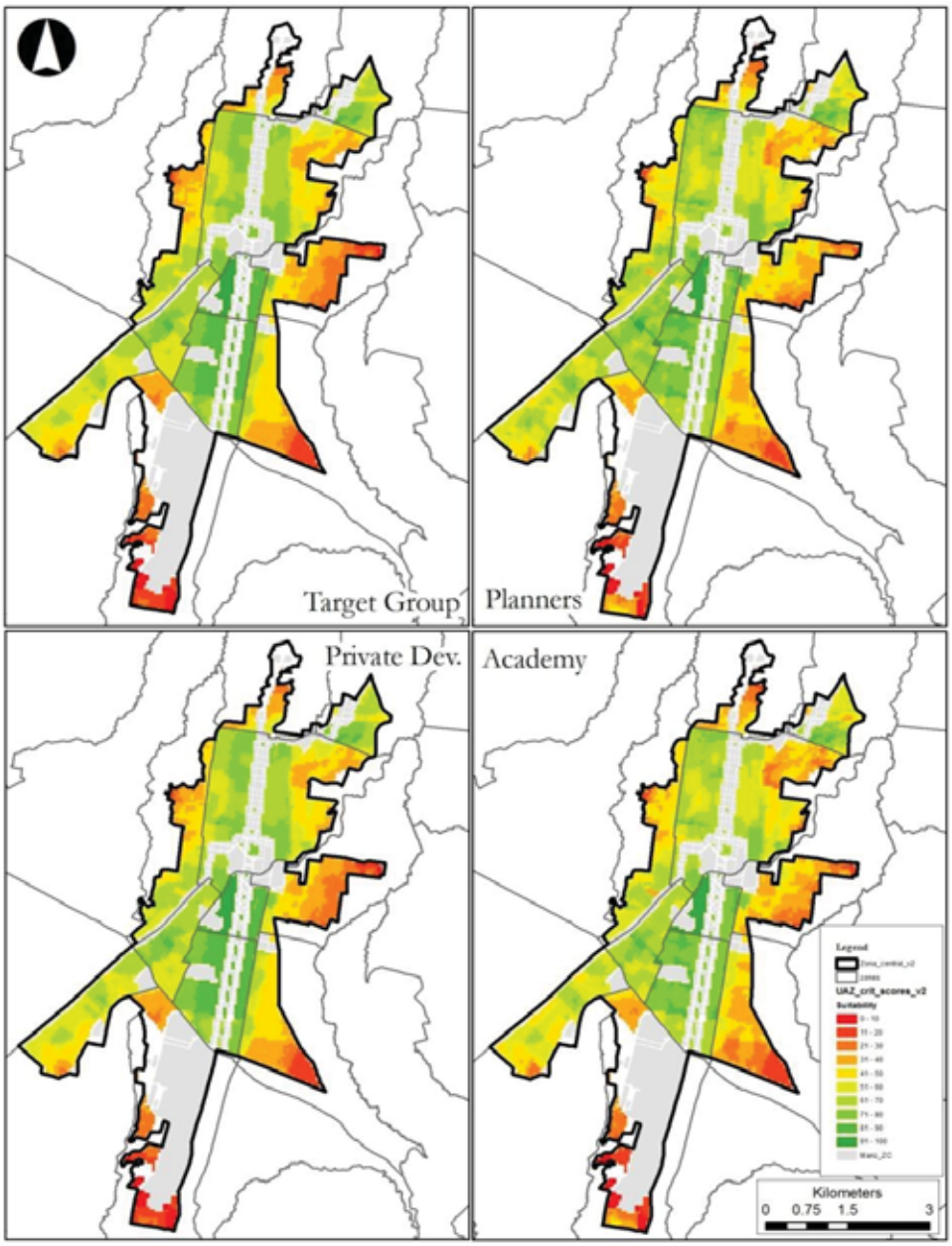

Figure 6.10.Suitability comparison based to stakeholders preferences. Own source

Comparing the five maps it can be observed a high degree of similarity. Variations can be observed on the areas with higher suitability scores in where there are only slight differences on the score. Still, the core area account for high suitability. This can be explained by observing table 6.2. Except by the municipal planners, proximity to municipal transportation system and nodes of commercial and services land use are two of the most important criteria. For the academics and municipal planners, proximity to municipal transportation systems and the proximity to dense and populated areas have equal priority. This is reflected in the map by the decrease of the performance in the north core areas.

6.1.7. Sensitivity analysis

A sensitivity analysis was performed on the overall group suitability analysis to analyse the variations of the outputs based on variations of the inputs, in this case the criteria weights. As it is discussed in section 5.4.3 and also noticed in table 6.2, the three groups of stakeholders (except by the municipality) coincide in assigning highest priority to the criterion of proximity to municipal transportation system and proximity to commerce and service land uses. Meanwhile the access to other means of mobility seems to be the least important. Noticing variations within the importance that the groups of stakeholders assign to the remaining, those are selected to exercise the variations of the inputs. Figure 6.11 shows the slider with the implemented criteria in the CommunityViz, the criteria tested is marked with intervals of 20% increasing and decreasing from the original weight value. Figures 6.12 to 6.14 show in the left side the suitability map produced using the group weights, in the middle the variation after decreasing the weight of the corresponding variable and in the right the variation of increasing the weight value.

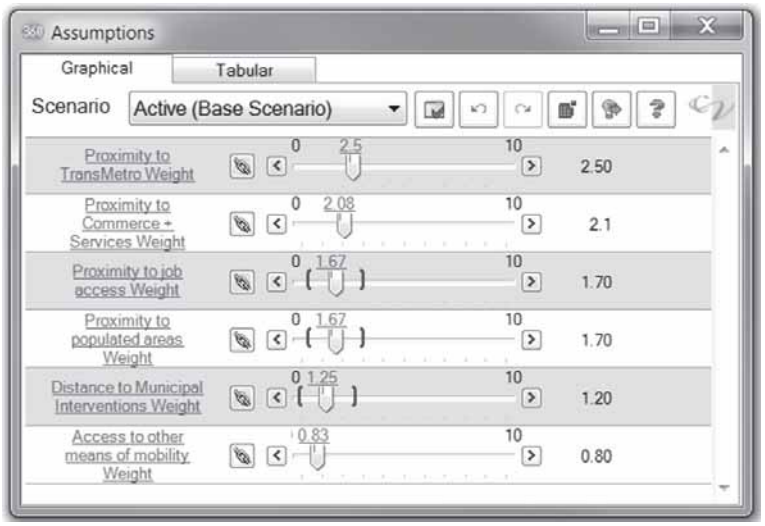

Figure 6.11. Implemented criteria in CommunityViz. Own source

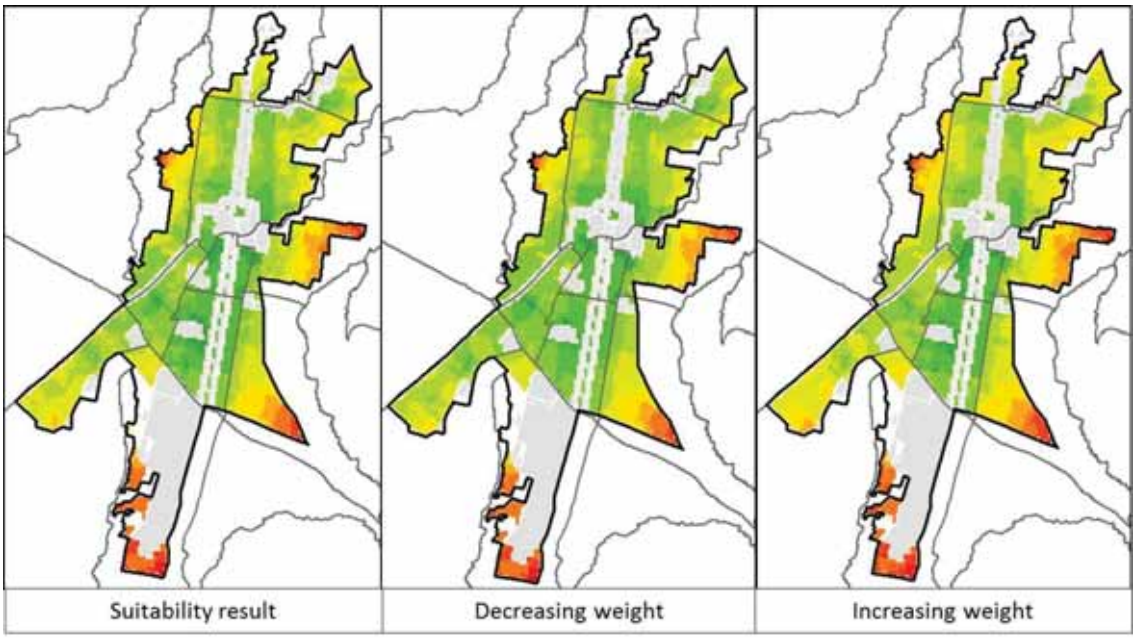

Figure 6.12. Sensitivity analysis on proximity to semi/qualified jobs criterion. Own source

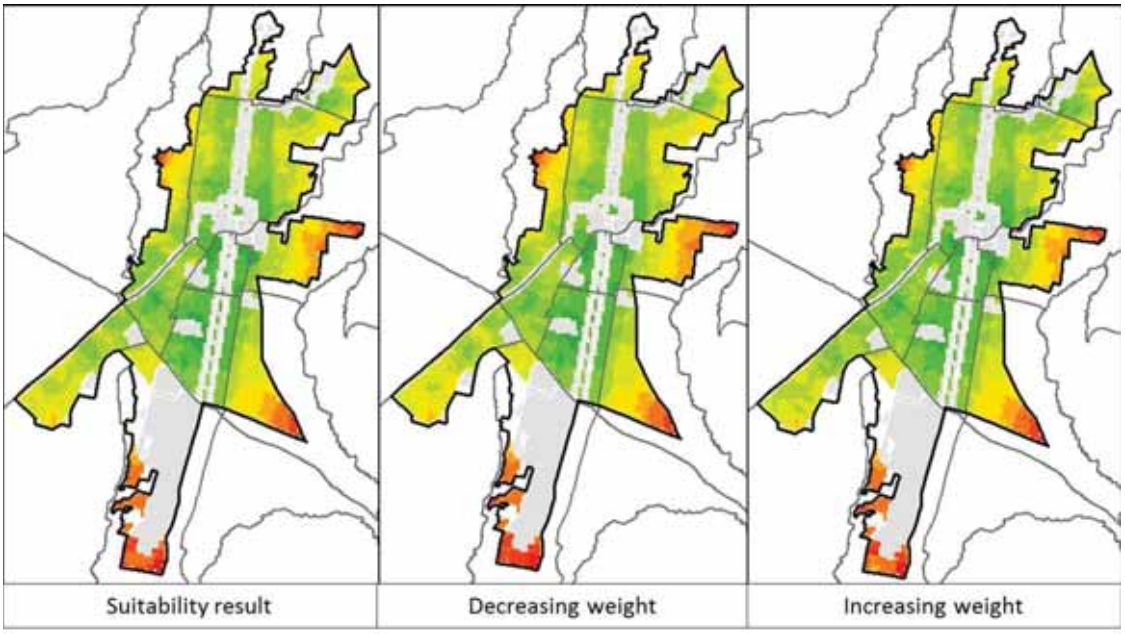

Figure 6.13. Sensitivity analysis on proximity to mature populated areas criterion. Own source

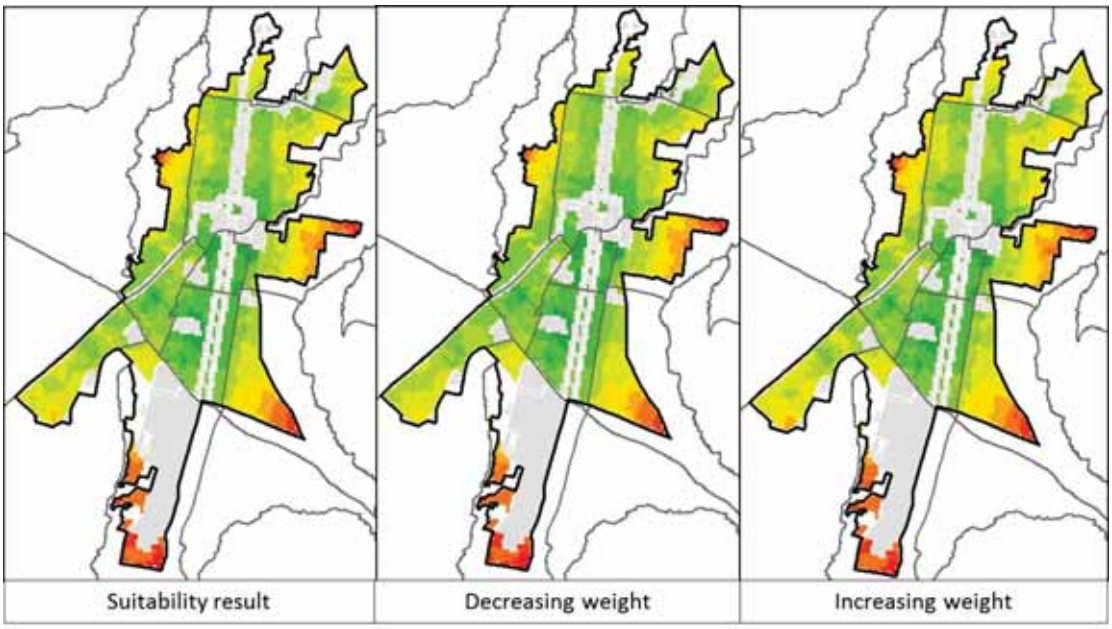

Figure 6.14. Sensitivity analysis on distance to municipal interventions criterion. Own source

In analysing the outputs of the sensitivity analysis, it is observed that in increasing or decreasing the weight of the variables some slight variation it is observed either resulting in an increase or decrease of the suitability scores. However in the three figures it is observed that in general there is no significant change in the spatial patterns of the suitability outputs. This gives reliability to the preliminary outputs, as the suitability map represents the combined interests and perspectives of the stakeholders.

6.2. Designing site options for housing developments

The sites were manually digitized in a new layer, and properties of the plots selected to be site options were added to the new layer (current land use, current built area, buildable area according to regulation, maximum height reachable).

6.2.1. Sites identification

The following criteria to design the options are established.

- Plots with an area above 500mt^2, this to ensure that for the cases in where just one plot embrace the site option, it already account with the estimated minimum area to develop the housing project. This was established by URBANISTICA.
- Empty plots, open air parking land uses or residential uses but with a high building potential are preferred. The first two conditions correspond to what is defined as potential available land established in URBANISTICA and CIFA (2010). The third conditions address the reflection that it can be easier intervention in an already residential use than a plot being use for any economic activity (commerce, office, industry) due to its economical productivity. Partially address the criterion that was left out in the suitability analysis (less construction the better).
- Sites within residential environments. This condition addresses the relevance of the housing projects in enforcing high quality and consolidated neighbourhoods, also intending the avoidance of current land uses not compatible with residential land uses.
- Sites not directly facing primary roads. This condition addresses the avoidance of negative externalities like noise and air pollution.
- Sites within an area with a suitability score above 60 points.

Figure 6.15 shows in the right the location of the preliminary sites designed in relation to the suitability map. In the right, the map shows the active layers used in order to accomplish with the criteria established to design sites options. The next step was to compare the preliminary sites designed against the suitability maps from the four groups of stakeholders to verify the accomplishment of the last in the five maps criteria.

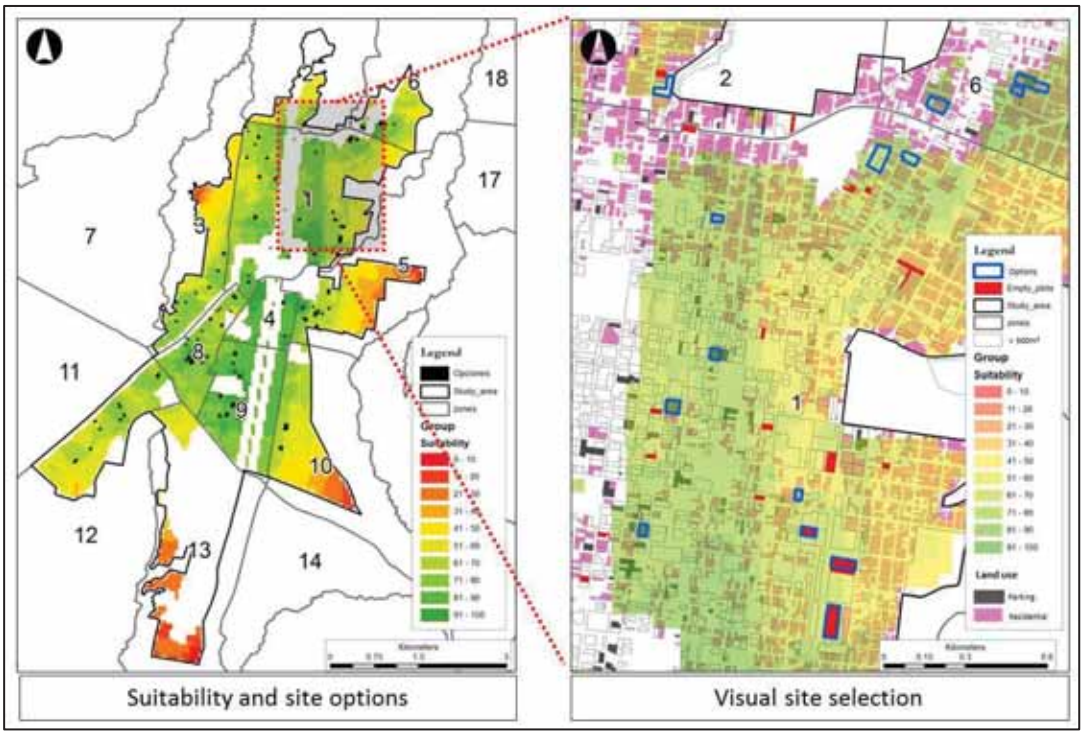

Figure 6.15. Sites options design process. Own source

6.2.2. Aerial visual rectification

Some inaccuracies were detected during the designing process in GIS due to non-updated data. Sites options were exported to Google Earth in a KMZ file. Using the images of GeoEye2012, an aerial visual rectification was done to modify or discard those sites in where the current construction had a more permanent characteristic or other land uses were identified (public areas), see figure 6.16. This process it also helped in doing a preliminary recognition of the surroundings of the sites proposed. In some cases, the sites where discarded due to the inappropriateness of the immediate current context for the housing projects, see figure 6.17.

Figure 6.16. Visual aerial rectification. Own source

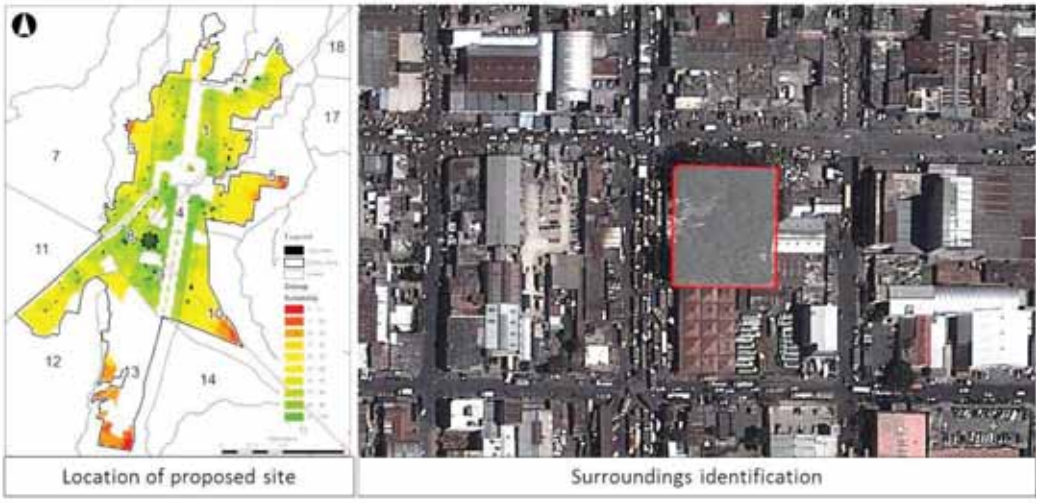

Figure 6.17. Sites' surroundings recognition. Own source

6.2.3. Outcome of the design process

In total, 63 sites were designed with a total surface area of 119,021m^{t2}. The current constructions on those sites add up a total of 44,762m^2. However based on the TOP regulations, a total of up to 675,331mt^2 can be built in those sites. In comparing the current construction versus what is possible to build in those sites, it is calculated that the sites are sub used in a range from 75% (the sites containing current construction) to 100% (empty plots or open air parking). The layer containing the designed sites was prepared for the next step (assessment). Data was added from the plot layer to the attribute table of the designed sites (surface area, number of plots combined -number of land owners-, current land use, current construction area, applicable norms according to TOP (maximum height and maximum construction area reachable).

KMZ files containing the suitability analysis output, the sites polygons, and 3D volumes of the current construction was made available so the stakeholders were able to explore each of the sites in a recognizable context as well as the suitability patterns within the study area.

Figure 6.18 shows a snapshot of the Google earth exploration, showing the geo-visualisation of the suitability analysis output and the sites options. Each site polygon includes basic information added to its attribute table. Using Google earth as the application to share and explore information gives various advantages. Information that usually is presented in 2D can be easily added to a 3D environment. In the case of Guatemala City, the data available in this platform allows to visualize the study area within its 3D context (topography and referential 3D buildings that had been modelled and uploaded by locals). Additionally, as is a common used application, stakeholders can easily get themselves oriented in exploring geographical information.

Finally, non-major discussions were done by stakeholders regarding the sites proposed. Therefore the preliminary sites designed were not modified after this step.

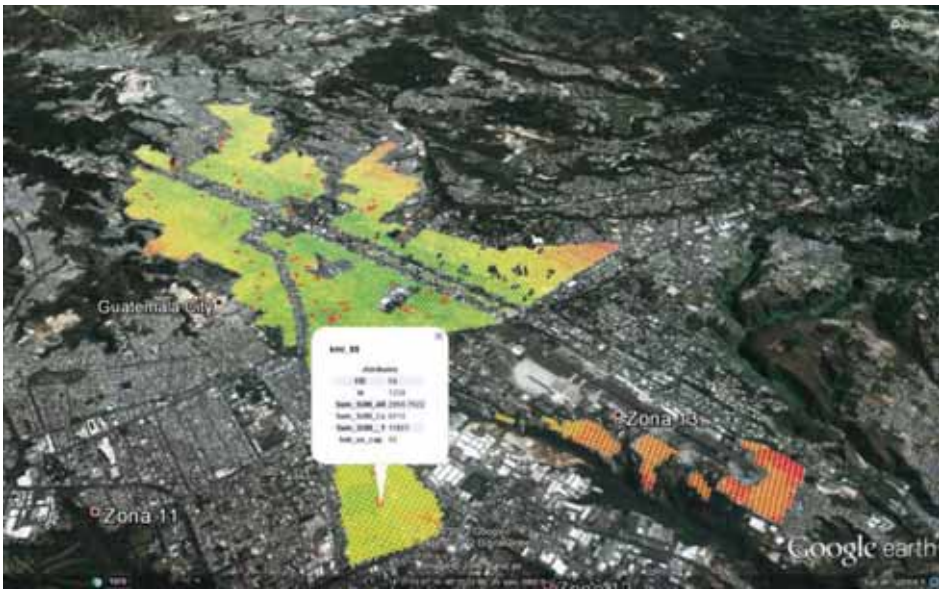

Figure 6.18. Geo-visualisation of suitability analysis and sites options. Own source

6.3. Assessing the site options

Assessing sites options for municipal housing development in Guatemala City, unlike different cases found in literature regarding the site-selection problem, where the decision support system is oriented towards assessing suitable land for new residential areas, comprehends a more complex and limited task. As one of the limitations of the Municipality is the availability of own land, the success of planning for municipal housing strongly depends on managing mechanisms to develop on private plots. Either following a scheme in where private investors are called to get involved and invest in housing developments together with the land owners or if the projects are publicly funded, the economic sustainability aspect and the easiness of intervention becomes relevant in determine which sites offer better opportunities.

In defining economic sustainability, some variables become relevant to assess the sites. Literature describes this concept as the economic viability for any given specific land versus the current land market constraints. In planning for sustainable housing development, this concept also refer to the opportunities for the economic vitality of the surrounding context. Commerce, daily supplies and transportation infrastructures as those rely on the agglomeration of residents to be economically efficient. For the housing project itself, the affordability of housing and accessibility of jobs for the future residents is also included in this concept. For the scope of this step, the focus is on the economic viability that can be calculated for each site given a specific ideal of balanced sustainable densification. The access to jobs was already analysed in the suitability assessment. Affordability of housing is incorporated as a fixed value of retail price that should have limited range of variation. Naturally, the size and the land price of each site combined with the allowed buildable construction area are key inputs in determine the profitability together.

However, in achieving sustainable housing development in a collaborative framework, other relevant concerns must be taken into account. Therefore, the assessment of sites also addresses locational aspects related to the current existing conditions of the sites' urban contexts. In addressing the concerns and interests of the different stakeholders, additional dimensions are incorporated to the assessment. Capacity of the current infrastructure to support densification as well as the quality of the neighbourhood in each site is assessed. Further detail is given in the content of this section.

6.3.1. Assessment framework

Two steps are performed in this framework. The first comprehend a scenario development exploration and one scenario is selected for further analysis. The second constitute incorporation of additional criteria and a MCE. See section 4.6.3.

Eight sites are selected to do the assessment, see table 6.4 and figure 6.19. The sites are identified from "A" to "H" and are classified by colour (sites G3 and G4) according to the urban regulations (buildability and maximum number of floors), see also section 3.4. This area is an intersection between the study area and the postal zone "12" and is denominated in this process as the "urban piece". The selection is justified for two reasons. First, it is characterized with a relatively homogeneous urban structure and residential land use. Second, the area is considered by the stakeholders with a great potential for housing due to its population. In a market research conducted by "Inspecciones Globales", the area ranks high within residents of the peripheral areas that were asked where they would like to live if they were thinking in going back to the city.

Site_ID	POT	Area_mt^2	Cu_co*	L_ow*	Sui*	Price_m^2	Land_price$
A	G3	3,013	586	1	70	200	602,559
B	G4	783	395	1	72	175	137,037
C	G4	1,457	310	2	75	175	254,976
D	G4	1,411	811	1	80	150	211,635
E	G4	1,302	813	1	77	125	162,767
F	G3	1,417	215	2	65	150	212,577
G	G3	1,448	531	2	61	125	181,019
H	G3	2,967	434	1	65	100	296,676
*Cu_co=current construction area *L_ow=number of land owners involved *Suiland suitability score							

Table 6.4. Description of sites. Own source

Table 6.5 indicates the TOP normative that apply to each type of plot. There are two parameters expressed as *base* buildability index or height and *expanded* buildability index or height. This logic responds to an incentive tool in where developments that accomplish with certain practices to favour their urban contexts are allowed to reach higher heights or make a more intense use of the land (expanded parameters). Otherwise the projects should submit to base parameters.

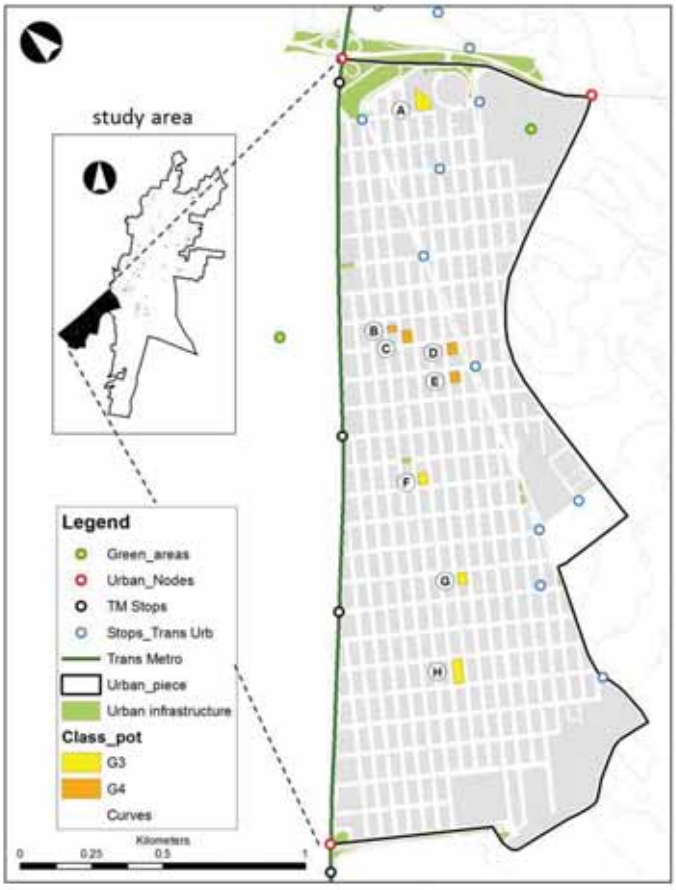

Figure 6.19. Scope of assessment. Own source

TOP normative				
Class	Base BI	Exp BI	Base H	Exp H
G3	2.7	4	5	10
G4	4	6	8	16

Table 6.5. TOP normative. Source: Territorial Ordinance Plan

6.3.2. CommunityViz model to explore scenarios

The main objective of this step was to explore the economic viability and selected indicators of the resulting housing projects. The explorations are based on the definition of three categories of input parameters and 6 output indicators plus 3D geo visualisation. Figure 6.20 describes the structure and the relationships between variables of the developed model.

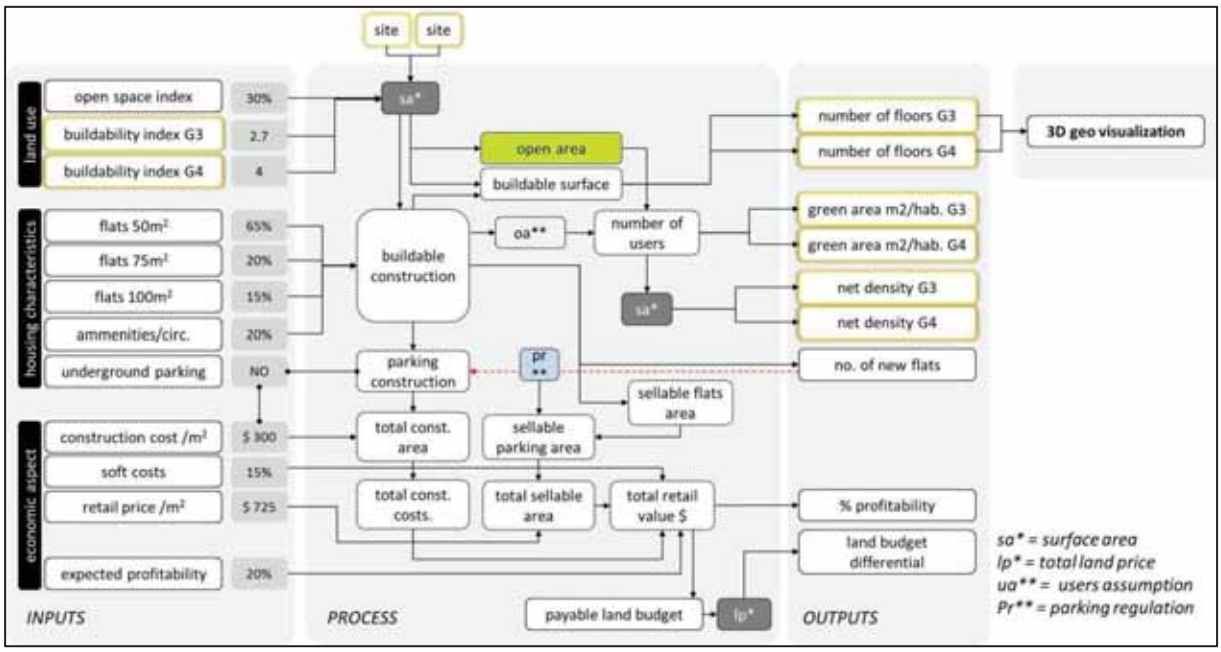

Figure 6.20. Development scenario exploration. Own source

The first group of parameters is the *land use*. Open space index indicates the percentage of the site dedicated to open space, applied evenly to all sites. The buildability indexes define the intensity of land use depending on the classification of the site (G3 or G4). In other words, it indicates how many times the surface area of the site can be repeated to calculate the buildable construction area.

The second group is the *housing characteristics*. The amenities and circulation parameters define how much of the buildable construction area will be dedicated to this uses. Consequentially from this parameter is calculated how much area is sellable and not sellable. The three parameters of flats define the percentages of distribution of the sellable area dedicated to each type of flat by size. It is assumed that 50mt² flats will be occupied by 1.5 users, 75mt² by 2 users and the 100mt² by 2.5 users. This, assumption is based on the target group (young single professionals or young families). The parameter of underground parking defines if the housing projects will include or not underground parking space.

The last group is the *economic aspect*. Here are defined the prices of construction and retail cost per square meter. Soft cost constitutes a percentage of the total retail value of the project to be paid in legal, selling and administrative costs. The expected profitability establishes the minimum profitability in order to define the project as viable or not. It is of particular interests to the private developers to evaluate their participation, but also for the municipality to evaluate how the housing projects can generate funds to subsidy housing for lower income groups.

In the process different calculations are defined. Additional intermediate variables are computed in order to produce the information required in the outputs. Six indicators are proposed in order to analyse the resulting scenarios against the idealization of a balanced densification that allow viable high quality housing projects. At this regard, the quality refers to the necessity of addressing concerns like the privacy of residents, access to open space, preserve opportunities of good ventilation and natural light, as well as considering the impacts of the projects in the current infrastructure and the surrounding neighbourhood. Even though not all required information is available and included in this model to evaluate this aspects quantitatively.

The indicators of number of floors reached, green area per inhabitant and net density are measured in two groups corresponding to the classifications of sites G3 and G4. This, as the land use parameters affect proportionally the intensity of construction and the size of the sites, reporting the same values according to this classification. Number of new flats, profitability and land budget differential are

indicated per individual site. This last indicator shows the difference between the budget that can be produced with the total retail value of the project minus the construction, soft costs and the expected revenue minus the current land price of the site. If the value is positive, means that the profitability can be increase up to the value shown in the profitability indicator. This is important as either the difference can be used to improve the quality of project (i.e. implementing energy efficiency technology), increase the profitability, cover unexpected costs or pay more for the land if it is required. Finally, a 3D model can be automatically generated in order to evaluate the volumetric behaviour or impact of each scenario.

The implementation of the model in the CommunityViz interface allows creating sliders to modify the different parameters and assess the results in charts of indicators at the same time that the 3D model can be visualized. For the scope of this research and the case study only the land use parameters, specifically the intensity of construction are explored. The rest of the parameters are defined by the researcher based on the orientation of the housing projects, information extracted from the interviews and phone conversations sustained with private developers and municipal planners. The definition of the construction costs are assumed based on the use of a bearing walls structural system. At this point, if underground parking is contemplated in the project, the construction costs increase as a more expensive structural system needs to be used.

6.3.3. Development scenarios exploration

For the *low intensity scenario*, the land use buildability index was tuned to two for both G3 and G4. The floors reached were 3 for both cases. The net density resulted in 423 habitants/Ha and 426 habitants/Ha for sites G3 and G4 respectively. The available open space indicates 7mt^2/habitant in both cases. The profitability index range from a minimum of 1.2% for site A and maximum 8% for site H. The land budget differential reported was ranging from the minimum value of -$800,000 for site A and -$500,000 for site H. The number of new flats ranged from minimum 21 flats for site B and both site A and H with around 100 new flats.

For the *medium intensity scenario,* the land use buildability index was tuned to 2.7 for sites G3 and 4 for G4. These are the values corresponding to the base buildability index according to TOP normative. The floors reached were 4 floors for sites G3 and 6 floors for G4. Then net density resulted in 572 habitants/Ha and 851habitants/Ha for sites G3 and G4 respectively. The available open space indicates 5mt^2/habitant in G3 and 4mt2 for G4. Figure 6.21 shows the three indicators of profitability, land budget differential and number of new flats.

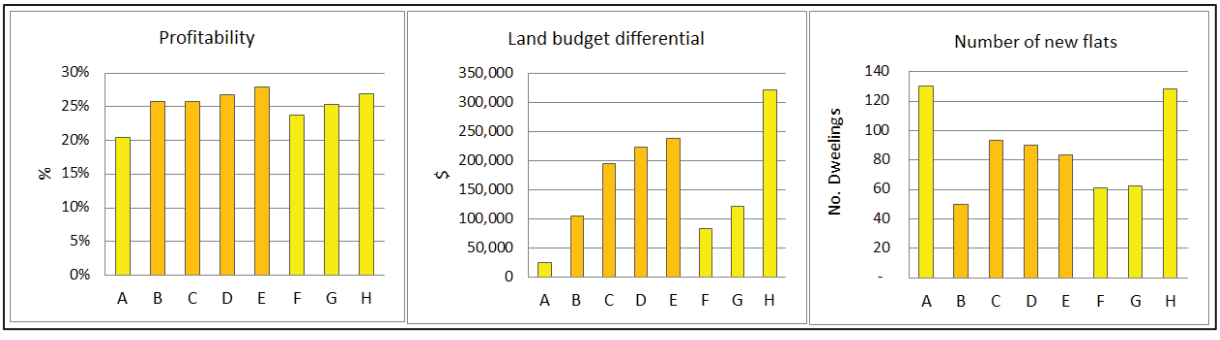

Figure 6.21. Medium intensity scenario. Own source

For the *maximum intensity scenario*, the land use buildability index was tuned to 4 for sites G3 and 6 for G4. These are the values corresponding to the expanded buildability index according to TOP normative. The floors reached were 6 floors for sites G3 and 9 floors for G4. Then net density resulted in 847 habitants/Ha and 1,277habitants/Ha for sites G3 and G4 respectively. The available open space indicates 4mt^2/habitant in G3 and 2mt2 for G4. Figure 6.22 shows the three indicators of profitability, land budget differential and number of new flats.

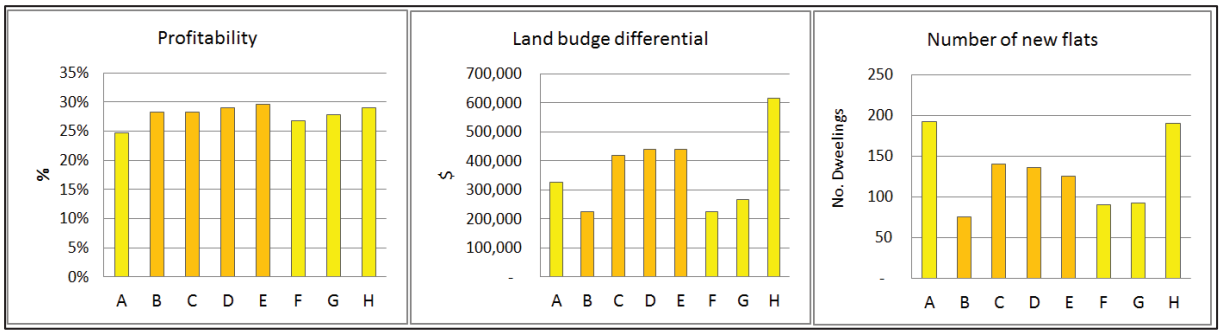

Figure 6.22. High intensity scenario. Own source

As it is observed in figure 6.22, the profitability for all sites is above 20% and naturally with positive differential values. This was not the case for the low intensity scenario. The net densities values are in the range established based on discussions with municipal planners URBANISTICA and CIFA (2010) (400-850 hab/Ha). Can be noticed a trade-off between the intensity of land use (increasing intensity resulting in higher profitability and more flats) but reducing the available open space down to 2mt^2/habitant for G4 sites. For this reason and considering the concerns expressed by the municipality about the capacity of the territory to support such intense of land use, the medium intensity scenario was selected for further assessment of the sites in the next step. Still, discussions can be stimulated regarding the volumetric impact of these projects in the given context. Therefore, 3D geo visualisation is constructed as part of the methodological framework in order to evaluate and understand the implications of this intensity of development, see figure 6.23. Lower heights could be achieved, but at expenses of the availability of open space per inhabitant.

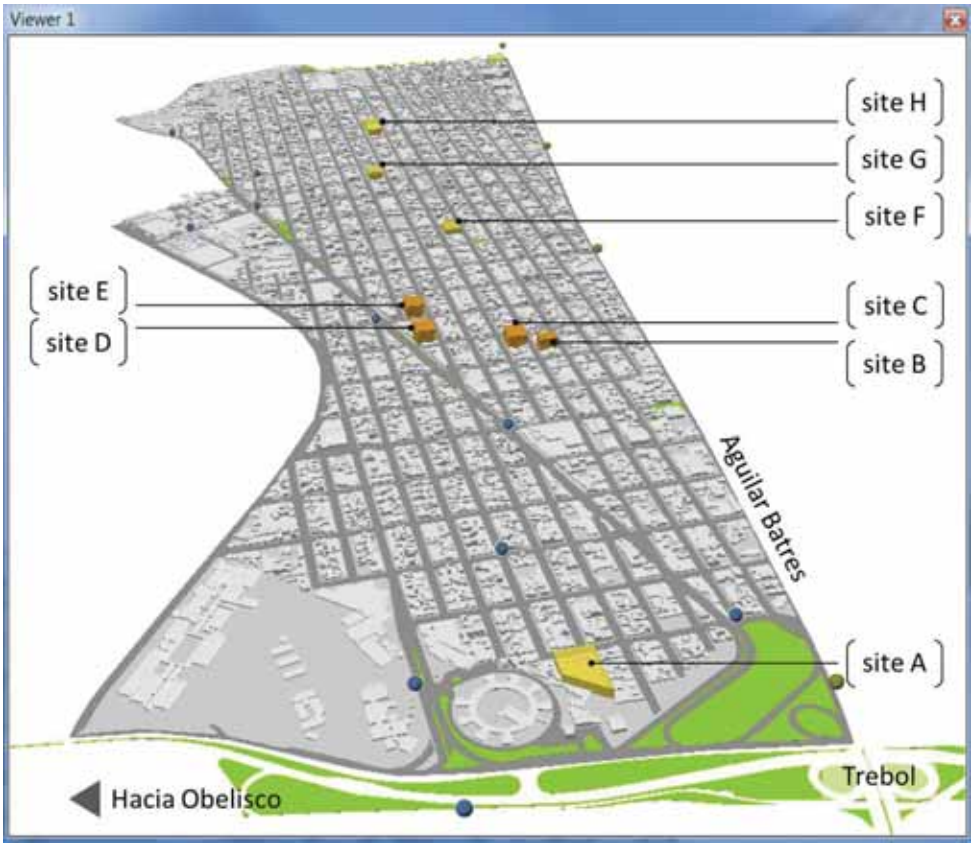

Figure 6.23. 3D Geo visualisation for sites assessment. Own source

An additional exploration was performed over the selected scenario but including underground parking. As explained before, this implies higher construction costs ($ 350/m^2) as the structural system change. The revenues dropped proportionally to 8% for the site A and 14% for the site E. It is observed a negative land budget differentials ranging from -$718,000 and -$236,000, respectively. In considering the stated preferences of the target group about the availability of parking spaces without compromising the viability of the projects, new alternatives should be explored.

6.3.4. Implementing a Multi Criteria Evaluation

A set of 5 criteria is proposed by the researcher based on the literature review and taking into account the concerns of the different stakeholders. Table 6.6 introduces four main objectives on where the assessment takes place. The ranking values for the main objectives (in grey) range from 1 to 5, being 1 most important and 5 the least important. All of those were established by one participant of each of the stakeholders groups. The weights were calculated when implementing the no spatial multi criteria evaluation using ILWIS, see figure 6.24. All the criteria were standardized using a maximum standardization method.

Maximize economic viability

In order to make the housing projects as efficient as possible independently of the scheme of intervention (public- private or just public), this objective is measured over the criteria of the profitability and the budget differential indicator calculated in the medium density development scenario. Both are considered equally important.

Facilitate development

Less land owners involved in each site is preferred as it is assumed that while more land owners are involved, the negotiation process could be much slower if not impossible. Second, current land uses are preferred. A score is given ranging from 0 to 5, being five most preferred. 1 for commerce, 2 for commerce and offices, 3 to residential and commerce, 4 to residential and 5 to sites with no land use (abandoned construction). Third, less construction (square meters) is preferred due that represents a minor costs in preparing the site for the new project.

Location and neighbourhood quality

The vulnerability to crime was measured and a score was given based on a map of levels of criminality (robberies in houses and street delinquency), see appendix E. Second, a perceptual qualification was given by the researcher based of local knowledge and visual inspection using images obtained in Google earth. The values range from 1 to 5, being 5 the better. The criteria were based on the desired or not desired qualities of the target group in relation to their own residence, extracted from discussions during the interviews. Third, the suitability score was included within these criteria as an indicator of good location.

Maximize positive impact

Even though for some cases the profitability can be very similar, the difference in the number of new dwellings that can be built in the same sites vary, therefore this indicator is used to measure the scale of the positive impact through the increase of the affordable housing opportunity.

Best access to infrastructure services

Considering the current conditions of the available infrastructure, percentages of coverage of those services in each site were obtained based on published maps by the municipality, see appendix E. The coverage of drainage and potable water are given more importance as those are more difficult to improve than the coverage of service of solid waste collection. The last one depends at some extent on the routes covered by the waste collector.

Assessment criteria		EI*		PD*		TG*		MP*		AC*	
		weight	rank	weight	rank	weight	rank	weight	rank	weight
Maximize economic viability	□	0.20	1	0.20	4	0.09	1	0.46	3	0.16
Higher profitability the better			1	0.50	1	0.50	1	0.50	1	0.50
Positive budget differential the better			1	0.50	1	0.50	1	0.50	1	0.50
Facilitate development	□	0.20	1	0.20	5	0.04	5	0.04	4	0.09
Less land owners invoved the better			1	0.61	1	0.61	1	0.61	1	0.61
Less existent construction the better			3	0.11	3	0.11	3	0.11	3	0.11
Empty plots or residences preffered			2	0.28	2	0.28	2	0.28	2	0.28
Location and neighborgood quality	□	0.20	1	0.20	1	0.46	2	0.26	2	0.26
Less vulnerable to crime the better			1	0.61	1	0.61	1	0.61	1	0.61
Higher perceptual qualification the better			2	0.28	2	0.28	2	0.28	2	0.28
Higher suitability score the better			3	0.11	3	0.11	3	0.11	3	0.11
Maximize the positive impact	□	0.20	1	0.20	3	0.16	4	0.09	1	0.46
Higher number of new dweellings the better			1	1.00	1	1.00	1	1.00	1	1.00
Best access to infrastructure services	□	0.20	2	0.20	2	0.26	3	0.16	5	0.04
Higher % of acces to water the better			1	0.44	1	0.44	1	0.44	1	0.44
Higher % of service of solid waste collection			2	0.11	2	0.11	2	0.11	2	0.11
Higher % of acces to drainages the better			1	0.44	1	0.44	1	0.44	1	0.44
*EI_Equal importance *PD_Private developer *TG_ Target groups *MP_Municipal planner*AC_Academy										

Table 6.6. Sites assessment criteria and stakeholders ranks. Own source

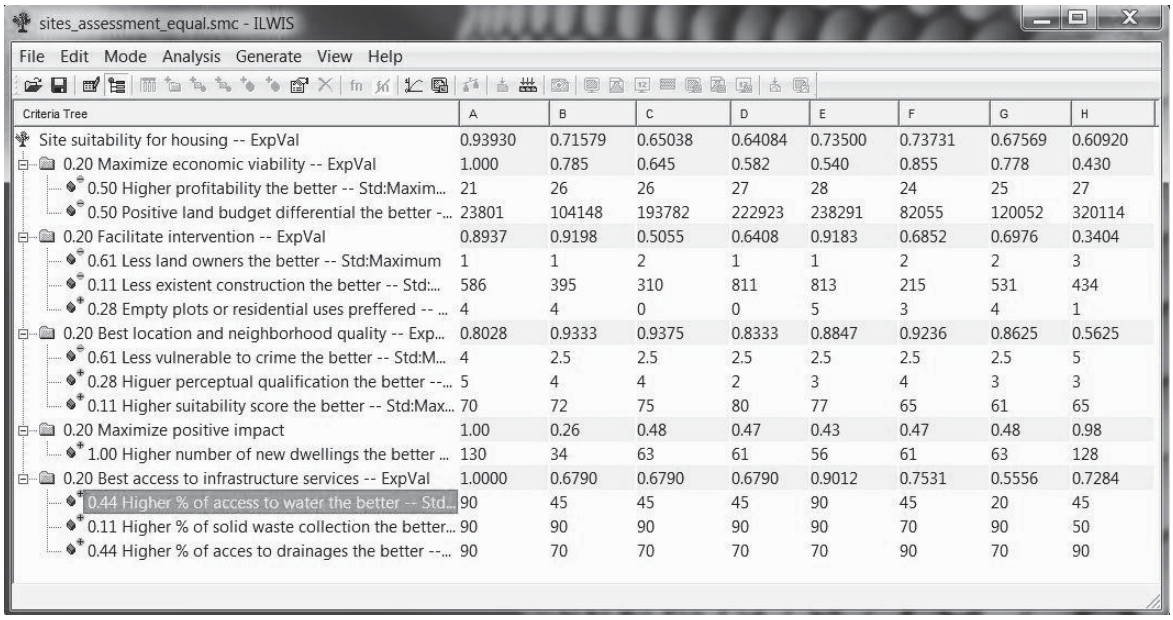

Figure 6.24. ELWIS MCE. Own source

6.3.5. Results of the assessment and sensitivity analysis

Four multi criteria assessments were exercised, one for each stakeholder perspective. Table 6.7 contains the resulting scores per site per stakeholder. In grey, it indicates the four best options per stakeholder. An average was calculated of all the scores. Finally, the rank indicates from 1 to 8 the resulting rank of the sites based on its scores. Being 1 the site towards more priority is suggested. Figure 6.25 graphically shows the preferences for each site by each stakeholder.

A sensitivity analysis was done in order to test the robustness of the MCE. The analysis was done by giving to each objective the maximum weight while leaving the other objectives in 0. From the resulting scores, see table 6.8, an average was calculated and a rank was then given. This method was also useful in visualize how each criteria add up to the final score obtained in the first part of the MCE, see figure 6.26.

Perspective	A	B	C	D	E	F	G	H
Private developer	0.79	0.65	0.73	0.74	0.75	0.67	0.61	0.75
Target group	0.84	0.72	0.77	0.74	0.8	0.76	0.69	0.7
Municipality	0.67	0.68	0.77	0.78	0.83	0.68	0.66	0.82
Academy	0.83	0.55	0.68	0.67	0.65	0.62	0.61	0.82
average	0.78	0.65	0.74	0.73	0.76	0.68	0.64	0.77
Rank of sites	1	7	4	5	3	6	8	2

Table 6.7. Multi Criteria Assessment scores and site's ranks. Own source

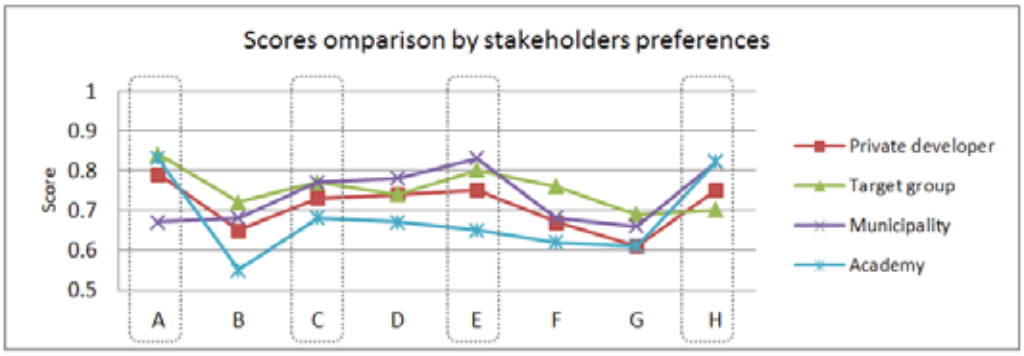

Figure 6.25. Sites preferences per stakeholder. Own source

Objective	A	B	C	D	E	F	G	H
Maximize economic viability	0.41	0.63	0.77	0.83	0.87	0.56	0.63	0.98
Facilitate development	0.73	0.75	0.78	0.92	0.64	0.63	0.53	0.51
Location and neighborgood quality	0.8	0.93	0.94	0.83	0.88	0.92	0.86	0.56
Maximize the positive impact	1	0.26	0.48	0.47	0.43	0.47	0.48	0.98
Best access to infrastructure services	1	0.68	0.68	0.68	0.9	0.75	0.56	0.73
average	0.79	0.65	0.73	0.75	0.74	0.67	0.61	0.75
Rank of sites	1	7	5	3	4	6	8	2

Table 6.8. Sensitivity analysis. Own source

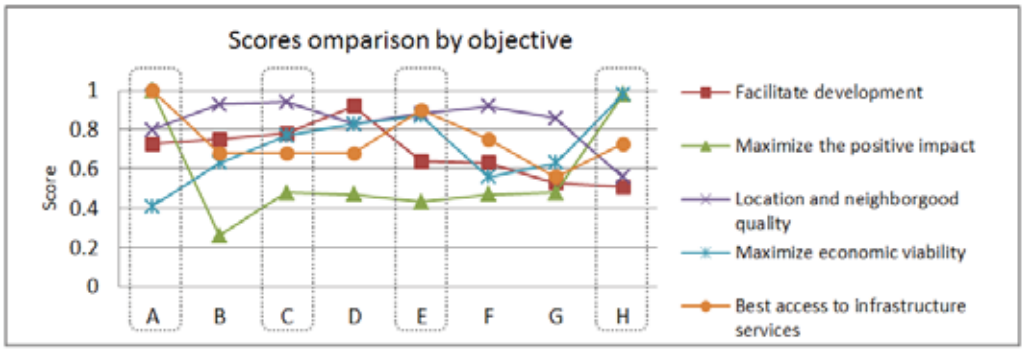

Figure 6.26. Site scores comparison by objective. Own source

Based on the outputs of the analysis a preliminary rank is suggested. Being site A the best option, site B the second best option while sites B, F and G are suggested to be the lasts options to prioritize efforts. For sites C, D, E as it is observed when comparing table 6.7 and 6.8, seems to be an intermediate group of options, but not clear and ordinal order among those. In figure 6.25, based on stakeholders preferences, it is observed a minor range in the scores for site C, but an increasing range when following

to site D and E. This can be explained when observing the different trade-offs existing between the scores in terms of the objectives, see figure 6.26. A clear example is the trade-off between the quality of infrastructure and the facilitation of development between site D and E. Considering that this objective have relatively less importance for most of the stakeholders, that from the three sites (C, D and E) is the one that offers better access to infrastructure and better economic viability, with a relatively similar score in the location and neighbourhood quality, and that have a relatively high punctuation for 3 of the stakeholder (except the academic), this site is suggested to rank in the third place. Site D is suggested in fourth place and site C in fifth place.

Still, strong discussions may arise regarding to sites A and B. First site A is the sites that punctuate high in most of the objectives, but with the lower score in maximizing economic viability. This is similar to state that is the site with higher economic risk when comparing it with the other sites. In the other hand, site H have the maximum score for the economic viability, however with a minor quality in access to infrastructure. In addressing the preferences of the target group, in terms of quality of the neighbourhood is the last preferred. This is also a risk for the project, in terms of the acceptance of the project, therefore difficulties in the market absorption.

7. CONCLUSSIONS AND RECOMMENDATIONS

This chapter synthetize and discuss the results of the research in the light of the initial objectives and research questions. Next, the concluding remarks and the recommendations for further research are presented.

7.1. Results and discussion

1. To identify methodology and process to support collaborative planning approaches for municipal housing projects aiming to sustainable development.

A collaborative framework is proposed in the conclusion of chapter 2, based in the scheme of the planning process (intelligence, design and choice), emphasizing the integration of concepts related to collaborative approaches (stakeholders, communication and visualisation). Chapter 4 describes the methods implemented for the operationalization of this framework.

Four groups of stakeholders are identified for the process based in Municipalidad de Guatemala (2012). Those are described in chapter four, table 4.1. Followed, during the implementation of the framework, table 5.1 list the participants that integrate the stakeholders groups. The definition of the target group and the selection of the participants have two weaknesses. First, this group is defined more in terms of income by academy and the municipality. The private developers define it also considering their capacity of investment and household characteristics. They also have a broader perspective about their preferences of housing choices depending on their household's characteristics (i.e. stage of life). The market researcher estate that, in Guatemala, groups cannot be classified by their income and stage in life alone (i.e. while something might be classified as medium income, his social group might be the high income group). He stress that defining the target group should be as specific as possible, as it have implications in the type of housing and the evaluation criteria to be included when analysing the suitable sites. Consequentially, before the workshop, definition of the profile of this group was not fully clear. Second, based on the characteristics that were discussed during the interviews with the municipal planners and trying to incorporate the considerations of exposed by the private developers the researcher proposed 4 candidates. Those were selected from the municipality institution to make the interviews, since it was easier to manage permission for them to also participate in the next activity (the workshop). A bias can be observed, as this group of participants are naturally identified with the municipality discourse on sustainable development and the policies of that institution.

Two methods were implemented in order to build knowledge based on stakeholders' experience described in section 4.3 and 4.4. As this was the first exercise of collaborative approach in relation to municipal housing development, the strategy of approaching the stakeholders was stressed. At this regard, the face-to face semi-structured interviews facilitated this. Face to face interviews were important in arising interest among the stakeholders to participate in the workshop.

The workshop allowed a collective approach to the planning task. Still, dominance by participants who acknowledge more information about the topic (housing development) was noticed. This makes reference to the expertise and personal experiences of private developers in developing housing projects. Academy and municipal planners also introduced a discourse that at some extent was taken to a level in where the target group didn't get fully involved.

Then participants formulated their criteria individually and then collective discussions allowed agreement in the resulting set. Rankin methods were used to assign priority in a collective manner, see section 4.4. In tracing back the stakeholders' group preferences the colour coding was used. However, other methods like individual questionnaires could had been used to validate this process and bring different results for the whole process.

Stakeholders' information requirements address to main aspects: *what* and *how* to present. The first, it addresses considerations of qualitative and quantitative information that can bring new information to lead to discussions by their side, but related to their own interests. This responds pretty much to their role and orientation in regard to the topic of housing development (i.e. economic viability for private developers). Adding up the different concerns, the collective information enforces the framework of collaboration as the interests of the groups become relevant in the multi-dimensional approach. The result is a comprehensive analysis across the stages in the framework that also stress aspects of sustainable housing developments. The second aspect (*how*) intends to make the process transparent and understandable considering the multi-background characteristic of stakeholders.

When addressing the objective 2 of and other findings in the research, more specific considerations where taken into account and incorporated to the framework. In this way the framework was contextualized to the case study's current context for collaborative approaches. At this regard, in combination with the information requirements from stakeholders to assess the sites, the stage of assessment was re-designed as originally proposed. From a scheme of site search-selection using Definite with remote located stakeholders, shifted to prioritize sites to manage a potential intervention. Two main considerations are addressed here. First, selecting a site was not meaningful, as the assessment was over private plots and there was no certainty in the possibility of involving the land owner or acquiring the land. Second, limitations on working with groups of stakeholders were found across the process due to their own schedules; therefore other alternatives were introduced instead of Definite, focusing more in a framework methodology that could be replicable. The explorer of scenarios tool and a non-spatial Multi Criteria Evaluation method were implemented using CommunityViz and ILWIS.

2. To explore the perspectives by potential stakeholders regarding the municipal housing development and the participatory planning approach.

The source of these discussions is based mostly on the outputs of the interviews, see section 5.2 - 5.3) and then on observations made by the researcher during the fieldwork. The stake of the different groups is naturally defined by their capacities and limitations in terms of their role in housing development.

Different dimension of sustainability are implicit within the interests of the different stakeholders. However, each one is limited by its own role and frame of action. Target group would like to reduce their trip distances and access to high quality housing within the city, but their capacity to afford it is limited. Current perceptions of the quality of life (i.e. quality of air, access to green and recreational areas, security and noise) in the inner city are a restriction for them. Even though characteristics of high quality housing are within the view of private developers, as are demanded by their target group, they are limited and oriented to the economic viability within the current housing and land market. Municipal planners have a more comprehensive theorization of the sustainability vision, but strategies in translating these concepts within the current context are strictly limited due its limitation in land source and budget.

Different opportunities identified by stakeholders. Cultural issues related to acceptance of shifting from horizontal property to vertical are gradually changing. Private developers see a potential market niche identified as young professionals (single or young families). Economic pressures of a steady increase in private generalized costs (budget and time) could be a factor to revert the current trend of migration toward peripheral areas. Associations between land owners and private investment alone or intermediated

by the municipality is stated as the most promising short coming opportunity to enforce development of housing. While the enforcement of the normative and management tools to enforce Municipality capacity for housing operations is a more long term process.

Still, important barriers need to be addressed. Land price speculation is one of the major brakes for development. The urban structure is characterized by several areas with atomized plots. Land associations are important in order to facilitate interventions in the long term. Bureaucratic procedures and uncertainty in the expenses to be covered in urban impacts rates seems to be one of the major reasons why private developers foresee higher risks in investing in the inner city. "Especially in housing projects (middle income groups) in where the economic viability model is *sensitive* to unforeseen expenses" (interviewed 8). In this type of projects additional costs might force to increase the retail value, leaving them out of the targeted market group. For these reason, between others, developing housing for high income groups within the city is less risky. As additional expenses can be easily absorbed increasing retail prices.

In general, the stakeholders foresee a good opportunity in the collaborative approach. Private developers see a chance in overcoming bureaucratic barriers and economic development by facilitating interventions. Target group see chances to indicate their preferences of location and characteristics of the housing unit. The municipality and academy see the relevance in leading housing operations towards a vision of sustainable development. However, the private sector estate that lack of transparency, budget, and political stress might play against the process. Also, those collaborative approaches may result in complicated and elongated discussions leading to nowhere. They estate that a better understanding and approach to target group is key fundamental in developing high quality and sellable products, but that can be done via market research (interviews, focus groups or other methods). The municipal planners are aware that with a more complete knowledge and experience by the side of private developers, they could introduce a strong bias in the formulation and conceptualization of the projects, especially in terms of the land use intensity in favor of higher profitability. Target group stress their limitations in availability of time and the real attention that could be addressed towards their suggestions.

Private developers see themselves as investors with the knowledge, experience and established structure on how to operate these interventions. If they are called to collaboration as investors they state high and almost single power in making decisions. Otherwise they could play a role of limited advisors, even though they suggest that the municipality should not embrace interventions in the housing market by themselves alone.

Municipal planners have a broad scope based on their role. One hand, the importance of enforcing current normative and procedures to improve the development process is stressed. Two modalities are foreseen. First, aware of their current limitations (land and budget) they recognize their role as facilitators and intermediate agents in the association of land owners and private investors, revising that the new developments accomplish with parameters of quality, but aware that maximum intensity of land use is expected due to interests of economic dimensions. Second, once new tools and enforced normative could help to overcome the current limitations, a full modality of new municipal housing can be implemented (using their own housing prototype). In both modalities, stating high hierarchy in the decision making process.

Target group participants see themselves as a source to investigate the users' preferences. In this case they state a high degree of collaboration as an opportunity to influence in the development of high quality housing. However, their involvement does not guarantee that they could be the actual buyers. At this regard, their interest in participate might vanish across the process in a real implementation case.

Academics addressed an important topic, especially in relation to the role of public superior education and decentralization. They foresee that linking facilities of virtual access to superior education with the municipal housing development could bring opportunities of decentralization and provide major access to a wide range of citizens. However, they suggest that their participation should be as mere advisors and the decisions should rely in technical and political bodies.

This discussion stress important relations with the literature. As discussed by Jones et al. (2010), economic viability for housing land uses as a shaper to turn the city towards an envisioned sustainable development should be addressed. The debate on what should be the degree of participation and dominance of the different stakeholders should be addressed. Aspects on how the collaborative planning could lead to promoting local economic development are seen by stakeholders in this approach.

3. To implement a collaborative planning framework to design and assess sites for municipal housing projects.

Based on the result of the workshops activity, criteria is used as the characterization of suitable land, see section 5.4 and 6.1. The output of the group activity was a set of 7 ranked criteria, see section 5.4.3. As the concerns of the different groups differ, the different ranks result in four additional sets of weights. These are analysed in table 5.6 and figure 5.1. It can be noticed, accessibility to the municipal transportation system and to nodes of commerce, education and service land uses are highly important for most of the stakeholders. Access to other means of mobility and the amount of current construction in the sites is the least relevant. The criterion of less construction is excluded in the suitability analysis, therefore weights are recalculated, see table 6.2. The results of including this criterion and using the plots as the unit of analysis were not tested, but as the criterion had low priority, no major changes in the results are expected. However, the effects of the irregularity of the unit of analysis (the plots) might introduce a slight new result in the suitability.

The suitability analysis was implemented using the via the suitability tool provided in the CommunityViz wizard. Other ways of doing the same analysis are possible in GIS or ILWIS. However in order to facilitate the introduction of this approach to the stakeholders the described approach was used. One disadvantage is that a hierarchy of the criteria cannot be implemented. Therefore, scores for the criteria in where more than one layer of data is combined where calculated previously. For this, criterion maps where created in forms of raster. Then, the corresponding measurements where extracted to a layer of points (corresponding to the centroids of the uniform units of analysis). The different measurements where then combined and added to UAS using spatial overlay techniques. The advantage by doing this is that, once produced this information, it was also used in explaining the operations performed to explain the multi criteria approach to the stakeholders.

One of the limitations of this analysis is the geographical extent of the study area. Recalling figure 3.9 can be observed that surrounding areas are also urban areas. At some extent this was considered in some of the criteria implemented (Transmetro stops, green areas and the land uses extracted from the layer of special uses defined by TOP). Still, proximity to commercial, schools and health services only account for the inner area of the polygon. Considering a certain buffer to include the adjacent urban areas could introduce higher suitability scores for some areas. Another limitation is the use of Euclidian distances analysis. Proximity in this sense is measured in a straight line or “as the crowd flyes”. Other types of analysis could improve the accuracy of the scores in considering the access based on current road network (network analysis).

Section 6.2 describes the techniques and criteria in identifying potential sites for municipal housing. Additional criteria address specific considerations that were not included in the criteria formulation for the suitability analysis. Still, even if those were had included, the limitations in using the plot layer would had led to the same strategy when addressing those concerns. In this step, specific characteristics of the plots are filtered (size, uses) and others are visually inspected (residential context). A weakness of this approach is that the selection of sites depends on the visual interpretation capacity of the researcher. Selection techniques available within the GIS using the criteria established for this process can be implemented. This can result in a larger amount of plots identified. The process of design implies either the selection of

one single plot to be proposed, or the association of more than one. Finally, due to inaccuracies in the layer of plots, visual rectification is useful on validate the design of the sites.

Section 6.3 describes the framework implemented for the assessment. During this stage, a model in CommunityViz was implemented to do scenario development explorations. Even though for the scope of this research and the limitations of time this tool was used exclusively by the researcher. However it constitutes a valuable tool in facilitating discussions in defining the types of intervention. As it was stressed in literature, in addressing sustainable housing development the design phase of the housing projects is key important in achieving sustainability.

The use of the multi criteria approach, again, facilitated incorporation of additional considerations related to the location of the sites. The results show that in planning for sustainable development, assessment of sites is more comprehensive. By following a mere market driven scheme some sites might be prioritized that not necessarily accomplish with other considerations to account for sustainability.

Depending on the availability of data, results of the whole process might differ. Access to spatial information was limited to the researcher. The maps from where the information was extracted to account for the access of services infrastructure was on a *pdf format, and the maps were classified in intervals of 10% in some cases and 20% in others. Therefore the percentage of access to a specific service was assign by the researcher using the middle percentage within the interval (i.e. if the percentage range was from 10 to 20, the percentage assigned was 15). If this spatial information is made available, is suggested to be included as a criterion for the suitability analysis. Different and more accurate outcomes could results for the whole process.

4. To critically reflect on the implemented collaborative framework

In previous discussion it was addressed that the implemented framework allowed introducing dimensions and concerns that are related to sustainable development. In this terms, the collaborative framework stress the advantage of have a more comprehensive lecture of the challenge to face when planning toward sustainable development. During the approach with different stakeholders could be noticed that different dimensions implicated in the economic, social and environmental aspects are already implied, however their materialization is limited.

The experience with this collaborative approach allowed also introducing a combination of methods (SMCA, MCE and Geo-visualisation) that stress the importance in using available geographic information. In this terms, building community within the group of stakeholders have other advantages. A feeling of commitment and openness to share information is observed.

Different difficulties were also present. During the workshop, dominance of stakeholders that account more knowledge in the topic is observed. This leads to easily unfocused discussions towards topics that even if those reveal interesting debates and information of the housing development topic, may fall outside of the focus of the conversation. Therefore, stressing more the passivity of other groups.

From the technical point of view, the process was fluid. Some limitations are worth to mention. The data that was combined is not up to date (land use, construction, demographic information and the polygons of attracted trips). This may introduce an important degree of inaccuracy to the framework.

Full account of the requirements of the stakeholders could not be considered, as the group of stakeholders that remained in the process was more limited (1 per each group). Still, their perspectives were incorporated to the suggested set of criteria during the last step of the assessment framework via e-mail survey. Due to time constraints, this last step could not be presented to the stakeholders. Therefore there is no feedback from their side regarding to the results.

Based on the stated experiences of the stakeholders in the questionnaires during the workshop and observations of the researcher some statements can be done in relation to the relevance of the information. Introductory discussions of the study area during the workshop enforced the understanding of the problem in task. The use of 2D and 3D geo visualisation enforce understanding and to focus the

scope of discussion to the study area. Using the advantages and popularity of applications like Google earth, information that normally is discussed based on 2D information (suitability analysis), can be combined with other layers of information and be explored in a pre-recognized context.

Still, methodological test and evaluation of the framework is required in order to test and measure different dimensions and interactions with stakeholders.

7.2. Final conclussions

The outputs of this research provide a collaborative planning framework through a comprehensive analysis that incorporates dimensions of sustainability for housing location and assessment of sites by means of a planning and decision support systems.

It can be concluded that different dimension of sustainability are implicit within the interests of the different stakeholders. However, each one is limited by its own role and frame of action. Economical aspect becomes important in addressing the planning process for municipal housing projects due to current land and housing market constraints. As stated by stakeholders that are aware of the operational constraints to develop housing within the city (private developers, municipal planers and academy) and Jones et al. (2010), expensive political efforts need to be done in constructing a sustainable market. At this regard, internalization of the social costs of land price speculation and reforms to the land taxation system should be addressed.

Addressing the role, strengths and limitations of each stakeholder, the implementation of this framework allowed a first approach to a collective perspective of the housing topic within a collaborative environment. It was also an opportunity to exchange visions, ideas and knowledge from each of the stakeholders that could enforce the reflection about the possibilities of interventions. As well as it was grounded the base to characterize suitable land to identify possible sites for intervention.

Outputs of the assessment framework demonstrate that a multi-dimensional approach to assess sites for housing location could stimulate fruitful discussions in planning for sustainable development. A mere market driven assessment would have resulted in a different rank of sites. However when including other stakeholder concerns such as sustainability, economic viability is still compatible.

Different techniques proposed for the Integrated Planning Support System allowed successful operationalization of the proposed framework. The Multi Criteria approach was used in two modalities, during the suitability analysis and the assessment of identified sites. Multi Criteria evaluation methods facilitate the incorporation of measurements of different nature and to incorporate perspectives of different stakeholders. By using the same approach in the two stages, it is expected easiness in the familiarization of the stakeholders with the technique, therefore a better understanding of how are proceeding the different analysis (suitability and assessment). Consequentially, it makes transparent and open to discussion the whole process.

In order to explore and stimulate understanding and discussions, a model for exploration of scenarios of development is implemented in CommunityViz. Even though for the scope of this research and the limitations of time for exploring this tool together with the stakeholders, it constitute a valuable tool in exploring typologies and intensity of intervention. Therefore, it allows a limited incorporation of design aspects.

The use of 3D Geo visualisations was incorporated in three phases. First, during the workshop in fieldwork, that can be called "training phase" in literature. Second, in the feedback presenting the results of the suitability analysis and the proposed sites. This was made available via Google earth file (*KMZ). And third, a 3D model is constructed to be able to explore and understand implications of density. The importance of this component of the framework relies on the necessity of addressing spatial understanding skills within a multi-background group of stakeholders. The positive or negative aspects of these techniques couldn't be tested in the second and third visualisation. Still results of the workshop questionnaires and comments from the participants during suitability feedback suggest that the use of these techniques facilitate flow of understanding. Especially in using popular applications like Google earth.

Different methodologies applied can offer a strong and transparent support to inform the planning process. However, in addressing the sites assessment for municipal housing project from multi-dimensional perspective, strong discussions should be stimulated in order to strength the decision-making process in collaborative environments.

As a final remark, re densification of central areas by means of municipal housing could enforce the path towards sustainable development. Still, individual household's behavior and choices for mobility and housing are equal important in order to achieve such goal. Aspects like the social significance of owning and using a private vehicle, promoting its use, could be addressed by parallel measures that internalize the social costs of such behavior at the same time that an optimal collective transportation system is being provided. At the same time, household's characteristics and aspirations should be considered in the housing projects for Guatemala City. As is stated by private developers and target group, the quality of life (quality of air, safety, access to recreational and green areas, quiet environment) that can be perceived in a housing project for raising a family is determinant in their choices. Even though the current projects are oriented to single or young families, considering their affordability capacity and possibly that this could be their one-time investment, such aspirations should be addressed.

7.3. Recomendations

From a collaborative perspective, it is strongly suggested to consider the involvement of the land owners within a framework of recognition and acknowledgements of their own needs, interests and limitations. This will provide a perspective about until what extent will be able to either get involved in an intervention, to sell, or to block the process of housing development. Different frames of involvement can be also studied in detail depending if the owner just own the land, or if is actually resides in the land.

Within the same scope, deeper understanding of various types of target group as stakeholders is also recommended. In order to promote social cohesion, it remains uncertain to what extent are different socio economic groups are willing to mix with others. As well as what could be the attractors to come, or to stay, in the city, as a compatible lifestyle with raising a family.

Additionally, research on techniques that can be combined with the dynamic of the workshops, or substitute the workshops in order to stimulate even participation is motivated.

From a more technical point of view, further steps for this research should seek ways to improve the information added to the model suggested in section 6.3.2. At this regard, research in where a more close approach is given to the design phase of the housing projects could enrich the input parameters the outputs indicators obtained in this phase. This means i.e. exploring the spatial arrangement and volumetric possibilities of providing high quality design and characteristics of adequate orientation, between others,

under a given open space index and the specified site. The last should address also consideration on the proportion of the sites selected, as constraints or opportunities in providing an optimal design. Exploring the design phase will allow to work with more real construction costs, considering also characteristics like soil properties, available technology, possible incorporation of energy efficiency devices, etc.

In terms of the territorial coverage, alternatives in implementing the framework for bigger areas, especially the assessment stage is also recommended. However, the characteristics of broader areas might be very heterogeneous and this could be a difficulty in implementing this stage of the model. One reason could be, -at least for the case study presented- that the housing market (selling price and interests and demands in live in certain areas) is not the same across a heterogeneous geographical area.

A methodical evaluation of the collaborative framework presented in this research is recommended. This implies to test it and measure its performance qualitatively and quantitatively. The objective should be to measure in each stage the degree of improvement in the understanding of the information being produced compared to the use of other methods.

Lastly, research on addressing the barriers identified to develop housing projects; specifically land price speculation and weakness in the taxation system are suggested as further topics of research.

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APPENDICES

Appendix A. Semi-structured interviews

Guiding structure of the interviews with private developers

Introduction: The objective of this interview/focus group is to support the academic research which main objective is to develop and test a framework to evaluate municipal housing projects location in a collaborative planning approach. Therefore, further research steps are going to be based on the knowledge building regarding the perspective of different actors over the sustainable housing development and the intended collaborative planning approaches by the Municipality of Guatemala City.

One of the main objectives of the Guatemala City Municipality is to promote redensification and urban revitalization within the Municipal boundaries. The Municipal Housing Enterprise and Urban Development (MHEUD) since January of the present year, is in charge of promote and develop programs and housing projects oriented to low and middle income groups, aiming to a strategic and sustainable urban development.

From the perspective of your own knowledge and experience

1. What is the definition of a profitable economic investment in a housing project development in terms of the costs against the revenue? Which indicators of the financial model of a project determine its profitability?
2. What should be the definition of the middle income group in terms of economic capacity?
3. What are the market opportunities of developing middle income oriented housing projects within the Municipal Boundaries?
4. What are the main limitations, barriers or difficulties in investing in these types of projects within the Municipal Boundaries?

What could be the aspects or factors to be evaluated in searching sites for these types of developments?

Introduction: One of the MHEUD attributions is to subscribe conventions of inter-institutional cooperation with diverse sectors: academic, private developers, non-governmental organizations, between others, linked to urban and housing developments. At this regard, planning in a cooperative manner could be the base for strategic alliances in public-private approaches to promote housing development.

5. How do you consider that involvement of private developers could benefit and strength the process of planning the municipal housing projects?
6. What could be your contributions to the process?
7. What could be your interests, motivations and/or limitations to participate?
8. What difficulties do you visualize could be faced regarding to the participation of the private developers together with other participants (target group, municipal planners, academic experts)?
9. In your opinion what could be the benefits/strengths of such approach?
10. Based on the types of roles described below, what should be the role of private developers regarding to making decisions across the process of development (site identification, selection, design and construction of these projects)? Do you consider that your involvement could be different according to the stage of the process of housing development and why?
    a. Consultancy and/or influencing the process but NOT making any decision
    b. Active involvement in the development of proposals but NOT making any decision
    c. Making decision in selecting the proposals that best suit the housing program objectives and the interest of the planning participants
    d. Making decision in approving which projects are going to be constructed

11. In a scale from 1 to 5, being 1 less interested and 5 most interested, how do you qualify your willingness in getting involved in a planning activity, together with others participants of different relevant disciplines, for the municipal housing developments? And why?

Guiding structure of the interviews with academics

Introduction: The objective of this interview/focus group is to support the academic research which main objective is to develop and test a framework to evaluate municipal housing projects location in a collaborative planning approach. Therefore, further research steps are going to be based on the knowledge building regarding the perspective of different actors over the sustainable housing development and the intended collaborative planning approaches by the Municipality of Guatemala City.

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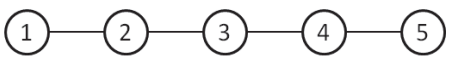
From the perspective of your own knowledge and experience

1. What is your definition of sustainable housing development?
2. How do you think that the Municipal Housing Projects could favor a sustainable development?
3. How do you relate the sustainability goals of the urban development with the location in where these projects should be located?
4. What are the opportunities and limitations/barriers to be considered in this enterprise?

One of the MHEUD attributions is to subscribe conventions of inter-institutional cooperation with diverse sectors: academic, private developers, non-governmental organizations, between others, linked to urban and housing developments. At this regard, participatory approaches could be the base for strategic alliances in public-private approaches to promote housing development.

12. What could be your stake in a participatory planning approach for the case of the municipal housing projects developments?
13. How do you consider that your involvement could benefit and strength the planning task?
14. What could be your interests, motivations and/or limitations in getting involved?
15. In your opinion what should be your role for the decision making processes regarding the site identification and selection?
    e. Decision influencer (formal or informal influencing in developing proposals)
    f. Decision shaper (in charge of developing high quality proposals)
    g. Decision-takers (ensure the quality of the proposals to be given to proposal approvers)
    h. Decision-approvers (sanctioning decisions)
16. In a scale from 1 to 5, being 1 less interested and 5 most interested, how do you qualify your willingness in getting involved in a participatory planning process for municipal housing developments? And why?



Guiding structure of the interviews with municipality planners (Municipal Housing Projects urban coordinator)

Introduction: The objective of this interview/focus group is to support the academic research which main objective is to develop and test a framework to evaluate municipal housing projects location in a collaborative planning approach. Therefore, further research steps are going to be based on the knowledge building regarding the perspective of different actors over the sustainable housing development and the intended collaborative planning approaches by the Municipality of Guatemala City.

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From the perspective of your own role within the municipality institution

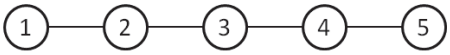
Urban Planning Manager of the MHEUD

1. What is the definition of sustainable housing development being used for the formulation of municipal housing projects?
2. What are the objectives to be met with these projects?
3. How these objectives are related with the vision of the Guatemala Municipality?
4. What is the profile or characteristics of the middle income groups (target group)?
5. What are, or could be the urban strategies for developing these projects? How the location of these projects could help in achieving the municipal goal of urban revitalization?
6. What are the normative policies or tools related to support the municipal housing projects?
7. What is the current established procedure for the formulation of these projects?
8. What are the aspects or factors being evaluated in searching and proposing sites for these projects?
9. How these factors relate to the concept of "productive housing"?
10. What are the criteria used to select the sites for development?

One of the MHEUD attributions is to subscribe conventions of inter-institutional cooperation with diverse sectors: academic, cooperatives, private developers, non-governmental organizations, international organisms of cooperation and public institutions, between others, linked to urban and housing developments. At this regard, participatory approaches could be the base for strategic alliances to promote housing development.

17. What could be the stake of the different potential stakeholders in a participatory planning approach for the case of the municipal housing projects developments?
18. How do you think that the involvement of different stakeholders could benefit and strength the planning task?
19. How do you think that it can be taken into account the interests, motivations and/or limitations of the different stakeholders getting involved in the planning task?
20. What should be the role of the involvement of stakeholders for the decision making processes regarding the site identification, selection, design and construction of these projects?
    i. Decision influencer (formal or informal influencing in developing proposals)
    j. Decision shaper (in charge of developing high quality proposals)
    k. Decision-takers (ensure the quality of the proposals to be given to proposal approvers)
    l. Decision-approvers (sanctioning decisions)

21. In a scale from 1 to 5, being 1 less important and 5 most important, how do you qualify relevance of implementing a participatory planning process for municipal housing developments?



Within the scope of this research, the use of geo-information tools as well as the communication means of the information being produced in order to support and improve the planning process in collaborative environments is being addressed.

22. What is the current use of geographical information and geographical information systems in the process of land assessment for doing the site search and selection for housing projects?
23. What are the current steps or methods being used, using geographical information and GIS to search and propose the site options?
24. What is the information (maps and/or 3D models) being produced to support the planning task?
25. What could be the information requirements to support and improve the planning task?

Guiding structure of the interviews with municipality planners (Municipal Housing Projects architectural prototype coordinator)

Introduction: The objective of this interview/focus group is to support the academic research which main objective is to develop and test a framework to evaluate municipal housing projects location in a collaborative planning approach. Therefore, further research steps are going to be based on the knowledge building regarding the perspective of different actors over the sustainable housing development and the intended collaborative planning approaches by the Municipality of Guatemala City.

One of the main objectives of the Guatemala City Municipality is to promote redensification and urban revitalization within the Municipal boundaries. The Municipal Housing Enterprise and Urban Development (MHEUD) since January of the present year, is in charge of promote and develop programs and housing projects oriented to low and middle income groups, aiming to a strategic and sustainable urban development.

Architectural prototype designers

1. What is the definition of middle income groups in terms of household profile characteristics? (size, average wage, educational level, job location, affordability capacity, among others)
2. How is described the prototype/s of the housing projects oriented for middle income groups? (type of housing, number of rooms, bathrooms, size)
3. What is the estimated cost per square meter required to develop these type of housing?
4. What is the occupation land index (percentage of the land being constructed) of these projects?
5. What is the minimum plot size required to develop these housing prototypes?

Guiding structure of the interviews with target group

Introduction: The objective of this interview/focus group is to support the academic research which main objective is to develop and test a framework to evaluate municipal housing projects location in a collaborative planning approach. Therefore, further research steps are going to be based on the knowledge building regarding the perspective of different actors over the sustainable housing development and the intended collaborative planning approaches by the Municipality of Guatemala City.

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Development (MHEUD) since January of the present year, is in charge of promote and develop programs and housing projects oriented to low and middle income groups, aiming to a strategic and sustainable urban development.

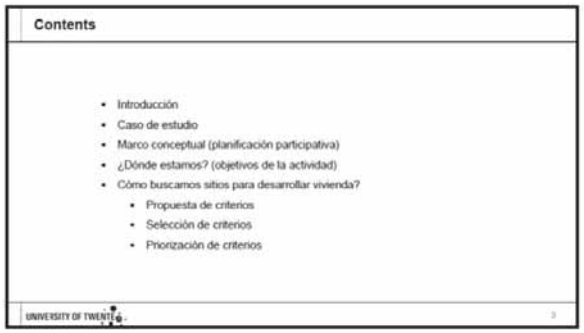
From the perspective of your own knowledge and experience

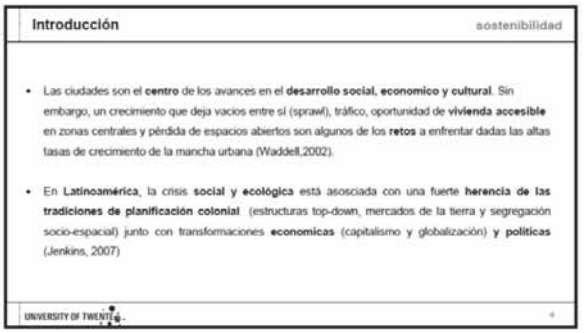
1. Do you live within the municipal boundaries? If NOT in which neighbor municipality / if YES in which sector of the city?
2. In case the person doesn't live within the municipal boundary. Would you be interested in living within the municipality boundaries? Why?
3. Describe the aspects that lead you to choose that option? Things that you like or look for, or not (economic, neighborhood characteristics, proximity to certain features of interests)
4. If you are about to buy a new house within the city, besides de economic aspects, which characteristics would you consider most important in choosing your residence (location, neighborhood characteristics, proximity to features of interests, avoidance of proximity to certain features, interests of your partner or regarding your kids if it's the case)?

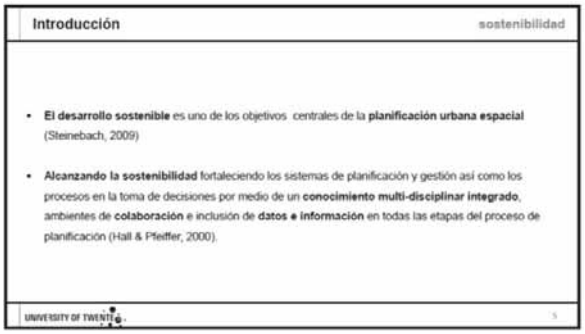
One of the MHEUD attributions is to subscribe conventions of inter-institutional cooperation with diverse sectors: academic, private developers, non-governmental organizations, between others, linked to urban and housing developments. At this regard, participatory approaches could be the base for strategic alliances in public-private approaches to promote housing development.

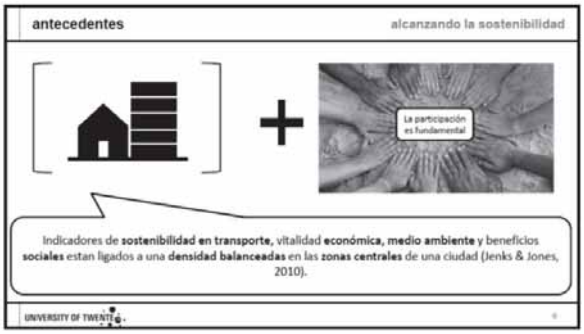
2. Had you ever been involved in a planning activity (discussions, solving issues or proposing solutions) together with your neighbors and/or participants of other entities for the sake of the neighborhood in where do you live? Was it a positive or negative experience and why?
3. Do you consider that your involvement together with other participants (private developers, municipal planners) could benefit and strength the activities related to develop housing projects (selecting a proper site - designing the projects)i n where you could be potentially interested?
4. What could be your contributions to these activities?
5. What could be your interests, motivations and/or limitations to participate?
6. What difficulties/limitations do you visualize could be faced regarding to your participation together with other participants (target group, municipal planners, academic experts)?
7. In your opinion what could be the benefits/strengths of such approach?
8. Based on the types of roles described below, what should be your role regarding to making decisions across the process of development (site identification, selection, design and construction of these projects)? Do you consider that your involvement could be different according to the stage of the process of housing development and why?
    a. Consultancy and/or influencing the process but NOT making any decision
    b. Active involvement in the development of proposals but NOT making any decision
    c. Making decision in selecting the proposals that best suit the housing program objectives and the interest of the planning participants
    d. Making decision in approving which projects are going to be constructed
9. In a scale from 1 to 5, being 1 less interested and 5 most interested, how do you qualify your willingness in getting involved in a planning activity, together with others participants of different relevant disciplines, for the municipal housing developments? And why?

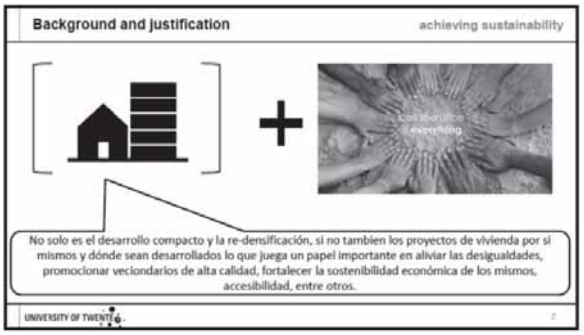
Appendix B. Workshop slides

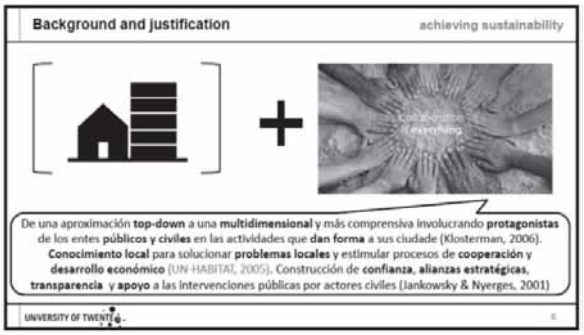






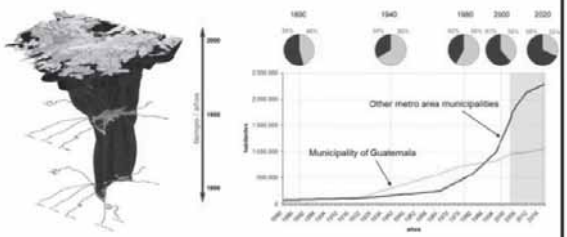






Caso de estudio

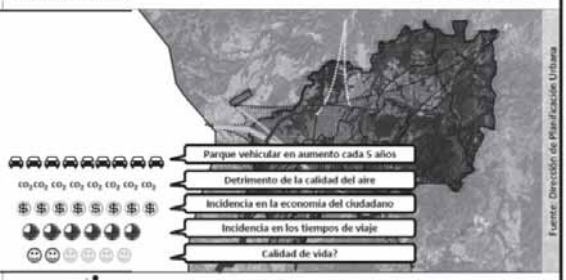
Ciudad de Guatemala



UNIVERSITY OF TWENTE. 11

Caso de estudio

Ciudad de Guatemala



UNIVERSITY OF TWENTE. 12

Caso de estudio

Ciudad de Guatemala

Asentamientos humanos informales, desarrollo desequilibrado + fallo en las antiguas experiencias de vivienda

UNIVERSITY OF TWENTE. 13

Caso de estudio

Ciudad de Guatemala

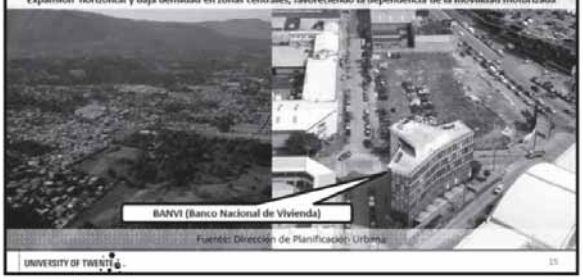
provisión de vivienda orientada por el mercado

UNIVERSITY OF TWENTE. 14

Caso de estudio

Ciudad de Guatemala

Expansión horizontal y baja densidad en zonas centrales, favoreciendo la dependencia de la movilidad motorizada

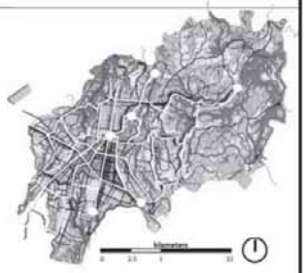


UNIVERSITY OF TWENTE. 15

Caso de estudio

Ciudad de Guatemala

- **Transmetro [BRT]**
- **Plan de Ordenamiento Territorial POT**
  - Modelo de transecto
  - 6 categorías de terreno
  - Instrumentos de incentivos



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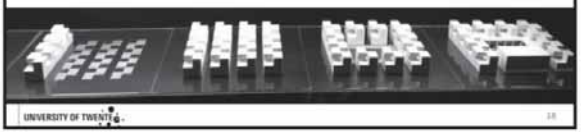
UNIVERSITY OF TWENTE. 17

Caso de estudio

Ciudad de Guatemala

- **Empresa metropolitana de vivienda y desarrollo urbano, desde enero de 2012**
  - Proveedora de vivienda accesible a grupos de ingresos bajos y medios
  - Clave en el objetivo de alcanzar una densidad balanceada en un entorno de usos mixtos en vecindarios de alta calidad.



UNIVERSITY OF TWENTE. 18

Caso de estudio

Ciudad de Guatemala

- Modalidades de vivienda

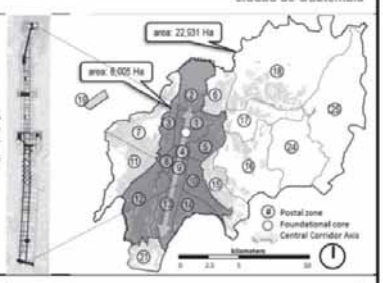
- Vivienda nueva
- **Vivienda nueva de gestión asociada [empresa municipal + inversionistas + dueños de tierra]**
- Reciclaje edificatorio

UNIVERSITY OF TWENTE. 19

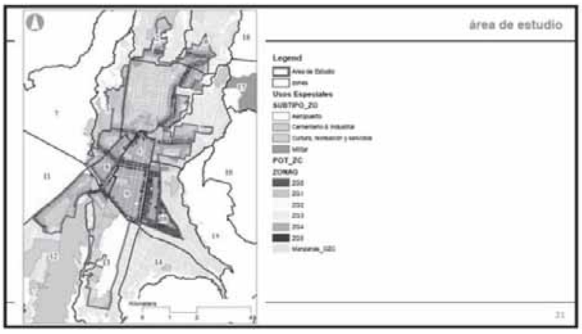
Caso de estudio

ciudad de Guatemala

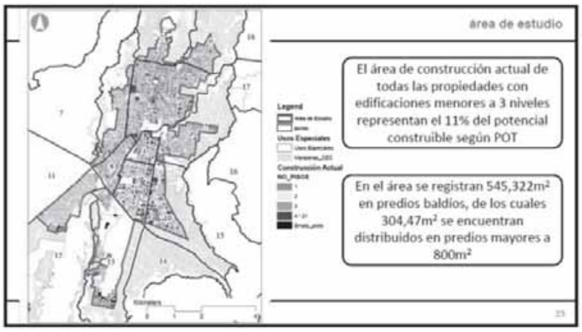
- Zonas que interceptan o adyacen una "zona central" e identificación de un corredor central demarcado como un eje de ciudad.

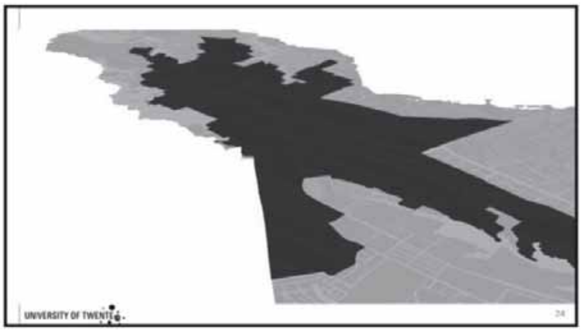


UNIVERSITY OF TWENTE. 20


área de estudio
Legend
Área de Estudio
zonas
Usos Especiales
SUBTIPO_ZO
Aeropuerto
Cementerio & Industrial
Cultura, recreación y servicios
Militar
POT_ZC
ZONAG
21


área de estudio
Legend
Área de Estudio
zonas
Estaciones
TM
Curvas
22


área de estudio
Legend
Usos Especiales
Construcción Actual
El área de construcción actual de todas las propiedades con edificaciones menores a 3 niveles representan el 11% del potencial construible según POT
En el área se registran 545,322m² en predios baldíos, de los cuales 304,47m² se encuentran distribuidos en predios mayores a 800m²
23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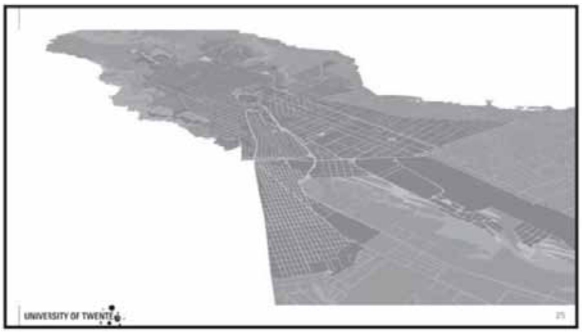
24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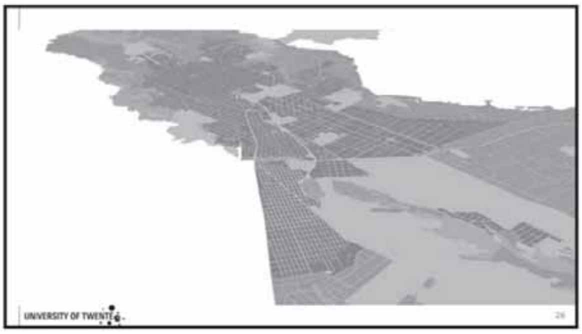
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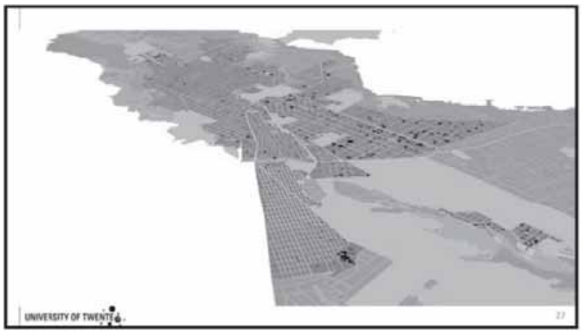
26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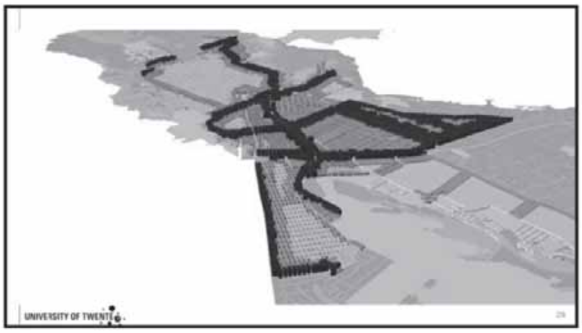
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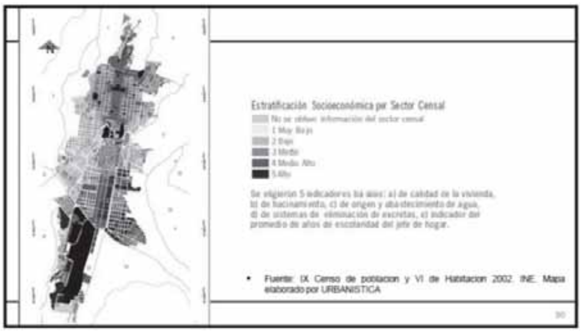
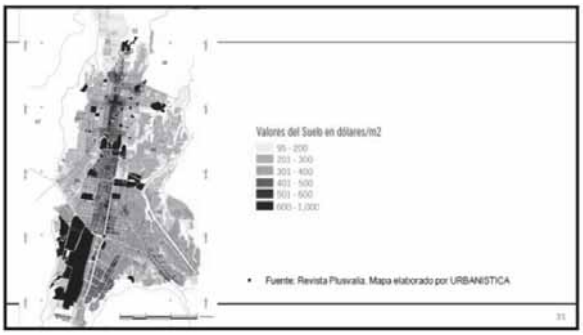
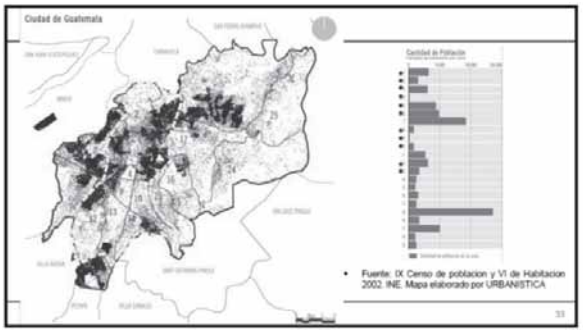
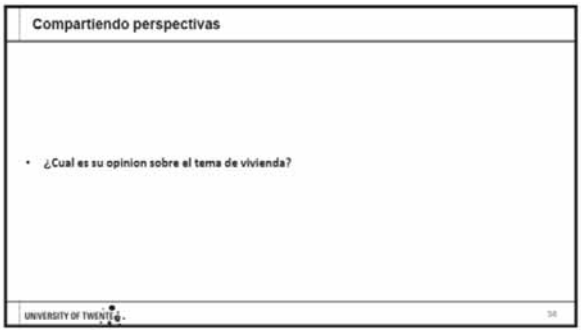
29

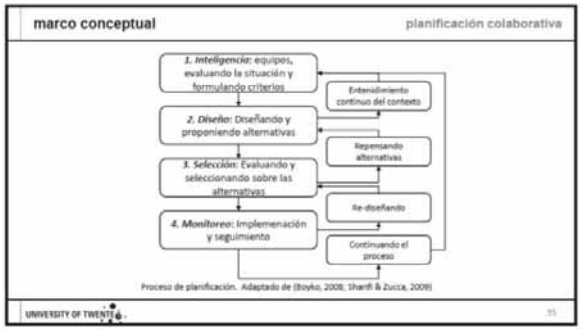

Estratificación Socioeconómica por Sector Censal
No se obtuvo información del sector censal
1 Muy Bajo
2 Bajo
3 Medio
4 Medio Alto
5 Alto
Se eligieron 5 indicadores básicos: a) de calidad de la vivienda, b) de hacinamiento, c) de origen y abastecimiento de agua, d) de sistemas de eliminación de excretas, e) indicador del promedio de años de escolaridad del jefe de hogar.
• Fuente: IX Censo de poblacion y VI de Habitacion 2002. INE. Mapa elaborado por URBANISTICA
30

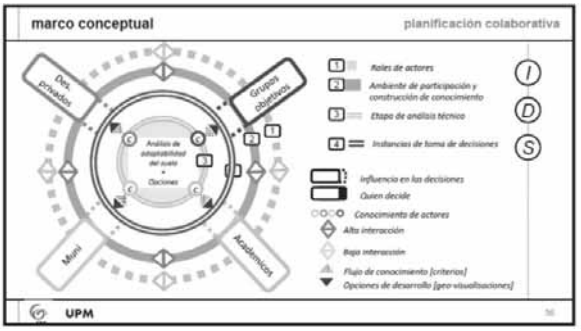

Valores del Suelo en dólares/m2
95 - 200
201 - 300
301 - 400
401 - 500
501 - 600
600 - 1,000
Fuente: Revista Plusvalía. Mapa elaborado por URBANISTICA
31

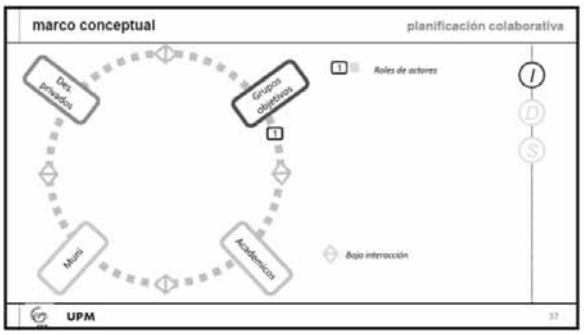

Zona Central
Indice integrado de calidad de la construcción
Ponderación de piso
Ponderación de techo
Ponderación de muros
32

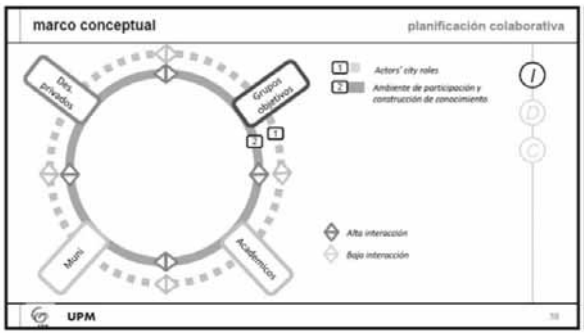

Ciudad de Guatemala
Cantidad de Población
Fuente: IX Censo de poblacion y VI de Habitacion 2002. INE. Mapa elaborado por URBANISTICA
33

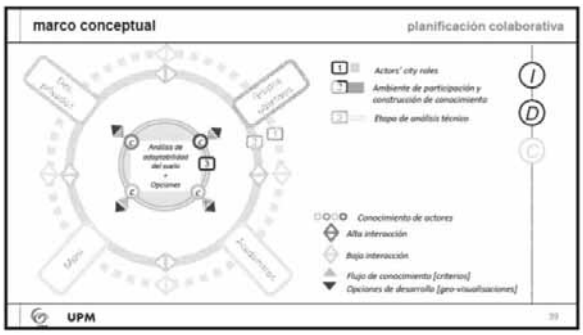

Compartiendo perspectivas
¿Cual es su opinion sobre el tema de vivienda?
UNIVERSITY OF TWENTE.
34

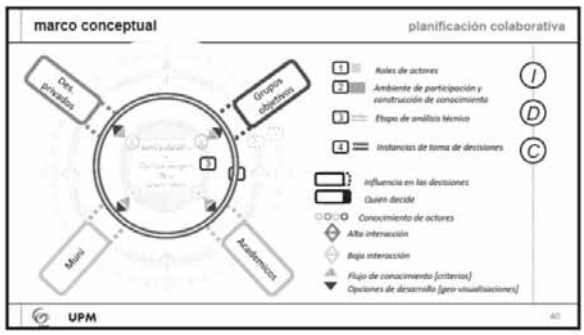

marco conceptual
planificación colaborativa
1. Inteligencia: equipos, evaluando la situación y formulando criterios
2. Diseño: Diseñando y proponiendo alternativas
3. Selección: Evaluando y seleccionando sobre las alternativas
4. Monitoreo: Implemenación y seguimiento
Entendimiento continuo del contexto
Repensando alternativas
Re-diseñando
Continuando el proceso
Proceso de planificación. Adaptado de (Boyko, 2008; Shanfi & Zucca, 2009)
UNIVERSITY OF TWENTE.
35


marco conceptual
planificación colaborativa
Dev. privados
Grupos objetivos
Mixti
Académicos
Roles de actores
Ambiente de participación y construcción de conocimiento
Etapa de análisis técnico
Instancias de toma de decisiones
Influencia en las decisiones
Quien decide
Conocimiento de actores
Alta interacción
Baja interacción
Flujo de conocimiento [criterios]
Opciones de desarrollo [geo-visualisaciones]
I
D
S
UPM
36


marco conceptual
planificación colaborativa
Dev. privados
Grupos objetivos
Mixti
Académicos
Roles de actores
Baja interacción
I
D
S
UPM
37


marco conceptual
planificación colaborativa
Dev. privados
Grupos objetivos
Mixti
Académicos
Actors' city roles
Ambiente de participación y construcción de conocimiento
Alta interacción
Baja interacción
I
D
C
UPM
38


marco conceptual
planificación colaborativa
Actors' city roles
Ambiente de participación y construcción de conocimiento
Etapa de análisis técnico
Conocimiento de actores
Alta interacción
Baja interacción
Flujo de conocimiento [criterios]
Opciones de desarrollo [geo-visualisaciones]
I
D
C
UPM
39


marco conceptual
planificación colaborativa
Dev. privados
Grupos objetivos
Mixti
Académicos
Roles de actores
Ambiente de participación y construcción de conocimiento
Etapa de análisis técnico
Instancias de toma de decisiones
Influencia en las decisiones
Quien decide
Conocimiento de actores
Alta interacción
Baja interacción
Flujo de conocimiento [criterios]
Opciones de desarrollo [geo-visualisaciones]
I
D
C
UPM
40

Appendix C. Workshop questionnaires

Introduction

The objective of this questionnaire is to get insights in the workshop experiences by the participants related to the information being used in the activity and the participatory approach.

Part I. Given the geographical delimitation of the study area

1. In a scale from 1 to 5, being 1 same as low opportunity and 5 same as high opportunity, do you consider that there are opportunities to develop housing projects for middle income groups?

2. In a scale from 1 to 5, being 1 same as barely developed and 5 same as highly developed, how much do you consider that the study area is developed in terms of constructed area?

Part 2. Given the geographical delimitation of the study area

3. In a scale from 1 to 5, being 1 same as low opportunity and 5 same as high opportunity, do you consider that there are opportunities to develop housing projects for middle income groups?

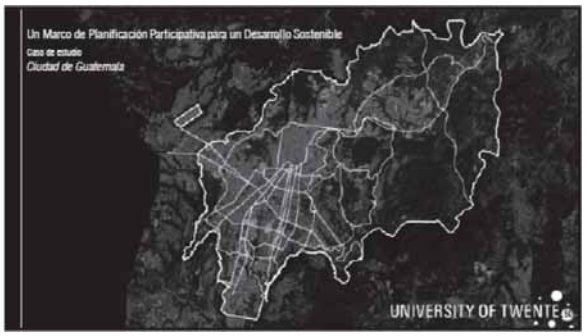
4. In a scale from 1 to 5, being 1 same as barely developed and 5 same as highly developed, how much do you consider that the study area is developed in terms of constructed area?

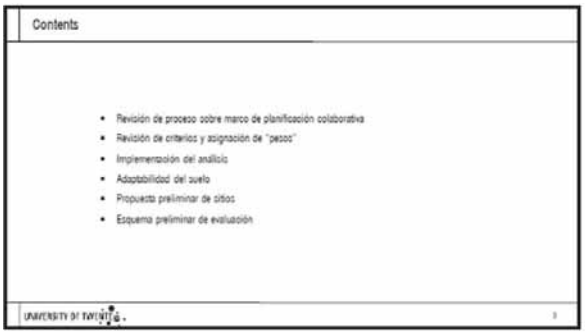
Part 3. Regarding the use of geographical information, 3D visualisation and the participatory experience

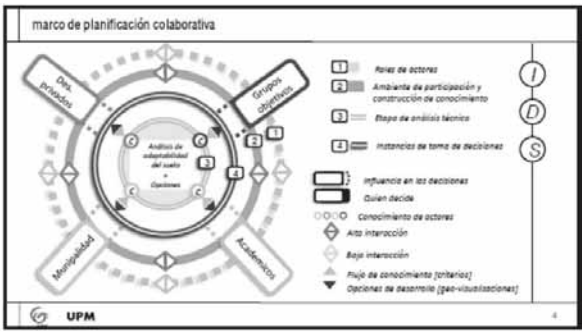
5. In a scale of 1 (low improvement) to 5 (high improvement), do you consider that the use of geographical information and 3D visualisations improved your acknowledgement of the study area? Why?

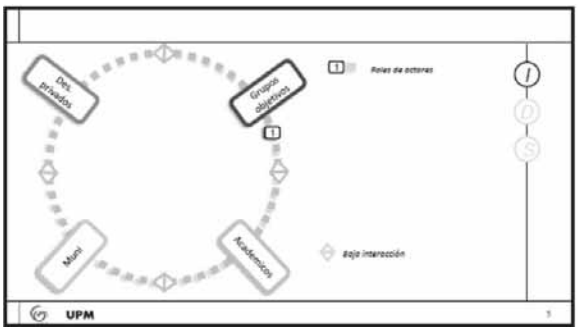
6. Do you consider that the level of realism of the 3D visualisations is appropriate given the nature of the workshop activity? Why?
7. What do you think are the strengths of this type of activities related to the participatory planning approach?
8. What do you think are the weaknesses?

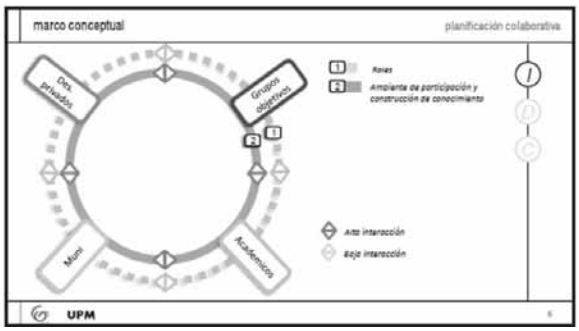
Appendix D. Sites design feedback

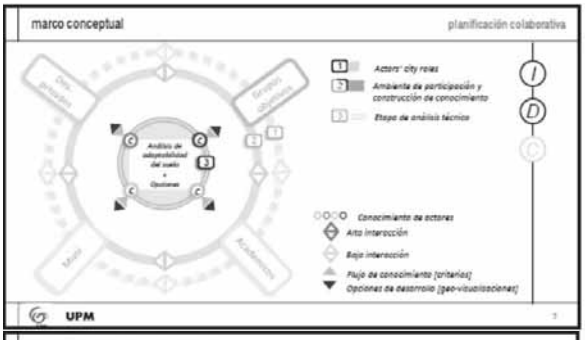


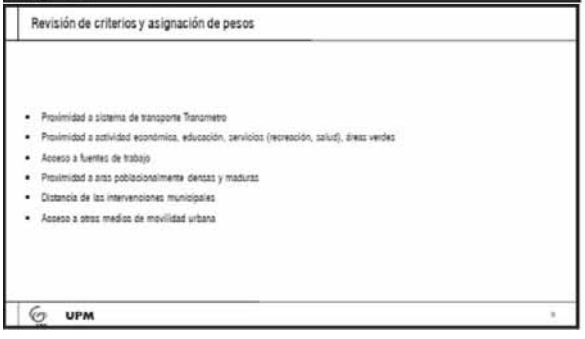


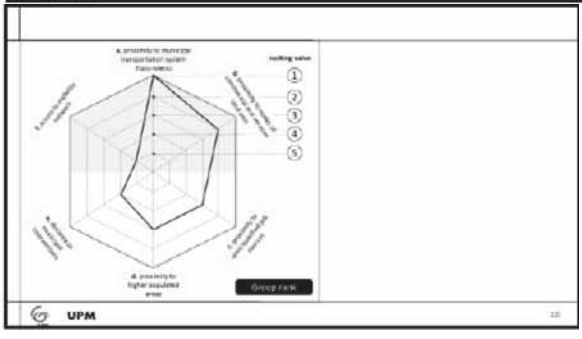












Revisión de criterios y asignación de pesos

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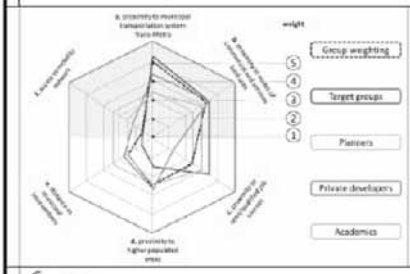
Revisión de criterios y asignación de pesos



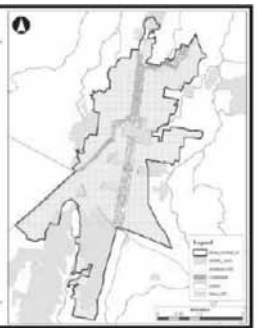
UPM

Implementación

Unidad y cobertura de de análisis

- Celda de 50mt * 50mt

- Restricción por usos especiales según POT
- Restricción por colindancia con intervención municipal

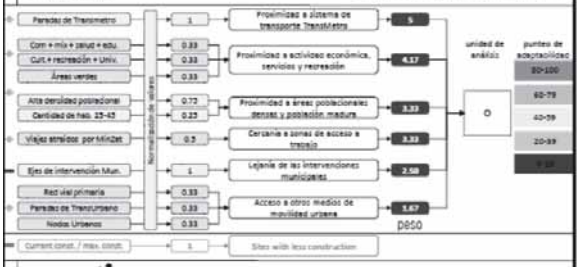


UNIVERSITY OF TWENTE.

- **¿Dudas o comentarios?**

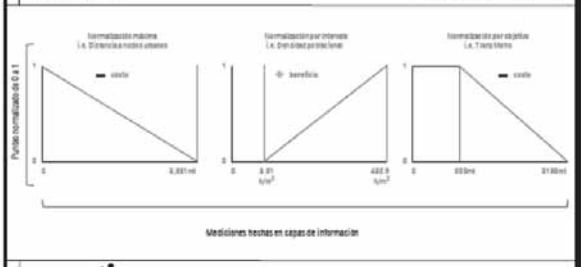
UNIVERSITY OF TWENTE.

Implementación — Variables y disponibilidad de información



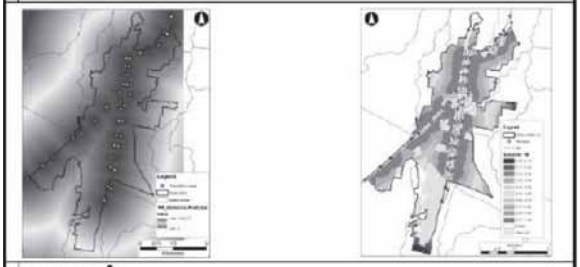
UNIVERSITY OF TWENTE.

Implementación — Métodos para la normalización



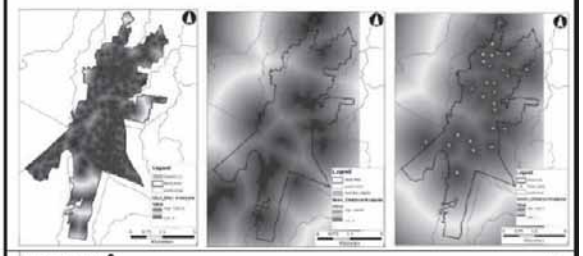
UNIVERSITY OF TWENTE.

Implementación — Proximidad Transmetro



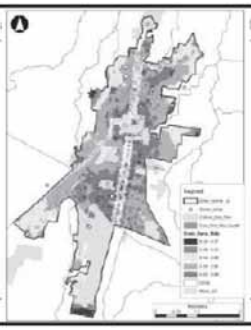
UNIVERSITY OF TWENTE.

Implementación — Acceso a actividad económica, educación, servicios (cultura, recreación), areas verdes



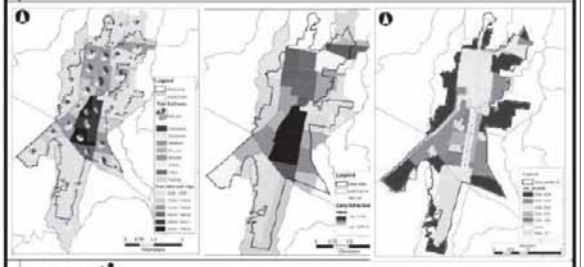
UNIVERSITY OF TWENTE.

Implementación — Acceso … tura, recreación), areas verdes



UNIVERSITY OF TWENTE.

Implementación — Acceso a fuentes de trabajo



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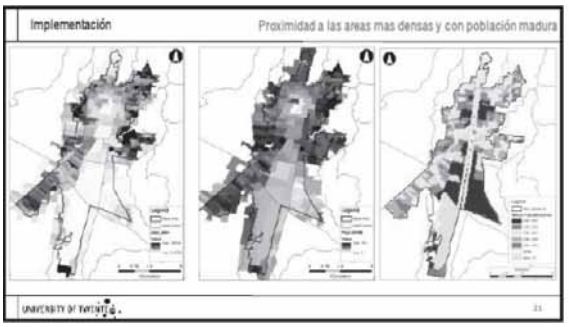
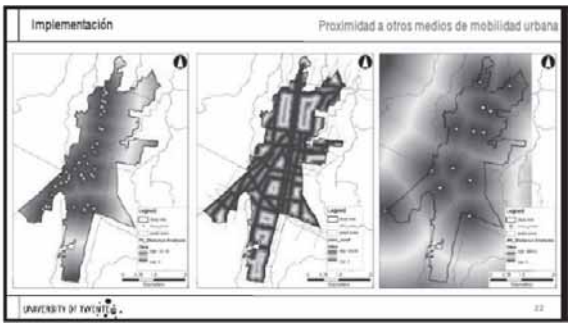
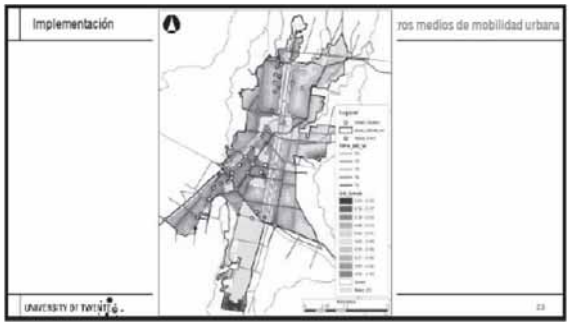
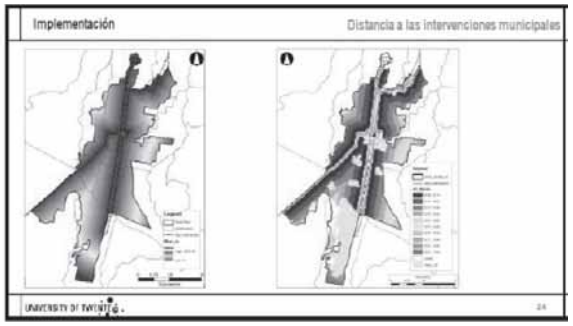
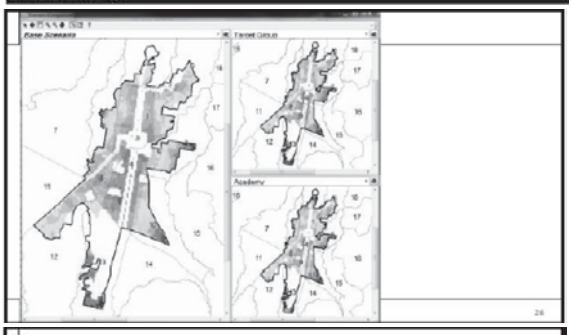

Implementación
Proximidad a las areas mas densas y con población madura

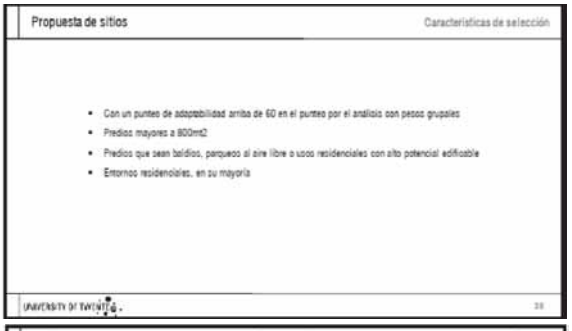

Implementación
Proximidad a otros medios de mobilidad urbana

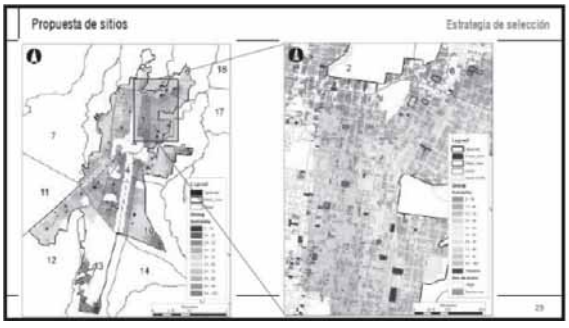

Implementación
ros medios de mobilidad urbana

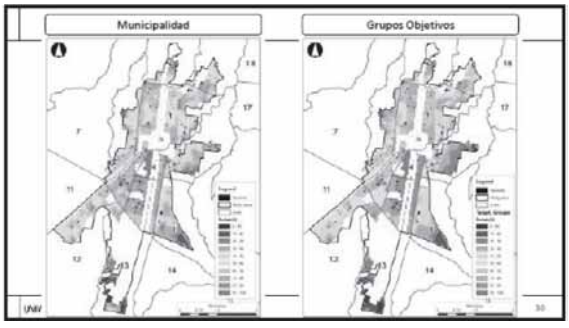

Implementación
Distancia a las intervenciones municipales

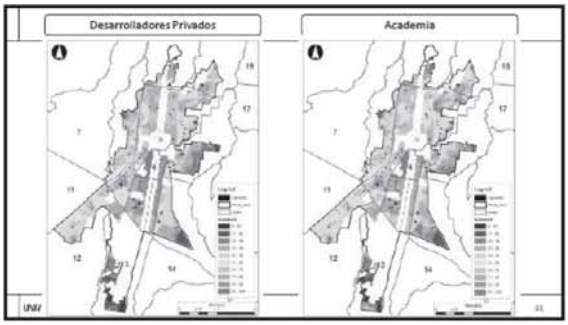


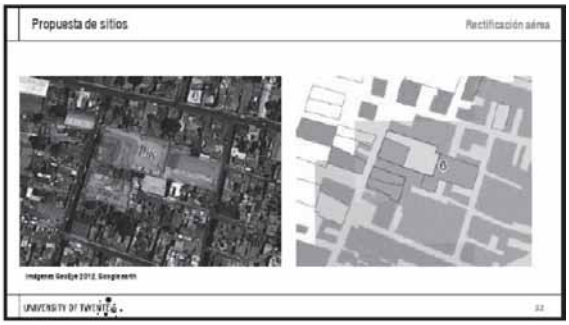

¿Dudas o comentarios?

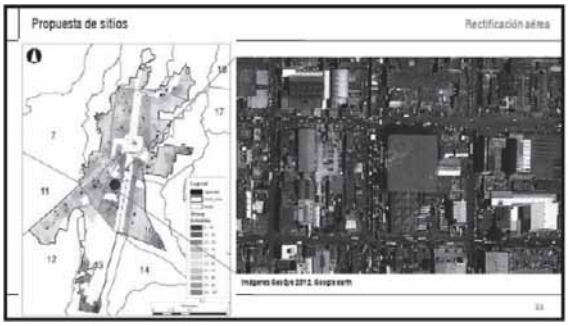

Propuesta de sitios
Características de selección
Con un punteo de adaptabilidad arriba de 60 en el punteo por el análisis con pesos grupales
Predios mayores a 800mt2
Predios que sean baldíos, parqueo al aire libre o usos residenciales con alto potencial edificable
Entornos residenciales, en su mayoría

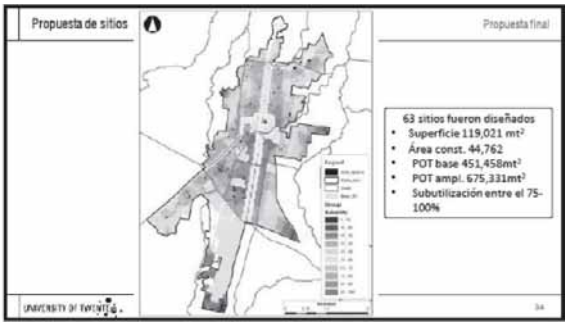

Propuesta de sitios
Estrategia de selección


Municipalidad
Grupos Objetivos

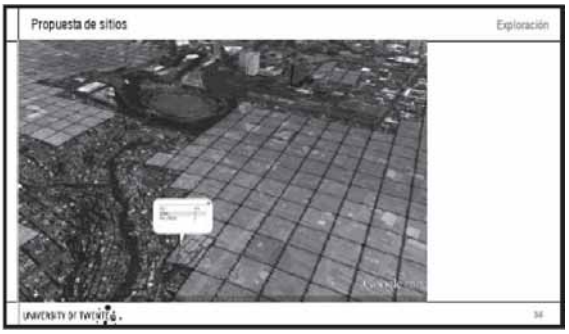

Desarrolladores Privados
Academia


Propuesta de sitios
Rectificación aérea


Propuesta de sitios
Rectificación aérea

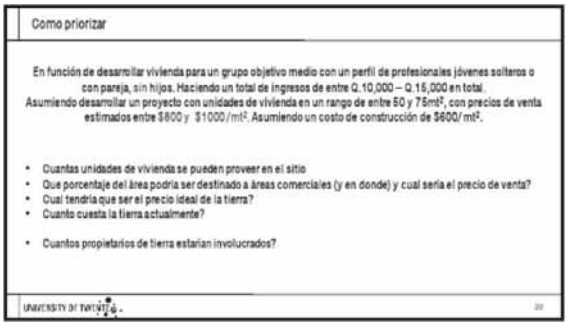

Propuesta de sitios
Propuesta final
63 sitios fueron diseñados
Superficie 119,021 mt²
Área const. 44,762
POT base 451,458mt²
POT ampl. 675,331mt²
Subutilización entre el 75-100%


Propuesta de sitios
Exploración


Propuesta de sitios
Exploración

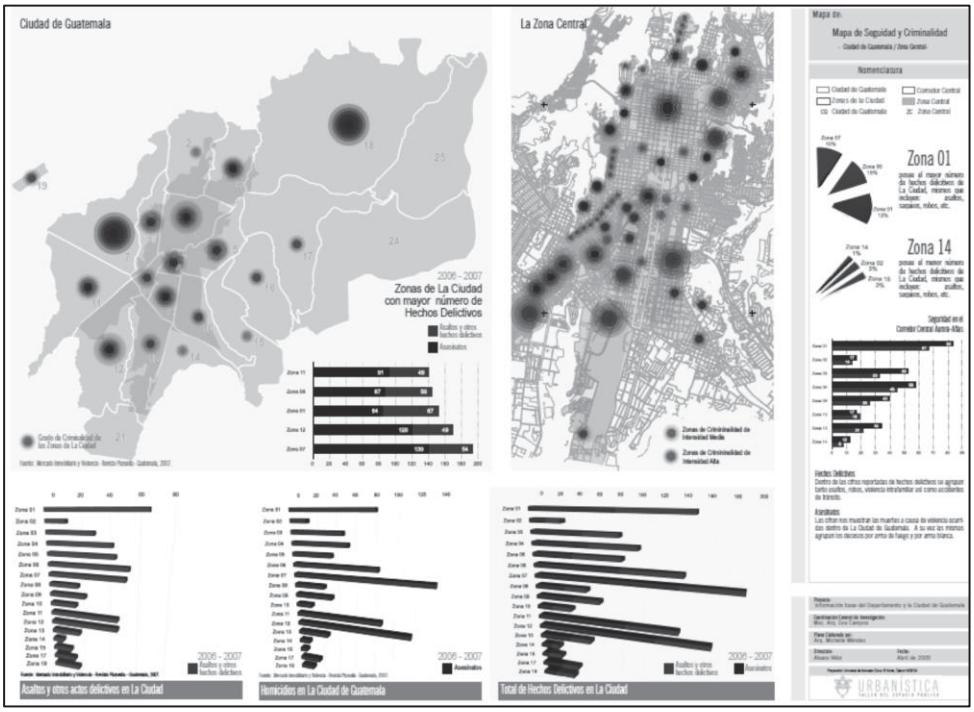

Propuesta de sitios
Información disponible
Potencial no utilizado actualmente


¿Dudas o comentarios?

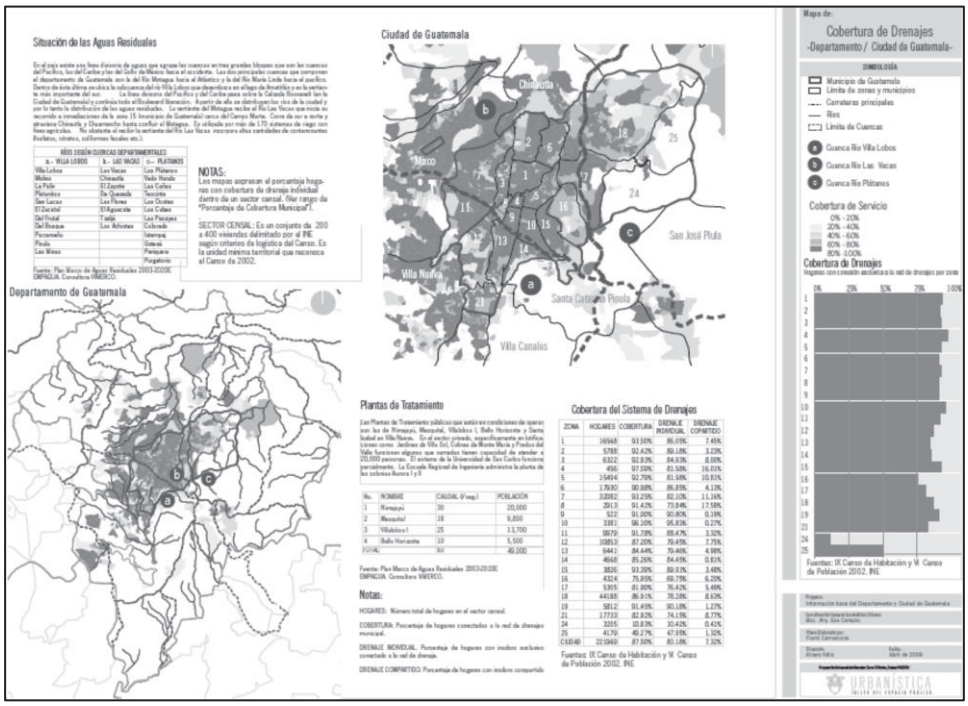

Como priorizar
En función de desarrollar vivienda para un grupo objetivo medio con un perfil de profesionales jóvenes solteros o con pareja, sin hijos. Haciendo un total de ingresos de entre Q.10,000 – Q.15,000 en total.
Asumiendo desarrollar un proyecto con unidades de vivienda en un rango de entre 50 y 75mt², con precios de venta estimados entre $800 y $1000 /mt². Asumiendo un costo de construcción de $600/ mt².
Cuantas unidades de vivienda se pueden proveer en el sitio
Que porcentaje del área podría ser destinado a áreas comerciales (y en donde) y cual sería el precio de venta?
Cual tendría que ser el precio ideal de la tierra?
Cuanto cuesta la tierra actualmente?
Cuantos propietarios de tierra estarían involucrados?


Como priorizar
Aproximación Multi Criterio
Aspectos de ubicación (punteo obtenido en los análisis de adaptabilidad)
Aspectos económicos (evaluación superficial de la viabilidad de inversión)
Aspectos de gestión (gestión asociada)

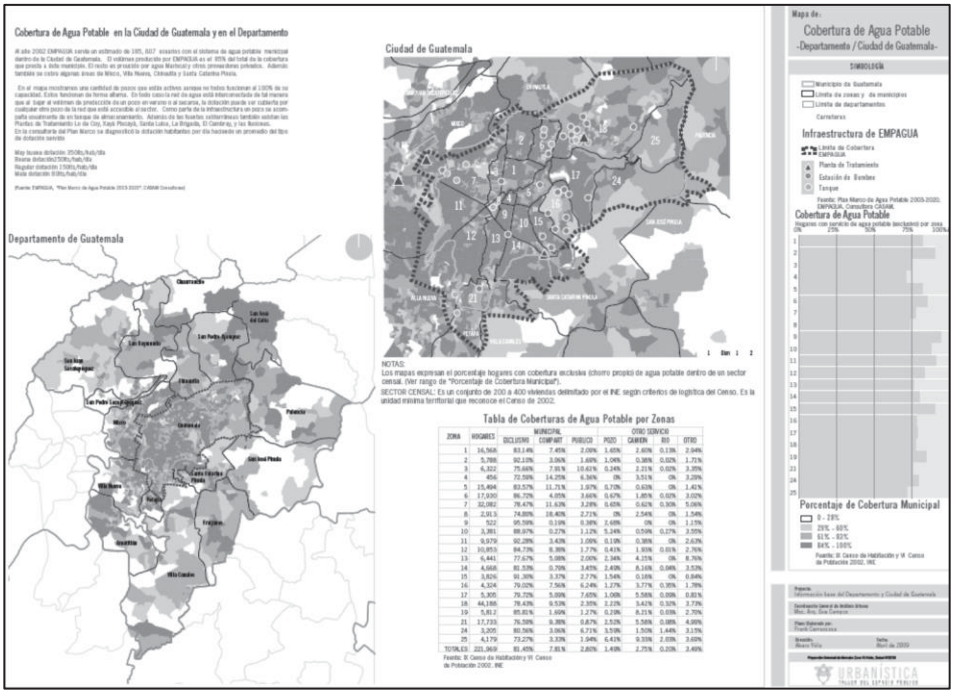
Appendix E. Maps on security and access to infrastructure services.



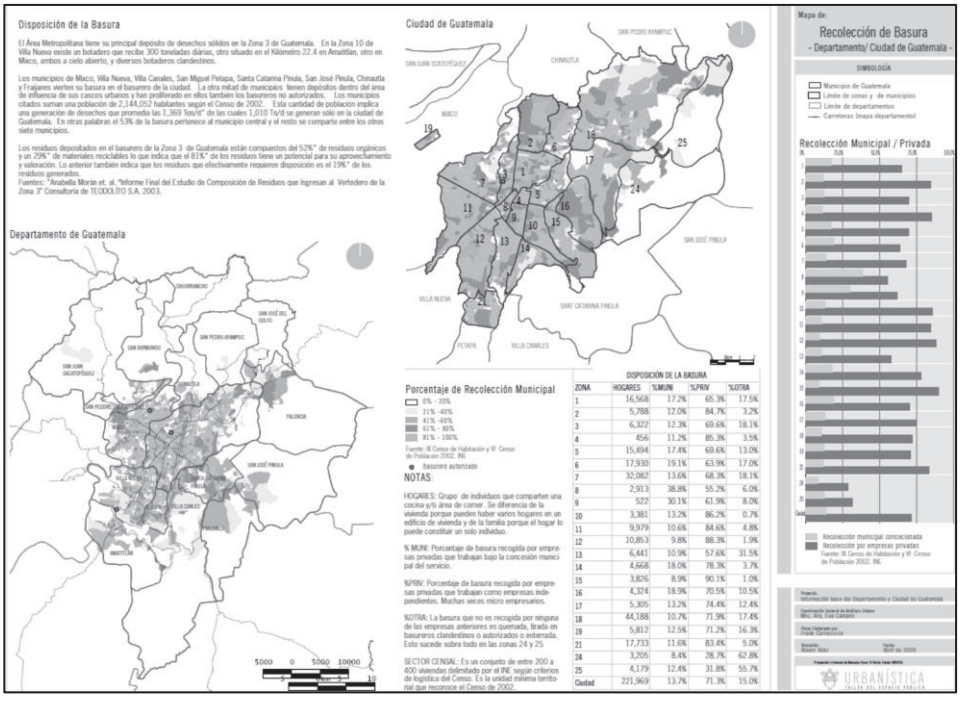
Security. Available at http://infociudad.muniguate.com/Site/atlasciudad.html



Drainage service. Available at http://infociudad.muniguate.com/Site/atlasciudad.html



Water service. Available at http://infociudad.muniguate.com/Site/atlasciudad.html



Solid waste collection. Available at http://infociudad.muniguate.com/Site/atlasciudad.html.