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Land and Housing Market: Increasing the Production of Affordable Housing in Quito

Constraints and Opportunities

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Executive Summary

The Quito metropolitan area faces an acute shortage of affordable housing. Based on the research presented in this paper, formal housing located in urban areas in affordable to households with incomes above the 80th income percentile. As a result, low and middle income households are forced to either, rent, build informally in the rural periphery of the metropolitan region or to double-up with relatives.

The major cause of Quito's lack of affordability is due to its severe topographic constraints—very steep hillsides to the west and east of the city's main core. This is exacerbated by Quito's lack adequate mass transit to facilitate large-scale suburban development in developable areas to the north, south and east. Given strong population growth and household formation, land prices are high and increasing—making affordability more challenging.

Another issue is the fact that, given limited developable land supplies, developers are inclined to build mid- and high-rise residential structure, which are more expensive to build than simple single family units. Therefore as the city continues to grow, it needs to intensify its use of developable land, revise land use regulations to lower building costs and to consider policies to boost household's ability to pay for housing. Another major intervention is for the city to vastly expand its transportation system to increase land supply outside the city core.

These topographic constraints result in medium to high density residential development the Quito valley. The constraints lead to land values that are relatively high, compared to household income. We estimate for the cadastral database that low density residential land currently sells for $120 square meter, mid-rise (1-6 stories) residential land sells for $140 square meter, and high-rise (1-12 stories) residential land sells for an estimated $280 per square meter. Although construction costs are reasonable relative to incomes (according to interviews with real estate developers), land prices are very high relative to household income. In addition, taller structures cost more to build, so another impact of Quito's limited land supply is that the increased densification of the city leads to higher housing prices, and undermines affordability. For example, low-cost single family residences in urban areas would sell for $33,400. This is six times median household income. For a low cost mid-rise unit the selling price would be $43,300 and is 7.8 times the median household income. Finally, for low–cost high-rise units, selling for $58,200, this would amount to 10.5 times the median income.

The paper relies on data form INEC, Ecuador's Census Agency and from the Metropolitan District's Cadastral office. Despite severe data limitations on income, land prices, construction costs and detailed planning regulations, it uses available data to analyze and assess housing affordability issues in the metropolitan region.

The paper offers a range of policy recommendations for consideration. While these are elaborated in the text, they include the following:

- Rental housing vouchers
- Grants for down payment assistance
- Efforts to increase mortgage terms and to lower interest rates
- Restructuring and alignment of land use planning to accommodate future growth
- Expanding transit connectivity in the northern eastern, and southern valleys

- Redevelopment of airport land into high density residential development (other under-developed sites could be redeveloped as well)
- Streamline land use and zoning regulations to foster more efficient and speedy development
- Introduction of inclusionary zoning to promote the development of affordable housing units

The paper is organized into 9 sections, outlined in the table of contents. Sections 1 to 4 provide extensive descriptive data trends on population, population density, housing and housing density in the metropolitan area. These sections provide clear substantiation of Quito's land constraints and the tendency for development in the relatively level valley to be characterized by high rise development. Sections 5 and 6 examined housing and household trends in the metropolitan area and offer an assessment of housing affordability in the metropolitan area. These sections draw on extensive interviews with developers and real estate brokers and use INEC 2010 income distribution data to gauge housing affordability. These sections also draw on cadastral data on housing and land valuation. The results of the sections illustrate Quito's housing affordability challenges.

Section 7 provides the results of a series of regression models to estimate 1) total housing values, 2) estimates of constructed area values, and 3) residential land values. Although the model results are used to inform our affordability analysis in section 6, because of the technical nature of the models, they are presented in a separate section. Generally the models are consistent with the cost and pricing data in section 7, but due to data limitations, we could not directly apply the model results to section 6 without making assumptions on building height, and plot size.

Section 8 offers a prognosis regarding Quito's future population and household growth and suggests that housing demand, driven by rural to urban migration, declining mortality rates and decreasing household size will fuel substantial demand for housing. This growth will be highly constrained by topography. Over the next 10 years it will need to add approximately 300,000 dwelling units.

Additionally, section 8 offers suggestions regarding possible policy interventions, exploring both demand and supply side solutions. On the demand side we consider reforms to housing finance systems—long term mortgages, lower interest rates, government subsidies for down payments and housing vouchers for renters. On the supply side we discuss reforming land use planning controls to permit higher density development—thorough both infill development of vacate or under-utilized parcels and increases in permitted building height. We also consider the use of inclusionary zoning were developers would be provided with density bonuses in exchange for setting aside a percentage of units for lower income households. Finally, section 9 outlines conclusions and recommendations.

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Ecuador's Land and Housing Market:

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Key Take-Aways

1. Quito's unique topography, which limits development to its north-south valley, impedes urban expansion.
2. The lack of developable land forces developers to build at high densities in the valley—making housing construction expensive.
3. The lack of developable land and limited opportunities for low cost construction makes housing expensive and unaffordable for low- and middle-income households.
4. The city and central government should consider ways to increase land supply and increase effective demand among the poor.

1. Introduction

Quito, the capital and leading business center of Ecuador faces a shortfall of decent and affordable housing. Nationally, the central government estimates that the shortage of affordable housing stands at roughly 2 million units—approximately 60 percent of the nation's total existing housing stock (World Bank, 2012). A large percentage of this shortfall is located in urban areas, particularly in Quito because of its typography and growth. Quito's expensive housing forces low and moderate income households to seek shelter in informal, unauthorized settlements that lack adequate infrastructure. Informal housing is largely self-built and housing is of varying quality – some of it lacks access to urban services. Based on our household income distribution estimates and housing costs, approximately 79 percent of households in Quito cannot afford to purchase formal housing. As a result in the metropolitan area, 43 percent of households rent. Given these conditions, this paper attempts to dimension and analyze Quito's housing market, illustrate the challenges of providing affordable to the poor, and offer a range of recommendations for increasing the supply of affordable housing in the metropolitan area.

2. Methodological approach and applicability to other developing country cities

The approach of the paper is to use both quantitative and qualitative methods to evaluate the performance of Quito's low-income housing market. The analysis is based on a combination of GIS-based econometric analysis and extensive field work. Extensive data on housing and land values, land use, infrastructure service proxies, property titles, structural characteristics of the housing stock have been tabulated at the parish and cadastral zone level. Socio-economic data on household income and characteristics have also been tabulated for parishes. In addition, we have collected spatial data on zoning regulations and the distance from each parish to Quito's historic center. The paper uses a variation of the Land Market Assessment (LMA) method, developed by the World Bank (World Bank, 1995). Annex 1 provides a short description of the LMA.

The report explores how land supply, housing demand, property titling, land use, zoning and infrastructure availability shape land and housing prices. Our intent is to identify key constraints to the production of affordable housing in the Quito metropolitan area and to then frame a series of recommendations on how the metropolitan government of Quito can increase housing supply and enhance housing affordability.

The basic approach used in this paper can be applied in other developing country cities. However, the approach will work best if there are spatially disaggregated data on land and housing conditions, construction cost, ideally city-level income distribution information, and market or cadastral data on land and housing prices linked with location, plot size, building type, infrastructure, and property rights. In the case of Quito not all the data attributes we wanted were available, but by supplementing the quantitative data with key-informant interviews, we have managed to provide a fairly comprehensive assessment of housing market performance and identify key constraints and opportunities. In the absence of land and housing price data and information on infrastructure and property titles, surveys and tabulations of available GIS information can be carried out.

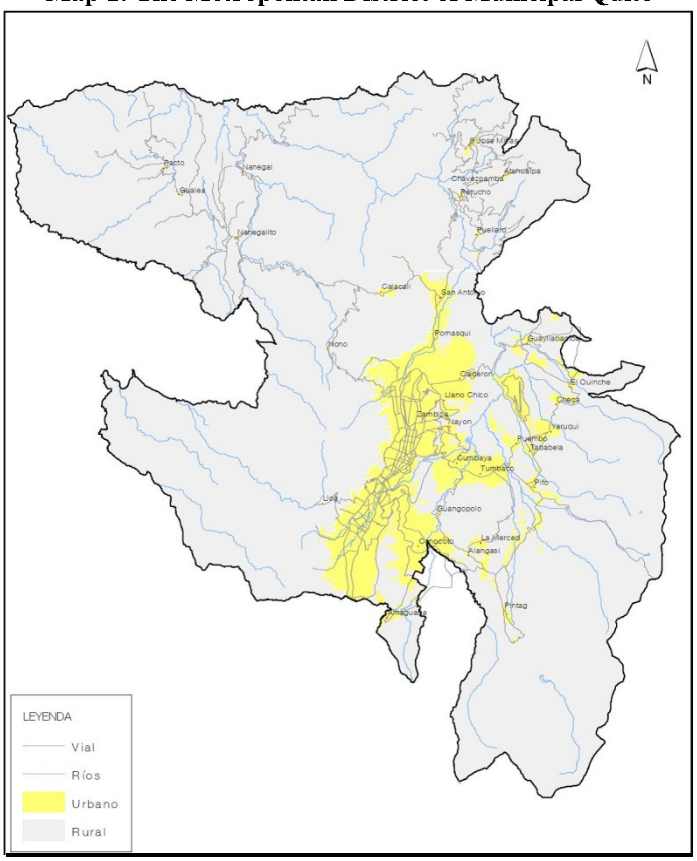
Our results in terms of methodology and policy recommendations are applicable to other cities in Latin America. Additionally, as in other Latin American cities, Quito has continued to attract migrants and receives significant overseas remittances—fueling housing demand while its planning and infrastructure programming have not kept pace with growth.

The remainder of this report is divided into 7 sections. Section 3 provides a background to the Quito metropolitan area, focusing on demographic trends. Section 4 reviews the metropolitan area's housing stock and estimates its households. Section 5 provides estimates of household incomes by decile in Quito, based on aggregate national level data and the use of various assumptions to scale these data to Quito. Section 6 presents data on housing values, structure costs, and land values in the metropolitan area. Section 7 focuses on using detailed cadastral data to model total housing values, structure values (construction costs), and finally land values. These assessments rely on multivariate regression models and offer estimates of the effects of titling, structure type, land use, and infrastructure proxies on these estimated values. Section 8 discusses Quito's future growth and estimates housing requirements to 2020. It also outlines a series of policy recommendations for accommodating future growth. Finally, section 9 outlines our main conclusions and recommendations.

3. Background on the Quito Metropolitan Area

Quito is located in the highlands at an average elevation of 2,800 meters above sea level. This metropolitan area is nestled in a very deep valley that runs north to south (Carrion and Vasconez, 2003). This has forced development to be highly linear—approximately 40-50 kilometers long and only 10 kilometers wide. These patterns are illustrated in Maps 1 and 3 (by parish level).

Map 1: The Metropolitan District of Municipal Quito



Source: MDMQ, Plan Metropolitano De Ordenamiento Territorial 2012-2022.

Metropolitan Quito, referred to as the Metropolitan District of Municipal Quito (MDMQ), had a population of 2,227,868 located in 65 parishes. The metropolitan area is located in the Province of Pinchaca. According to census agency tabulations from INEC, the total land area of the metropolitan area is 3741 square kilometers (INEC, 2014)[1]. Due to its typography, the urbanized area of the metropolitan region is only 527 square kilometers, or 16 percent of the total land area.

INEC classifies parishes as either urban or rural. Map 2 provides a map with the location and name of the 65 parishes that comprise metropolitan Quito. According to INEC, in 2010, 32 of the 65 parishes were reported as urban. In total, these areas contained 1,661,219 persons in 2010. In 2001 (the previous census) these same areas contained 1,415,976 persons. The remaining rural parishes (33) contained 569,857 persons in 2010 and 410,495 in 2001. So between the two census periods 2001 and 2010, the metropolitan increased by 404,785 persons. While both rural and urban areas increased, and the metropolitan area sprawled outwards into developable areas, most of the metropolitan area's population growth took place in urban areas—accounting for approximately 61 percent of the 10 year increase. Table 1 provides a tabulation of these urban and rural population trends. Overall, the metropolitan area grew by nearly 2.0 percent annual compound growth rate between 2001 and 2010. The rural areas had a smaller absolute increase, but their CAGR was much higher—3.3 percent.

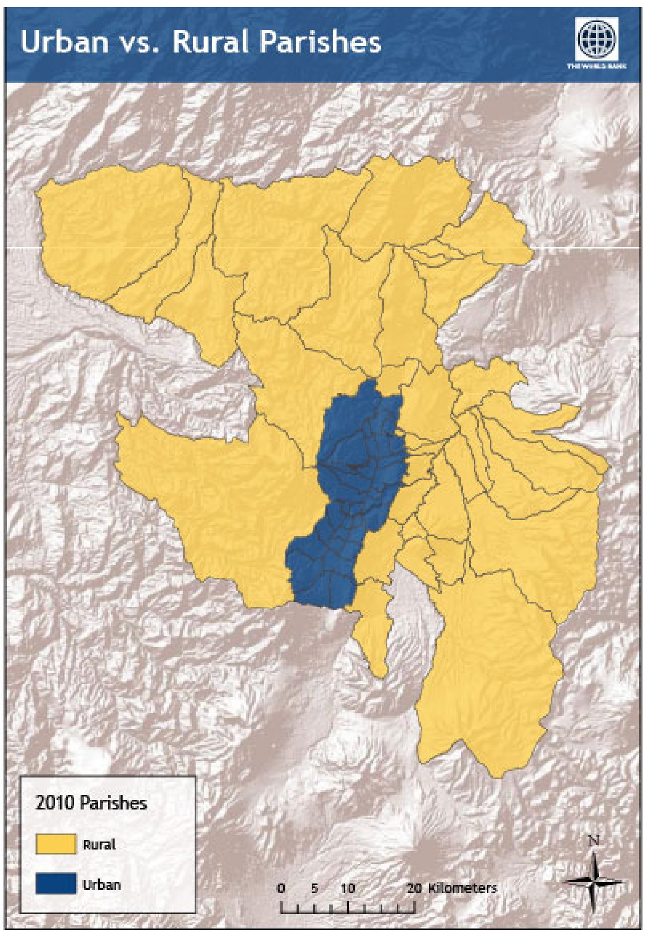
Map 2: Parishes in the Metropolitan District of Municipal Quito

Source: INEC, 2014.

[1] The MDMW itself calculates the total metropolitan area at 4,231 square kilometers. Since all of the spatial data (with the exception of cadastral values) comes from INEC, we use the 3,741 total area in our analysis.

Most of the lower elevations in the bottom of the valley have been developed, including both the city's historical and modern commercial center. The metropolitan area is clearly constrained in terms of development potential, since its steep slopes impede development in many areas, particularly to the west (World Bank, 2008). Development occurring on the steep western flank of the city requires expensive infrastructure—water reservoirs and pumping stations and road construction that calls for cut and fill grading. In very steep areas, storm drainage and flood control measures are needed. In addition, Quito's steep hillsides are environmentally sensitive and should not be subject to extensive "cut and fill" development and the expansion of impervious surface—since both will exacerbate run-off and soil erosion. Because of the topographic structure of the metropolitan region, development in bottom of the valley is fairly dense and high-rise. This reflects the limited supply of easy-to-develop building sites. Again, referring to Map 3, Quito's urbanized area is surrounded by steep slopes devoted to environmental protection and agriculture—mainly grazing. Overall population density is very low—averaging 5 persons per hectare for all parishes. This average is deceiving, since, in the intensely urbanized areas of the valley, where development predominates—densities exceed 100 persons per hectare in 8 parishes.

Map 3: Urban and Rural Parishes in the Metropolitan District of Municipal Quito in 2010



Source: INEC tabulations, 2014.

Nineteen parishes have densities in excess of 50 persons per hectare. These 19 parishes account for less than 121 square kilometers (only .02 of a percent of the total metropolitan area. Gross (total parish land area) population densities per hectare averaged 5.96 in 2010 and 4.88 in 2001. If we use census defined urban land area to calculate density (using 2010 estimates which are the only ones available), the figures are much higher—42.33 and 34.65 persons per hectare respectively.

So as the data indicate, the variation between rural and urban area densities is approximately 8 times higher in urban areas. This is not uncommon and reflects the level of urban development—particularly apartment construction which allows more households and population to live in a smaller area. These aggregate statistics reveal the relatively asymmetric spatial development patterns of the Quito metropolitan area. The main drivers of these patterns are topography, restrictions of the development of hillside areas, and access to infrastructure in hazardous areas. As we will discuss below, Quito will need to develop higher density residential housing, to accommodate forecasted population growth (Quito Distrito Metropolitano, 2012). Maps 4, 5, and 6 present parish level population densities for 2001 and 2010, as well as percent change in population densities by parish between 2001 and 2010, respectively.

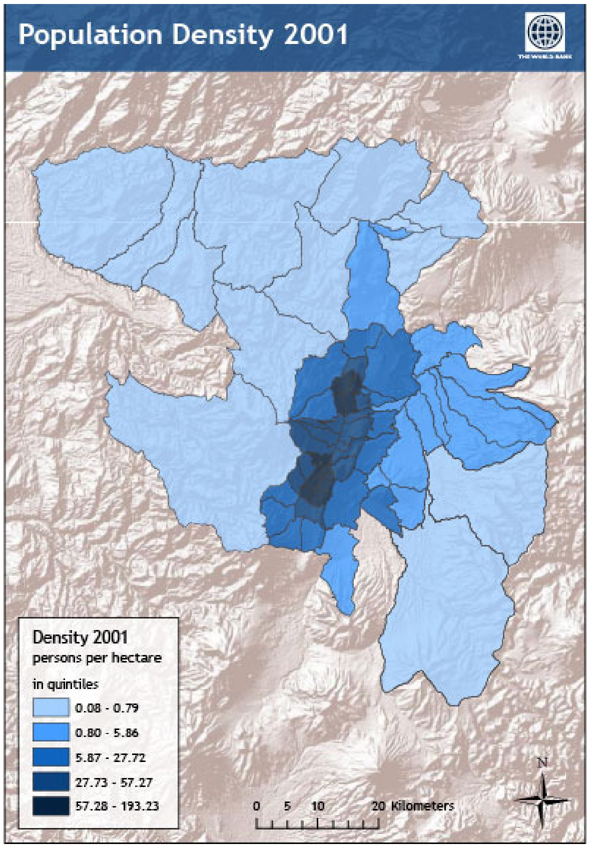
Table 1: Population trends in Metropolitan Quito, 2001 and 2010

Category	2010	2001	Absolute change	Share of change (%)	CAGR (%)
Urban	1,661,219	1,415,796	245,423	60.6	1.6
Rural	569,857	410,495	159,362	39.4	3.3
Total	2,231,076	1,826,291	404,785	100.0	2.0
Source: INEC 2001 and 2010 Population and Housing Census.					

Another way of looking at this is to rank of the parishes from largest to smallest in terms of population size and calculate how many parishes would need to be combined to reach just over 50 percent of the population. In the case of the Quito metropolitan area, the 16 largest parishes (in terms of population) would be required to reach 51.6 percent of the total metropolitan area. However, these 16 parishes would account for only 545 square kilometers—12.9 percent of the total metropolitan land area. In terms of population density, these 16 parishes have a combined gross density of 21 persons per hectare. The remaining population of 1,078,382 is spread over 3,685 square kilometers, at an average of 2.92 persons per gross hectare (total land area of each parish). This very low density reflects the topographic constraints Quito faces—most of the rural land either undevelopable or would be very expensive to develop.

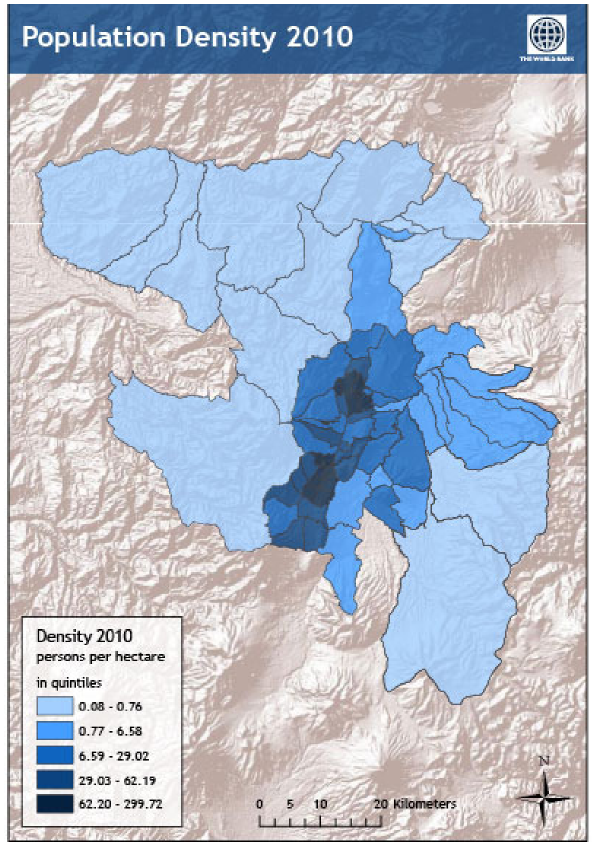
To summarize, with limited developable land, the metropolitan area faces significant challenges accommodating future urbanization. INEC, the national census institute, classifies parishes as being urban or rural. Of the metropolitan area's population of 2,239,191 in 2010, 72 percent resided in urban areas—that is parishes classified as urban (see Map 3). The remainder, 28 percent lived in rural areas around the city in low density areas. As discussed above, this again indicates severe constraints of developable land within the metropolitan area.

Map 4: Population Density by Parish, 2001



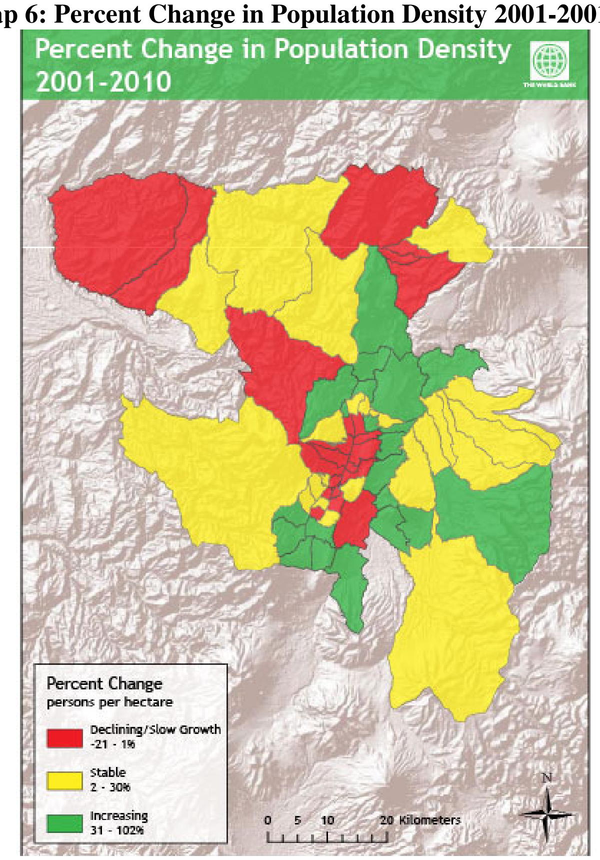
Source: INEC tabulations, 2014

Map 5: Population Density by Parish, 2010



Source: INEC Tabulations, 2014.

Map 6: Percent Change in Population Density 2001-20010



Source: INEC tabulations, 2014

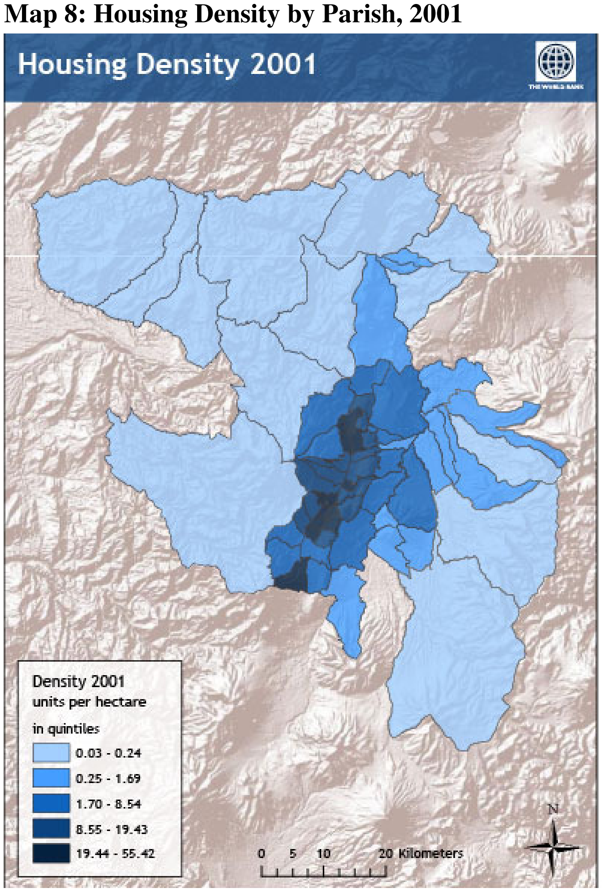
4. Housing stock in metropolitan Quito

INEC provides tabulations of the number of housing units by parish for 2001 and 2010. Maps 7, 8, and 9 present housing unit density for 2001, 2010 and the percent changes in housing unit density from 2001 to 2010. Map 9 is interesting since it illustrates that housing density is increasing to the north, east and south. The core is declining or stable in terms of housing density. In 2010, Metropolitan Quito had a total of 840,612 units in 2010, up from 662,626 units in 2001. Housing stock increases were proportionately higher in urban areas (54 percent than in rural areas (46 percent). Table 2 presents tabulations of changes in the MDMQ for 2001 and 2010. Similar to Table 1, it illustrates the concentration of housing in urban areas. These are areas that are typography suitable for development and have access to services.

Table 2: Housing Stock Trends in Metropolitan Quito, 2001 to 2010

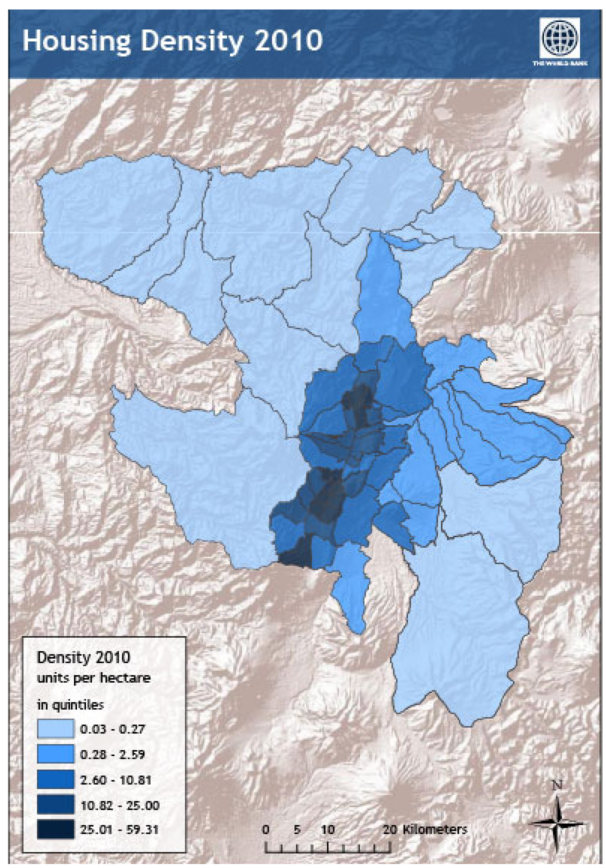
Category	2010	2001	Absolute change	Share of change (%)	CAGR (%)
Urban	626,697	529,904	96,793	54.4	1.7
Rural	213,915	132,742	81,173	46.4	4.9
Total	840,612	662,646	177,966	100.0	2.0
Source: INEC 2001 and 2010 Population and Housing Census.					

Map 8: Housing Density by Parish, 2001



Source: INEC tabulations, 2014.

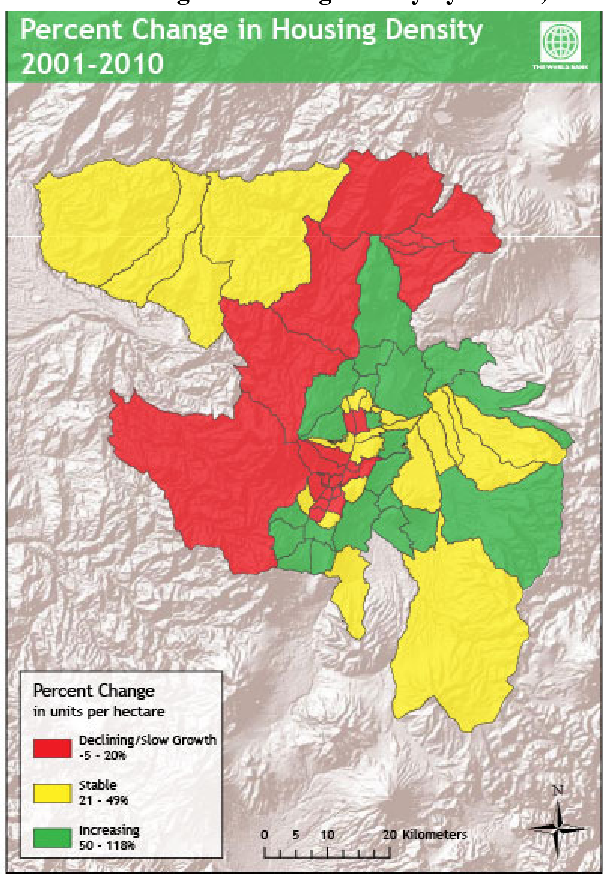
Map 7: Housing Density by Parish, 2010



Source: INEC tabulations, 2014.

Despite the severe supply constraints on developable land, INEC data on households indicates that many housing units are unoccupied. Of the total of 840,612 units counted by INEC in 2010, only 629,314 households were enumerated. This is a difference of 211,298, suggesting a large number of vacant units. Many of the vacant units are in rural areas—nearly 18,000 units. Relative to the total rural housing stock this is a vacancy rate of 8.5 percent, high by international standards. The reasons for such high vacancies could vary. In some cases, the dwelling units could be second homes. Another reason could be that the units are vacant and on the market for sale or rent. This would suggest and oversupply of housing stock. But the most likely reason is that many Ecuadorians work outside of the country for periods of time and their units remain vacant. A more normal vacancy rate would be 5 percent, suggesting about 10,000 vacant units. Table 3 provides a tabulation of households by urban are rural areas for 2001 and 2010.

Map 9: Percent Change in Housing Density by Parish, 2001-2010



Source: INEC tabulations, 2014.

Table 3: Household Trends in Metropolitan Quito, 2001 to 2010

Category	2010	2001	Absolute change	Share of change (%)	CAGR (%)
Urban	459,856	370,804	89,052	58.5	2.2
Rural	169.458	106,379	63,079	41.5	4.8
Total	629,314	477,183	152,131	100.0	2.8

Source: INEC 2001 and 2010 Population and Housing Census.

It is important to point out that household formation, although lower in absolute terms than the housing stock for 2001 and 2010, is increasing faster than dwelling unit production. The overall CAGR for dwellings between 2001 and 2010 was 2.0 percent and for household formation it was 2.8 percent. This is largely due to declining household size in Quito's urban and rural areas. In 2001, the overall average household size was 3.83 persons, but by 2010 it had fallen to 3.55 persons. As average household size declines, more households are formed for a given population. This is common in most developing and developed countries. It means that Metropolitan Quito will need to build more residential units for each 10,000 increase in population. Table 4 provides data on trends in household sizes for urban and rural areas of the metropolitan area.

Table 4: Average Household Size Trends in Metropolitan Quito, 2001 to 2010

Category	2010	2001	Absolute change
Urban	3.61	3.82	-0.21
Rural	3.36	3.86	-0.50
Total	3.55	3.83	-0.28
Source: INEC 2001 and 2010 Population and Housing Census.			

5. Household incomes and affordability in metropolitan Quito

Unfortunately, INEC does not ask questions in its household census regarding income that are disaggregated at the parish level. Similarly, they do not ask about household or per capita income in metropolitan Quito. However, in 2010 a nationwide questionnaire was administered and we have relatively good national level (undifferentiated by urban or rural area) data. These income are presented in Table 5 for both per capita levels and household levels, assuming that there are two wage earners per household. The income levels are presented in deciles (10^{th}), from the lowest to the highest. In addition, based on the most recent LSMS survey conducted by the World Bank, we assume that household incomes in Quito are double the national average (world Bank, 1998).

Table 5: National, Urban, and Metropolitan Quito annual per capita and household incomes by deciles, 2010

Decile	National per capital annual income*	National Annual household income**	Quito annual Household Income***
1	322	644	1288
2	620	1240	2480
3	880	1760	3520
4	1127	2254	4508
5	1392	2784	5568
6	1718	3436	6872
7	2140	4280	8560
8	2800	5600	11200
9	3968	7936	15872
10	9110	18220	36440

Source: Encuesta Empleo y Disempleo, 2010 INEC.

* Based on tabulation by INEC, 2010.

** Household income assumes that there are two workers per household, so the per capita income are doubled.

*** Quito's household income is assumed to be double the national rate, based on the results of the Ecuador 1998 LSMS which indicates that urban poverty is 50 percent lower in urban areas than in rural areas.

Based on Quito's household income patterns, how affordable is housing? We next provide an assessment of housing affordability in Quito. Assuming an interest rate of 10 percent for a 15 year, 180 month mortgage term, with 10 percent down; we can calculate the maximum price households can afford to pay for housing. In Table 6 we calculate maximum purchase prices assuming that Quito households devote no more than 33 percent of the monthly income to principal and interest.

The maximum house purchase prices do not include property taxes or hazard insurance. While we lack accurate data on taxes and insurance premiums, purchase prices net of these charges are likely to be 2-5 percent lower than stated in the table. Since we do not have detailed household income data for the metropolitan area of Quito, the following affordability analysis should be viewed as indicative and not definitive. With these estimates we can now assess the ability of low and moderate income households to purchase formal units in the metropolitan area of Quito.

Table 6: Maximum house purchase price, assuming 10 percent down payment, 15 year mortgage at 10 percent, a monthly payment of no more than 33 percent of total household income in USD

Decile	Annual Household income*	Maximum mortgage	Down payment (10%)	Maximum purchase price
1	$1,288	$3,296	$366	$3,662
2	$2,480	$6,347	$705	$7,052
3	$3,520	$9,008	$1,001	$10,009
4	$4,508	$11,536	$1,282	$12,818
5	$5,568	$14,249	$1,583	$15,832
6	$6,872	$17,586	$1,954	$19,540
7	$8,560	$21,905	$2,434	$24,339
8	$11,200	$28,662	$3,185	$31,847
9	$15,872	$40,618	$4,513	$45,131
10	$36,440	$93,223	$10,358	$103,581

* Based on estimated annual household income in Quito presented in Table 5.

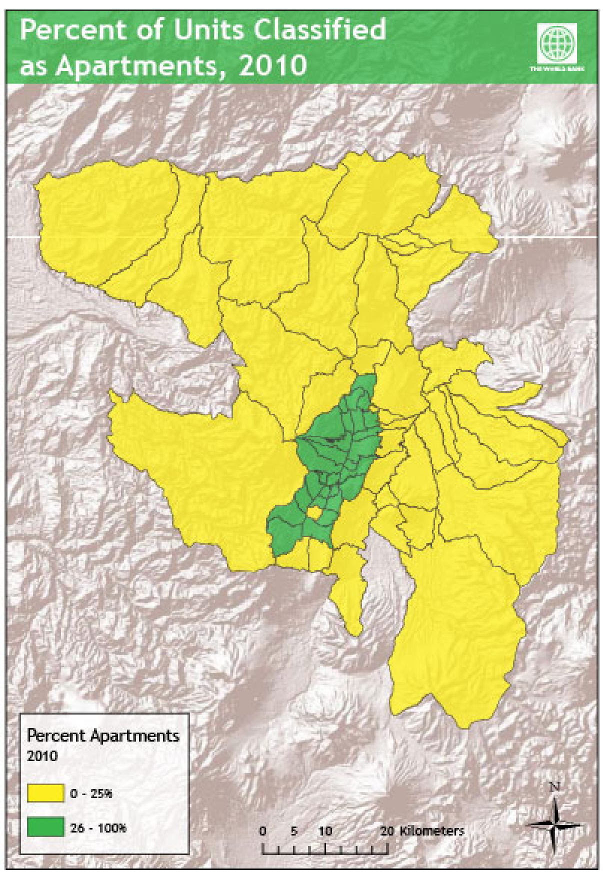
To illustrate the size of the affordability gap, the next section reviews housing prices for apartments and casas in urban and rural areas of the metropolitan region. Price information were obtained from the Municipality of Quito's Cadastral Office for 2012.

6. Housing prices in the Quito Metropolitan area

In this section we draw on the extensive data provided by the Cadastral Office of metropolitan Quito (Municipio del Distrito Metropolitano de Quito, 2012). We obtained over 30,000 records containing data on location, plot size, services, local land use (categories), building materials and type of structure. The organization of these data was extremely complicated and documentation of data and data structures was limited. Given the very large size of the data provided by the Cadastral office, we decided to extract a 20 percent sample—nearly 6,000 cases. The sample was stratified by parish, and structured so that we had nearly 100 cases within each of the 63 parishes (in some rural areas the Cadastral office had less than 100 cases due to very limited development and the lack of official surveys).

In the case of multi-unit structures, where the cadastral office had multiple records for each unit we developed a series of algorithms to estimate average per square meter prices for units in each building. We attempted, but were not able to calculate plot areas for multi-story building due to missing data. Based on data reduction and aggregation analysis we were able to develop 15 variables from the cadastral office records. These are presented below in Table 11. We use these variables to assess housing affordability and to conduct regression analyses for total dwelling unit structure, the costs of structure (net of land) and estimates of land values. Unfortunately we were not able to estimate land values by the number of stories and had to resort to using a dummy variable to designate whether the structure was multi-story.

Map 10: Percent of Units classified as Apartments, 2010



Source: INEC tabulations, 2014.

As an initial overview, we have constructed cross tabulations of total appraised value for housing units that are located in urban or rural areas. As indicated above in Table 2, Metropolitan Quito contains 840,612 units. Of this amount, 74.6 percent are classified as apartments—626,697 (see Map 10 for the percentage of apartments in 2010). Of these, 79.9 percent are located in urban areas. Single family units (casas) account for 213,915 units or 25.4 percent of the total stock. Approximately 35 percent are in urban areas. Based on cadastral records from 2012, dwelling units in the metropolitan area average 296 square meters. Of the total housing stock, 66 percent are in urban areas. Table 7 provides tabulations of the average size of casas and apartments by urban and rural areas.

Table 7: Average Size of Houses and Apartments in Urban and Rural Areas (square meters), 2012

	Urban	Rural	Total
Houses	359	172	295
Apartments	402	301	382
Source: Tabulations from Quito Cadastral Office, 2014.			

The averages presented in Table 7 are very large and are most likely skewed by the existence of very large apartments and casas. For the purposes of calculating affordable housing, we rely on interviews we held with low income housing developers in Quito. Our interviews with low income developers indicated that low to moderate income units typically range from 40-50 square meters in size. Most real estate professionals familiar with the low income sector indicated that no-frills basic construction costs average between $300 and $600 per square meter, depending on the type of structure. These prices do not include interior finishes—basically a concrete shell for new construction. Units are usually 2 to 6 stories with no elevator or common areas. In the case of high-rise residential buildings, units average 12 floors and include elevators and parking. The most significant problem is the lack of affordable land for housing. This is to be expected since there are significant limitations to developable land.

We rely on cadastral data to estimate land values for single family, mid-rise and high rise plots. Table 8 provides tabulations for single story and multi-story units in urban and rural areas. Overall urban land prices in Quito average nearly $100 per square meter. In rural areas the price is about $30 per square meter—less than one third. In areas zoned for multistory development land prices are higher, by about 20 percent on average. However, the actual incremental increase will depend on the permitted number of housing units allowed per hectare and the selling price of the units. The higher the density, the higher is the land price, other things being equal.

In the affordability analysis below, we increase these estimates by 25 percent to incorporate infrastructure, site works and excavation. We will also concentrate only on urban land values from Table 8 so for single story/family units, land values are estimated at $120 per square meter. Unfortunately, as mentioned above, we do not have detailed land values for various high rise structures by the number of floors. In the example we outline below, we use $140 per square meter for mid-rise structures (assumed to be 6 stories with 24 units). We use the $112 figure from Table 8 below, increased by 25 percent for infrastructure and site works. For high rise structures, which we assume to be 12 stories and contain twice as many units, we double the mid-rise land value estimate to $280. Although this is based on crude assumptions, the increase follows the logic of land residual analysis commonly used in real estate analysis.

Table 8: Average Land Values per Square Meter for Residential Development in Urban, Rural and Single Story and Multistory Zones, Quito in $USD

	Urban	Rural	Average
Single story	$94	$29	$64
Multi-story	$112	$36	$100
Average	$99	$30	$78
Source: Tabulations from Quito Cadastral Office, 2014.			

Photos 1, 2 and 3 below show the construction of low cost concrete units in Cuenca. In Quito, given higher land costs, development will need to be high-rise concrete construction. The higher construction costs associated with high-rise would need to offset land cost savings.

Photos 1, 2 and 3

Low cost formal housing construction using poured in place concrete

How affordable are houses in Quito? If we make a number of assumptions, we can design hypothetical cases of various types and sizes of housing units. To make the analysis straightforward we will limit our analysis to three types of units: 1) a small single story unit in a urban area of the metropolitan area (most likely in the south); 2) a medium rise apartment in urban Quito in a 6 story structure, and 3) a high rise apartment in urban Quito in a 12 story structure. Below we describe the characteristics of each example.

Small single story structure in an urban area of Quito: The unit is 45 square meters and is situated on a 100 square meter plot. Land costs are $120 per square meter for a total of $12,000. The structure costs $360 per square meters to build for a total of $16,200. The total cost of the unit with land is $28,200. In addition, the developer would require an additional 20 percent for overhead and profit--$5,640. Therefore the total price of the unit would be $33,840. The unit would be very small for a three person household. It would also need additional investments in finishes, floors, lighting, kitchen fittings, etc. This would add an additional $2000 to $5000, but it could be done over time.

Medium rise apartment in an urban area of Quito: The unit is 50 square meters and is situated in a six story building with four apartments per floor. The building has 24 units. The footprint of the building is 300 square meters and the plot is 400 square meters. Construction costs for the apartments are $450 per square meter or $33,750 per unit including common areas such as entries and hallways. The land cost is $56,000 for the site, including infrastructure and excavation (an average of $140 per square meter), so the average land cost per unit is approximately $2,333. In this example the apartment would cost $36,083, plus 20 percent for overhead and profit, so the total price for the unit would be $43,300. The buyer would need to pay for finishes and fittings, which could be done over time.

Hi-Rise apartment in an urban area of Quito: The unit would be 50 square meters and situated in a 12 story hi-rise. The building would contain approximately 48 units and have a footprint of 300 square meters (3,600 square meters of total constructed area). The plot would be 600 square meters-$168,000 total land cost at $3,500 per unit, including infrastructure and excavation. For each unit the construction costs would be $600 per square meter--$45,000 (including common areas), plus $3,500 for the land per unit. Add to this 20 percent developer overhead and profit, and the total unit price would average $58,200.

Table 9: Affordability of 3 Prototypical Housing Units (in USD)

	Casa 45 square meters	Mid-rise apartment 50 square meters	Hi-rise apartments 50 square meters
Price (cost plus developer profit and overhead)	\$33,840	\$43,300	\$58,200
Downpayment (10%)	\$3,384	\$4,330	\$5,820
Annual Mortgage (180 months at 10% interest)	\$3,927	\$5,025	\$11,142
Annual household income to qualify at 33 percent mortgage to income ratio	\$11,782	\$15,076	\$33,764
Income decile to qualify	Within the 8^{th} decile	Within the 9^{th} decile	Within the 10^{th} decile

As Table 9 illustrates, single family, mid-rise and high-rise units are affordable to households within the 8^{th}, 9^{th}, 10^{th} household income deciles estimated for Quito. Overall, households below the 80^{th} income percentile, face affordability challenges. Although the situation looks dire, many Ecuadorans work overseas and repatriate funds to build housing. In addition, lower income households settle in lower cost rural area and incrementally build houses. Lower income households also rent rooms or small units. This suggests that the Quito metropolitan area should make efficient public transit a key investment priority to improve access to lower cost areas to the north, east and south flanks of the city. In addition, policies to reform land use regulations—to permit more dense development and smaller units would help alleviate low income housing affordability challenges (Trujillo, 2013).

Lower interest rates for mortgages and longer mortgage terms would also help improve affordability and will be discussed below.

To make this point clear, Table 10 presents tabulations of maximum house purchase prices for each decile listed above. It is based on the same assumptions as used above—10 percent down payment, 10 percent mortgage interest rate and mortgage term of 180 months (15 years) and a 33 mortgage payment to income ratio.

Table 10: Maximum Affordable Housing Price by Income Decile (in USD)

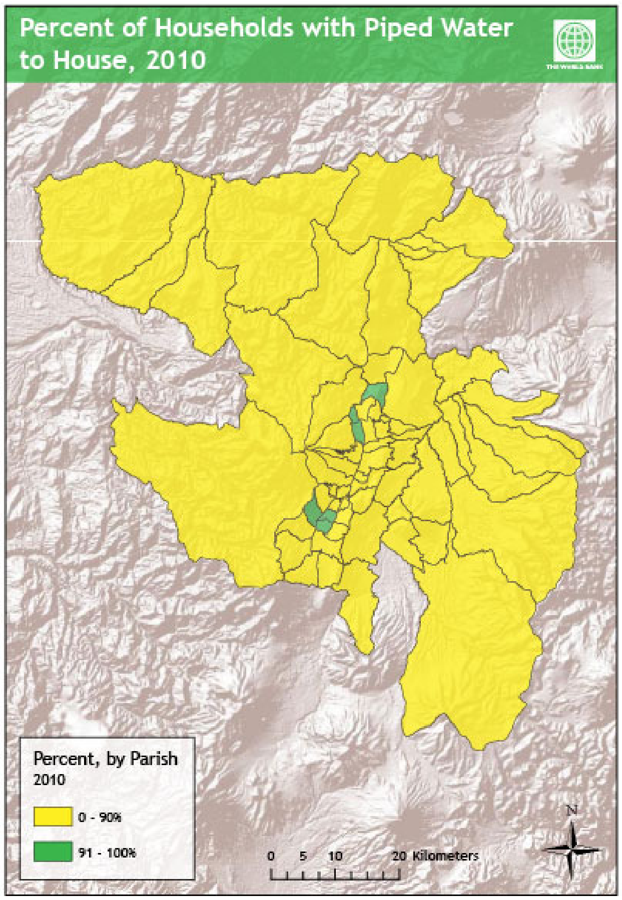
Decile	Annual household income	Maximum monthly mortgage payment	Maximum Mortgage	Down payment	Maximum purchase price
1	$1288	$35.42	$3,296	$366	$3,662
2	$2480	$68.20	$6,346	$706	$7,052
3	$3520	$96.80	$9,008	$1,001	$10,009
4	$4508	$123.97	$11,536	$1,282	$12,818
5	$5568	$153.12	$14,249	$1,583	$15,832
6	$6,872	$188.98	$17,586	$1,954	$19,540
7	$8,560	$235.40	$21,906	$2,434	$24,340
8	$11,200	308.00	$28,662	$3,185	$31,846
9	$15,872	$436.48	$40,618	$4,513	$45,131
10	$36,440	$1,002.10	$93,253	$10,361	$103,614

Comparing Tables 9 and 10 reveals the complete disconnect between the formal housing market and the ability of low income households to purchase units. For the bottom 7 income deciles, purchasing a formal unit is not feasible. This leaves them with two options: 1) rent a room or very small apartment with shared bathrooms and kitchens, or to squat on public lands and build housing incrementally. Renting avoids the accumulation of down payments, but it may require security deposits or payment of first and last month rent. Living with relatives may also ease this burden. Overall 31 percent of Quito's households rent, with 43 percent renting in urban areas and 20 percent in rural areas. Building incrementally requires living without public services and living in structures which may not afford protection from the weather. In urban areas most units have cement roofs while in rural areas only 56 percent do (INEC 2010 Census). Urban housing has access to better services—87 percent have piped water to the house and 97 percent have sewerage connections. In rural areas the respective percentages are 63 piped water and 58 sewer connections. Map 11 shows parishes by percent of in house water connection in 2010.

So in many ways low income households have two coping strategies, they can rent or opt for informal housing in rural areas. Rural casas are 50 percent the cost of urban units per square meter.

Given high land and construction costs in Quito (relative to incomes), the government may wish to consider a range of housing subsidy schemes to make housing more affordable to households in the 4th to the 7th income percentile. Subsidies could include a range of policies—, on the demand side, they could increase the terms on mortgages from 15 to 30 years, reducing interest rates, grants to help fund down payments, and reductions in interest rates. The government should also consider the use of housing vouchers for rental housing. On the supply side, the government should consider reducing building standards, increasing densities, and lowering minimum unit sizes by 10-20 percent (Trujillo, 2013).

Map 11: Percent of Households with Piped Water to House, 2010



Source: INEC tabulations, 2014.

7. Determinants of residential property values in Quito—structural and policy factors

As mentioned previously, we used the cadastral data set from which we took a 20 percent sample, stratified by parish. We assembled a database of approximately 6000 observations for 2012 on housing characteristics, and appraised land, structure and total values. In this section we present a multivariate analysis of these data, illustrating the impacts of various determinants of real estate value (see Quigley and Rosenthal, 2005). Data were collected from multiple sources. We collected 2001 and 2010 data form INEC, the Ecuadorian Census agency, much of these data have been utilized to assess population, households, housing stock and the condition of the housing and access to urban services in previous tables and figures.

Table 11: Cadastral Variables Constructed for Statistical Analysis

Variable Name and characteristic	Mean value
Piso (the floor where the unit is located)	.6889
Unidad (number of units in building)	1.099
Multsty1 (dummy variable where 1= unit is located in a multistory building)	.3870
Sdf1 (dummy variable where 1= unit is a single family detached unit)	.9751
Parroquia the name of the parish were the unit is located	Na
Urban1 (dummy variable where 1= that the unit is located in area of the metropolitan region that is classified as urban (zoning proxy)	.6586
Title1 (dummy variable where 1=unit has property title)	.8271
Res1 (dummy variable where 1= that the unit is located in a predominately residential neighborhood)	.7598
Disthistoric is the distance from the unit to the center of the historic center of the city in meters	12,892
Strvlm2 is the per square meter valuation on the unit's structure (excludes land)	218.9
Ldm2 is the per square meter valuation of the land the unit is occupying	78.00
Totlvm2 is the per square meter valuation of the unit including constructed area and land	296.91
Lntotvm2 is the natural log of the variable totlvm2	5.5337
Lnldm2 is the natural log of the variable ldm2	3.7962
Lnstrm2 is the natural lop of the variable strvlm2	5.2231

We next ran a series of semi-log regressions, where the independent variable is the log (natural) of the total unit value (including land and house), structure value, and land value. The regressions were conducted in a step-wise manner, and include only dependent variables that are statistically significant at the 0.01 confidence level.

For the total value of the unit model, the coefficients all have the correct sign and as indicated are significant. The equation has an adjusted R^2 of 43.13. The constant value in USD is $163.13 per square meter. If the unit is located in an urban area the value increases by 2 times, to $353.12 per square meter. This indicates that on average, a 50 square meter unit would sell for nearly $18,000. The effect of being in a multistory building is positive and would increase the constant to $169.84. In the case of the unit being a single family detached unit, the total value would decrease to $126.09. If the unit has a property title, the constant value would increase to $179.14. Finally, if the unit is located in a predominantly residential district, the constant value would increase to $173.24 per square meter.

Table 12: Ordinary Least Square Regression Results: Dependent Variable Log(base e) of Residential Unit Value (Land and Structure) in USD per square meter

	Coef.	Std. Err.	t	P>|t|	Standardized Coefficient (β)
Located in urban area dummy	.7722608	.0149416	51.69	0.000	.5895047
Multistory dummy	.1516399	.0133831	11.33	0.000	.1188954
Single family detached dummy	-2575863	.0400537	-6.43	0.000	-.0645423
Has title dummy	.0936194	.0163767	5.72	0.000	.0569886
Located in predominantly residential area dummy	.060106	.015982	3.76	0.000	.0413333
Constant	5.094554	.0445904	114.25	0.000	.
Number of observations= 5975; F-Stat=880.06; Adjusted R^2= 0.4313					

How should we interpret these results? In the case of the urban dummy, the positive impact is to be expected, urban areas have better services, are generally closer to centers of employment and services (this may explain why distance to the CBD or historical center do not show up as positive since they are positively correlated). Map 12 plots total dwelling value with property titles. Map 13 plots dwelling values without property titles.

Next we modelled the relationships between a structure's value per square meter in log (base e) against relevant variables such as urban1, multistory1 title1 and distance to the historic center. This model was less robust that the total value model and had an adjusted R^2 of 30.77.

Table 13: Ordinary Least Square Regression Results: Dependent Variable Log(base e) of Residential Structure Value (excluding Land) in USD per square meter

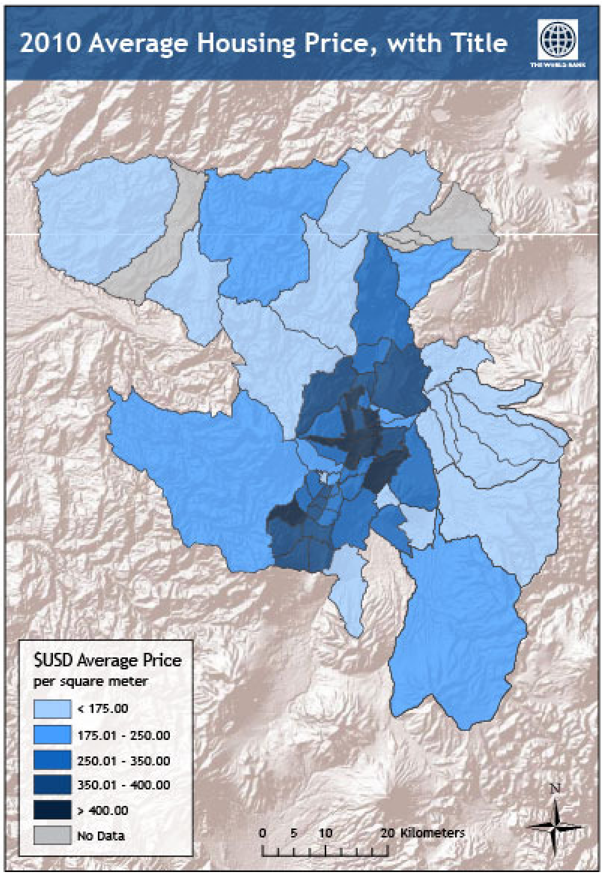
	Coef.	Std. Err.	t	P>|t|	Standardized Coefficient (β)
Located in urban area dummy	.7515816	.0192368	39.07	0.000	.5657799
Multistory dummy	.126369	.0148717	8.50	0.000	.0977102
Has title dummy	.2287675	.0184827	12.38	0.000	.5657799
Distance from historic district	6.41e-06	9.47e-07	6.75	0.000	.0973777
Constant	4.407348	.0270381	163.00	0.000	.0973777
Number of observations= 5975; F-Stat=644.88; Adjusted R^2= 0.3077					

For the structure value of the unit model, the coefficients all have the correct sign and as indicated are significant. The constant value in USD is $82.05 per square meter. If the unit is located in an urban area the value increases by 2 times, to $173.97 per square meter. If the unit has a property title, the constant value would increase to $103.14. The effect of being in a multistory building is positive and would increase the constant to $93.10. Finally, for each meter the unit is located away from the historic center, the structure value increases by $0.01.

How should we interpret these results? In the case of the urban dummy, the positive impact is to be expected, urban areas have better services, are generally closer to centers of employment and services. The positive impact of the title is to be expected since it provides more secure ownership. The multistory positive increase is also expected since building taller buildings require increased construction costs. Finally, the positive relationship between distances to the historic center does not typically arise with land prices, but in the case of structures, it may reflect the fact that newer buildings cost more to build and would not have to conform to historic preservation codes.

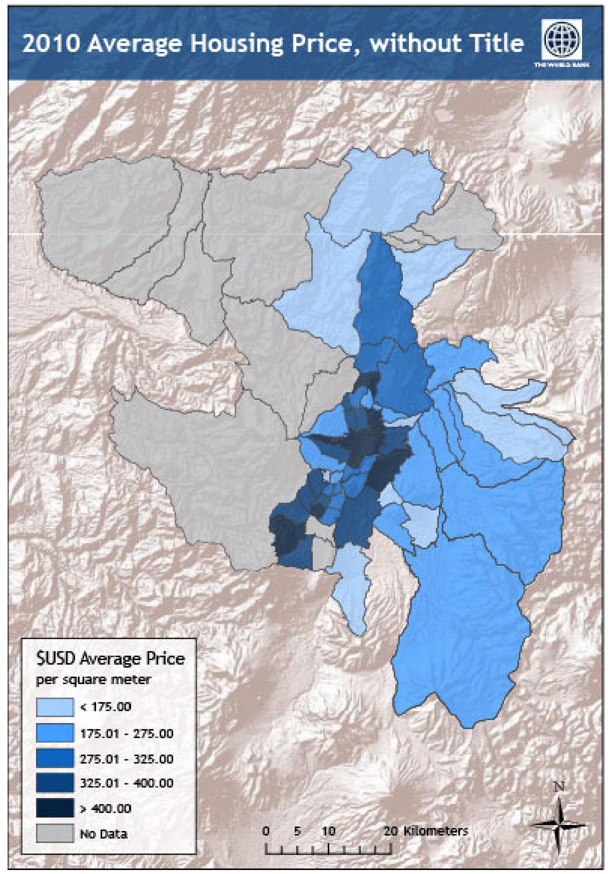
Finally, we modeled land values and their determinants. We used a similar semi-log ordinary least squares approach, converting land values per square meter to log (base e). The modeling results are very robust with an adjusted R^2 of 46.69. The final model included: urban location, distance to historic center, residential land use adjacent to parcel, title, multistory dummy and single family dummy. The results are presented in Table 14.

Map 13: Average Housing Price with Title, 2010



Source: Quito Cadastral Office tabulations, 2014.

Map 12: Average Housing Price without Title, 2010



Source: Quito Cadastral Office Tabulations, 2014.

For land values, plot values generally follow expected trends. The one exception is with respect to title, which shows a negative relationship with land value. The constant plot value in USD is $50.57 per square meter. If the plot is located in an urban area the value increases by 3 times, to $153.22 per square meter. Distance from the district center marginally decreases land value by about $0.01 per square meter—probably due to building restrictions. If the plot is located in a predominately residential neighborhood, the land value increases to $79.07 per square meter a sign of limited negative externalities. If the unit has a property title, the constant value would decrease to $36.66. This seems counterintuitive. But it may be due to the fact that untitled land is located in rural areas or areas that are not deemed suitable for development. Another reason by be that developers buy untitled land and then if they build, they secure title. Map 13 shows average housing prices by parish for units without title. The effect of being in a multistory building is positive and would increase the constant to $93.10. If the plot is in a multistory district, its land value will increase to $63.39 per square meter—reflecting the higher profitability of building on this site. Finally, if the plot is zoned for single family development, its value will significantly decline to $28.07 per square meter, reflecting the low profitability of building single family units and reflecting the fact that the plot is located in a suburban or rural area.

Table 14: Ordinary Least Square Regression Results: Dependent VAriable Log(base e) of Residential Land Value in USD per square meter

	Coef.	Std. Err.	t	P>|t|	Standardized Coefficient (β)
Distance to historic district	-.0000344	1.92e-06	17.93	.0000	-.2365411
Multistory dummy	.2259493	.0291454	7.75	.0000	.0789658
Single family dummy	-.588594	.087006	-6.76	0.000	-.0657376
Located in urban area dummy	1.108548	.080791	29.11	0.000	.3771847
Has title dummy	-.3216746	.0360172	-8.93	0.000	-.0872801
Located in predominately residential area dummy	.447002	.0361917	12.35	0.000	.1370151
Constant	3.923297	.1051376	37.32	0.000	.1370151.
Number of observations= 5975; F-Stat=847.00; Adjusted R^2= 0.4669					

The overall results of the regression models suggest that land and housing will become more expensive as the city urbanizes, High rise construction will cost more per square meter and land values will rise with higher densities. Quito will need to develop new policies to provide additional land and building opportunities—open up new areas for development—such as the old airport site and areas to the south and east. Policies to promote the provision of affordable housing will be needed to increase the stock of units accessible to low and moderate income households (Trujillo, 2013). Additionally, the metropolitan area will need to improve its transit system to facilitate commuting (Quito Distrito Metropolitano, 2012). In the next section, we assess Quito's future housing needs out to 2020.

8. The growth of metropolitan Quito to 2020: housing affordability challenges and opportunities

Between 2011 and 2020, metropolitan Quito is expected to grow from a population of 2,231,076 persons to a total of 2,698,477 persons (Quito Distrito Metropolitano, 2012). This is an absolute increase of 467,401 persons---nearly 500,000. In terms of the increase in households, if we assume that household size continues to decline at 0.09 percent per year, Metropolitan Quito's household size will fall from 3.54 person in 2010 to 3.23 persons in 2020. This suggests that metropolitan Quito's households will increase from 629,314 in 2010 to 835,442 in 2020 an increase of 206,128 households.

Land constraints appear to be a major impediment to the provision of affordable housing. Based on our data analysis and discussions with private and public real estate developers and brokers, limited land supply is driving up land prices. Metropolitan Quito needs to consider increasing residential land supply in suitable areas and provide adequate transit connectivity. Environmentally sensitive land should be protected, but demand for housing should be accommodated by increasing areas of residential development and increasing residential densities in areas of the metropolitan region that can support additional population.

While developers commented that construction costs were not serious impediments to the provision of affordable housing, they did mention the problems of development approval and "red tape" regulatory delays add to construction costs by increasing the time to complete projects and therefore increasing construction interest costs (Trujillo, 2013).

In addition to these new, required units, metropolitan Quito will need to upgrade or replace 20 percent (approximately 100,000 units) of the existing metropolitan area's dilapidated or overcrowded housing stock (based on the assumption that all units lacking private toilets need upgrading or replacement) as well. So in terms of total housing needs, metropolitan Quito will need to construct—306,128 units between 2010 and 2020. Since these estimates are approximations, we assume that the total need (new and replacement stock is 300,000 units—30,000 per year).

Based on current patterns, approximately 40 percent of the units will be rentals and 60 percent will be for ownership. Rental units will need to be affordable—and monthly rents will need to be less than $125 to make them affordable to the 40th household income percentile. To generate an adequate return on investment, these units would need to cost approximately $12,500 (100 times monthly rent). This is below current construction costs for urban multistory units. One possible solution would be to provide housing rental vouchers. The vouchers would need to bring rents to between $340 and $430 per month (the amount need to generate a return on a $34,000-43,000 unit—see Table 9). The voucher could be paid directly to the landlord. The voucher will cost the government between $2,600 and $3,700 per household per year, depending on their income level. So to calculate a rough approximation of the total voucher cost—40 percent of units would be rental—120,000 units. Of these up to 80 percent may need assistance ranging from $2,600 to $3,700 per year. So the range of voucher subsidies could range from $312-450 million per year.

Owner occupied units are likely to increase by 180,000 units between 2010 and 2020. Again, given the acute affordability crisis in Quito, much of this housing will need to be subsidized. There are two basic approaches that policy-makers can take with respect to housing provision—one is a demand side approach, where the government provides grants and subsidies to low income households—grants for down payments for example, or interest rate subsidies or assistance in the payment of mortgages (Ruiz Pozo and Sanchez Romero, 2011). The other approach, referred to as a supply side policy, is for the government to build or have the private sector build low cost housing.

One significant problem is that Ecuador's housing finance system is underdeveloped. Only 4 percent of the country's GDP is made up of housing finance (compared to 62.4 percent in Spain and 20 percent in Chile). However, the country has a well-developed banking system that is capable of collecting deposits. There are numerous microfinance and credit cooperatives that target low-income groups. The country has experience with developing secondary mortgage markets and banking regulations are sound. If reforms to the banking system are carried out, it may be possible to increase the mortgage term to 30 years from 15 years, and to lower the interest rate on mortgages to approximately 7 percent. This would have a significant impact on affordability, even if the 33 percent income to mortgage payment and 10 percent down payment underwriting criteria remained. For example for a mortgage of $30,000, the monthly payment would decline from $72.38 per month for a 10 percent 15 year mortgage to $24.59, a reduction to nearly one-third. This would increase affordability significantly. For more detail on housing finance issues in Ecuador, see (World Bank, 2012).

Low income households would still have problems generating the required down payment of 10 percent of the purchase price. Here a government subsidy on mortgage insurance could be used to reduce the down payment to 5 percent, which would improve access. For the very low income, the government could provide cash transfers to help households maintain a 33 percent income to mortgage ratio—similar to the rental voucher program discussed above. To discourage speculation, deed restrictions could be imposed on owners to limit their ability to sell units for a set period of time or to limit the rate of increase in the sale price (say by limiting it to increases in the CPI).

The design of these policy instruments requires a detailed assessment of housing conditions—more accurate data on dilapidated units, the number of overcrowded units, and better data on current and future household income distribution. With these data better and more efficient policy instruments can be designed. But in the absence of these data, we have assumed that 96,000 units are dilapidated and an unknown number of households are overcrowded.

We have discussed some strategies for housing finance, but now we need to examine land and real estate development strategies. Metropolitan Quito, given its typographic constraints needs to move out in the northern, southern and eastern valleys. New residential subdivisions should be zoned to promote affordable housing—very small plots, and the development of townhouses and mid-rise apartments. An effective instrument for promoting the construction of affordable housing is called inclusionary zoning. Developers are provided with a density bonus of 20-25 percent additional units and floors pace if they agree to allocated 20 percent of the units to low and moderate income households. This incentive will increase the production in all areas of the city that are designated as inclusionary zoning districts. These programs have been very effective in New York and California in terms of producing affordable housing (both rental and owner-occupied).

Private developers should be required to build a set percentage of units for low- and moderate-income households. Perhaps as much as 20 percent; with the government providing subsides for the remaining demand. This type of development will be of moderate density and will need to be provided with adequate transit services—BRT (bus rapid transit) systems for example. These BRT systems should connect with Quito's new metro system (Quito Distrito Metropolitano, 2012).

Within the city, residential densities should be increased---multistory apartment blocks of 6 to 12 stories should be the norm. One area where this could be done is in the old airport area, which is 124 hectares. If 50 percent of the land is set aside of roads and open spaces, 62 hectares would remain. Developing this area at the same density as La Libertad or La Ferroviaria (115 person per hectare) would generate a population of approximately 7,130 persons or about 2,200 households.

9. Conclusions and recommendations

This final section summarizes the results of this paper and offers a range of policy recommendations for consideration. Sections 1 to 4 provide extensive descriptive data trends on population, population density, housing and housing density in the metropolitan area. These sections provide clear substantiation of Quito's land constraints and the tendency for development in the relatively level valley to be characterized by high rise development. Sections 5 and 6 have examined housing and household trends in the metropolitan area and offer an assessment of housing affordability in the metropolitan area. These sections, draw on extensive interviews with developers and real estate brokers and use INEC 2010 income distribution data to gauge housing affordability. These sections also draw on cadastral data on housing and land valuation. The results on the sections illustrate Quito's housing affordability challenges.

In section 7 we provide the results of a series of regression models to estimate 1) total housing values, 2) estimates of constructed area values, and 3) residential land values. Although the model results are used to inform our affordability analysis in section 6, because of the technical nature of the models, they are presented in a separate section. Generally the models are consistent with the cost and pricing data in section 7, but due to data limitations, we could not directly apply the model results to section 6 without making assumptions on building height, and plot size.

Section 8 offers a prognosis regarding Quito's future population and household growth and suggests that housing demand, driven by rural to urban migration, declining mortality rates and decreasing household size will fuel substantial demand for housing. This growth will be highly constrained by topography. Over the next 10 years Quito will need to add approximately 300,000 dwelling units to accommodate growth and to address overcrowding and the repair and rebuilding of dilapidated units. This poses a significant challenge due to the region's high concentration of low- and moderate income households. The report's analysis has illustrated that housing affordability for both renters and buyers will be a challenge going forward.

These topographic constraints result in medium to high density residential development the Quito valley. The constraints lead to land values that are relatively high, compared to household income. We estimate for the cadastral database that low density residential land currently sells for $120 square meter, mid-rise (1-6 stories) residential land sells for $140 square meter, and high-rise (1-12 stories) residential land sells for an estimated $280 per square meter. Although construction costs are reasonable relative to incomes (according to interviews with real estate developers), land prices are very high relative to household income. In addition, taller structures cost more to build, so another impact of Quito's limited land supply is that the increased densification of the city leads to higher housing prices, and undermines affordability. For example, the single family residences (see Table 9 and the three paragraphs preceding it) would sell for $33,400. This is six times median household income. For the mid-rise unit in Table 9, the selling price would be $43,300 and is 7.8 times the median household income. Finally, for high-rise units, selling for $58,200, this would amount to 10.5 times the median income. So clearly there is an housing affordability issue in Quito.

Section 8 offers suggestions regarding possible policy interventions, exploring both demand and supply side solutions. On the demand side we consider reforms to housing finance systems—long term mortgages, lower interest rates, government subsidies for down payments and housing vouchers for renters. On the supply side we discuss reforming land use planning controls to permit higher density development—thorough both infill development of vacate or under-utilized parcels and increases in permitted building height. We also consider the use of inclusionary zoning were developers would be provided with density bonuses in exchange for setting aside a percentage of units for lower income households.

To summarize, we recommend that the QDM, along with the central government, consider the following strategies to temper housing prices and to increase affordability:

- Rental housing vouchers
- Grants for down payment assistance
- Efforts to increase mortgage terms and to lower interest rates
- Restructuring and alignment of land use planning to accommodate future growth
- Expanding transit connectivity in the northern eastern, and southern valleys
- Redevelopment of airport land into high density residential development (other under-developed sites could be redeveloped as well)
- Streamline land use and zoning regulations to foster more efficient and speedy development
- Introduction of inclusionary zoning to promote the development of affordable housing units

In conclusion, our analysis and field work indicates that constrained land supply and high prices are the main impediments to the provision of affordable housing. Private and public sector housing developers and specialists all report that building material and construction costs are low relative the incomes of the low- and middle-income housing market segments. They point out that the main impediment is the high cost of land. Our economic analysis provides a useful factual base to pinpoint key bottlenecks in the land market and position us to offer useful recommendations. The paper concludes with a series of recommendations that the metropolitan government should consider to expand land supply by moving development into outlying buildable areas, redeveloping the old municipal airport site for affordable housing, and revising zoning and planning regulations to permit higher density development in areas with adequate infrastructure and appropriate typography.

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Annex 1: Description of the Land Market Assessment method and its benefits

The land market assessment is to provide an accurate and up-to-dale core of information on the operation of the urban land market. This information includes prices, statistics on the supply of serviced land, and detailed descliptions of present and projected projects. Thus it provides the concrete foundation needed to define appropriate strategies for improving land market performance. LMAs can be used to support four broad activities: governmental planning and decision-making; the evaluation of government policies and actions; the structuring or land-based taxation systems; and private sector investment and development decisions. We start by defining the potential uses and benefits of the LMA.

Providing Information for Public Sector Planning and Decision-making

The most significant benefit of the LMA is that it can vastly improve the 4uality of land development planning and policymaking by providing public officials with basic assessments of the state of the land market. In development planning, as in medicine, diagnosis is the first step in problem solving. The LMA is a method for assessing the current condition of the land market. Therefore, one of its primary objectives is to answer the following questions:

1. Is the supply of urban serviced land expanding to meet growing population and employment needs?
2. Which land uses are growing the fastest?
3. Where is urban land conversion taking place?
4. Where is urban land conversion outstripping the supply of serviced land?
5. Are land prices increasing faster than the overall rate of inflation?
6. Where land are prices the highest and where are land prices increasing the fastest?
7. Is there enough serviced land to accommodate urban growth for the nextt five years?
8. Is the price and affordability of housing and commercial and industrial space changing-are real occupancy costs greater now than before?
9. Which segments of the population do not have access to housing from the formal private sector?

Land market assessments can also be used to provide baseline estimates of future urban land requirements. They can be used to guide infrastructure programming and investment decisions and the development of land-use planning policies. For example, LMAs can be used to estimate the demand for residential plots and commercial and industrial space associated with projections of population and employment. Armed with these estimates, planner can gauge the adequacy of the current supply of land for urban expansion and develop plans for expanding the supply of serviced land.

Using LMAs to evaluate government policies and actions

Governments exert great influence, both positive and negative, over land market outcomes.

Through investments in infrastructure and regulations over land development, governments shape the operations of land markets, creating the potential for substantial increases in land values. At times, however, government plans and regulations unintentionally cause negative side effects on land market operations. Given the important role that governments play in shaping land market outcomes, it is extremely important that the implications of their investment and regulatory decisions to be understood.

Unfortunately, adverse effects of planning regulations are complex and frequently difficult to estimate-in large part because little is known about the price of land or the demand and supply conditions. With the land market assessment, an information base can be established to monitor land markets and thus evaluate the potential effects of new government policies and programs. The LMA can be used to answer a variety of questions: Are certain public policies or actions constraining the land market? Is infrastructure placement limiting residential development? Are greenbelts or agriculture land preservation policies limiting development? Are planning standards and building codes pushing up housing prices?

Using LMAs for structuring land-based taxation systems

As local governments begin to seek new approaches for financing urban development, techniques such as special assessment districts and beneficiary charges will come into use. These fiscal tools cannot function without accurate information about land values and the impacts of infrastructure developments on land values. The LMA, by systematically cataloging land value information, can play a critical role in making these new financial tools functional. As a first step, the LMA can serve as a foundation for gauging trends in land prices. Over time, as data on land prices are tabulated, the government can gauge the impacts of public investments and use the information to set taxes, fees, or user charges.

Providing information for private sector investment and development decisions

Unlike stock, bond, and commodity markets, land markets are disorganized. There is no central clearinghouse for information about land prices, land conversion, and the demand for land. Most private sector land developers must take substantial economic risks when launching projects. Unfortunately, the lack of information about land and property markets in most cities of the developing world has thwarted attempts by private sector developers, bankers, and consultants to prepare feasibility studies of potential projects.

LMAs can fill this gap. For example, by illustrating the effective demand for low- and moderate-cost housing, LMAs can help stimulate the production of such units by the private sector. At the same time, LMAs can indicate when the production of certain urban uses far exceeds effective demand and thus help to bring about faster land market corrections. In the long run, with improved information about the market, the risk associated with development is reduced and developers may be able to operate with lower rates of profit (Walters, 1983).

The information provided by LMAs can also help improve the quality of loan underwriting and private investment decision-making. Overall, more informed lending decisions can lead to a more efficient use of private capital for land development.

Conclusions Regarding the Benefits of LMAs

As should be clear by now, the benefits of LMAs are significant and are likely to draw widespread support from public and private sector planners and decision-makers, as well as many other quarters of the public and private sector. As explained below, when organizing for the LMA, care should be taken to involve the full participation of benefiting agencies.

Organizing for Land Market Assessments

Before the LMA process is even begun, it is important to develop broad support for it. The best way to do this is to invite both the public and private sectors to participate in the planning and execution of the LMA. To avoid conflicts between competing line agencies in government, the responsibility for executing the LMA should he lodged with the executive office of the local government and should include the full participation of the private sector.

In San Pedro Sula, Honduras, for example, it was suggested that the city create a line agency, the Department of Land and Housing Development that would report directly to the mayor. Among its man y powers, this agency would have statutory authority to compel government agencies and public utilities to gather relevant information on land market operation. It was felt that a centralized authority responding directly to the mayor was the only effective way of implementing the assessment. In other cases, this manner arrangement may not work.

The full col1peration of the private sector is essential. To this end, a land market assessment steering committee should be established, consisting of prominent professionals in the private sector development community. The group should be established at the start of the LMA process to discuss how the LMA can be used to improve the performance and efficiency of the private and the public sectors. Agreement must be reached about which types of data to collect and the frequency of collection, and firm protocols should be set for preserving the confidentiality of sensitive market information. Procedures for periodically disseminating land market assessment reports should also be drafted. It is also important to address the concerns of citizens who feel that the government is snooping. Here, the most effective method is to take the time to explain what the surveys will be used for and what they will not be used for (for example, for land-use planning purposes, not for tax collection audits). Survey teams must explain how the anonymity of those interviewed will be protected (for example, the survey teams are not to submit the names of those interviewed to the government agency managing the LMA).

The surveys must be conducted in both formal and informal areas of the city or town. The process in both areas is essentially the same, but it may be necessary to slightly modify the surveys or the types of info1mation collected in informal areas. Experience in Karachi, Jakarta, and Bangkok indicates that in f01mal land brokers can be identified quite easily and that they have little difficulty responding to questionnaires. The housing project survey discussed below and presented in Appendix C may need to be modified to accurately capture relevant information about informal land and housing developments.

In Bangkok, the Housing Policy Subcommittee of the National Economic and Social Development Board serves as the steering committee for carrying out periodic aerial photographic assessments of the region's land and housing markets. The committee seeks input from the Thai Real Estate Association and from the financial and academic communities.

Resources Necessary for Setting up a Land Market Assessment Process

The LMA is carried out by several types of professionals: a land economist with experience in market survey research; a land planner with experience in interpreting aerial photographic and satellite images; a statistician with experience in computing and managing data; two data analysts for coding, entering data, and fieldwork; a draftsperson; and a team of research assistants for conducting field surveys. A team of this size will not be needed in smaller towns. The minimum level of staffing is probably one urban planner who has been trained in applying the LMA and one to two survey assistants.

In large cities and metropolitan areas, a computer system will be needed to develop the data base and to conduct statistical analyses. The minimal system is an IBM AT compatible system with 640k RAM, two disk drives, and 40mb hard disk. The system should have graphic capabilities, with either a color or monochromatic monitor. A high-speed dot matrix printer is necessary and it should be able to handle continuous feed paper up to 14 inches wide (35.5 centimeters). For large metropolitan areas, the best method of presenting land and housing market information is to use a computer-mapping system. Such a system can be run on the IBM compatible system with a type “A” multicolor pen plotter and a 12-by-12-inch (30-by-30-cm.) digitizing pad. The total cost for the computer equipment is between US$6,000-7,000, or US$4,000-$5,000 without the computer- mapping capability.

The software for running the computers and developing the data base and map files will require a spreadsheet system, an advanced statistical package such as STAT, and ArcGIS, a computer-mapping system. A word processing system such as WordPerfect, Microsoft Word, and graphics program such Powerpoint will be needed for preparing reports. The prices of these software packages vary considerably, but should cost less than $2,000. Thus, for less than $10,000 a complete computer installation can be created for conducting the land and housing market assessment. This system can also be used for other management and research functions such as financial modeling, demographic projections, data base management, and report production. In smaller cities and towns, the data can be analyzed manually using a small pocket calculator or adding machine.

Timetable for Conducting Assessments

The time required to prepare a land market assessment will depend on the size of the city, the level of detail of analysis, and the number of professional staff assigned to the project. If the city is starting from "scratch," it will take approximately one to two years to fully complete a land market assessment. However, much of the information needed for the land market assessment has probably been collected already, shortening the time required for completion. The LMA should be updated every three to five years, depending on the rate of urban growth and available resources.

Dissemination of land market assessment information

A principal benefit of the land market assessment is that it increases the level of understanding about the current state of land market operations. Thus, it is important for the results of the analysis to be widely disseminated. This can be accomplished by way of seminars, reports, and briefings to public and private sector professionals. In the long run, it is desirable to issue an annual report on the state of the land market. This report should pin point key constraints in the land market and identify actions for removing land-supply bottlenecks. The report should be widely distributed to both public and private decision-makers.

Developing Baseline Information

The first step in launching a land and housing market assessment is to review the reports and data that have been compiled by public and private agencies on the land and housing conditions in the metropolitan area. Meetings should be held with government officials and private real estate developers, brokers, and bankers.

Using the results of these preliminary efforts, the study team can proceed to define the precise scope of the land and housing market assessment, including the size and shape of the study area, the types of data to be collected and analyzed, and the specific policy questions to be addressed.

Define Area

The definition of the area will depend on the political boundaries of the local government, the spatial organization of tabulated data (such as population, infrastructure, and cadastral and building activity), and the location of employment centers and commuting patterns in the metropolis. The size of the land and housing market assessment area will depend on how far into the periphery households one will search for housing (to purchase or rent) over the next ten years. In most cases, the information is tabulated at a district or sub-district level, and these units form the basis for defining the study area with respect to data collection and availability.

Establish geographic zones for data organization

If the LMA data base is to be useful in assessing precise land market conditions and is to effectively gauge the impacts of government policies and investment decisions, it should be spatially divided into zones.

On a conceptual level, these zones should be defined so that each provides a homogeneous pattern of land and housing market characteristics. For example, the boundaries of the zones should be set so that the land-use patterns within zones are roughly similar, not a mixture of commercial, industrial, or residential areas. In outlying areas, the zones should be similar with respect to the pattern and density of urban development. The zones should also be similar in terms of social and economic conditions such as household income. The finer the grain and the more homogeneous the zones, the more accurate are the data base and the assessment of the effects of government policies and investments. At the same time, the greater the number of zones, the more difficult and expensive it will be to collect and update data.

Another consideration in defining zones is that their size and total number should be based on the underlying base of existing data. Although it is impossible to delineate different zones from those in the data base, zones can be combined into larger groupings. In large metropolitan areas (with a population of 1,000,000 or more) where the potential number of zones is large and is likely to be difficult to manage, it is appropriate to combine zones. The zones should he small enough, however, to illustrate the activities of fundamentally different housing and land markets hut not too large to mask important differences in market activity. (On the problems of large-scale urban models, see Lee, I 974). A land and housing market information base of 344 zones was developed in Bangkok, a metropolitan region of six million or more. Map 1 illustrates the zone system used for the Bangkok Land Market Assessment. In Karachi, 271 were tabulated. In other cities, the number of zones for urban modeling has ranged from I00 to more than 1,000. For purposes of analysis, given computer and software capabilities, the total number of zones should be limited to less than 500. The limitation of a maxim um of 500 cases should not present any significant problems for developing a clear assessment of a metropolitan area's land and housing market.

Basic land-use and population data for tabulation

For each geographic zone, data on land use and population attributes should be collected for at least two points in time-a "base year" and "current year." Ideally, the two years should span a period of five to ten years. Data on the following variables should be collected:

1. zone identification number
2. size of zone in hectares
3. x and y coordinate of the centroid of the zone
4. total urbanized land in base year in hectares
5. total urbanized land in current year in hectares
6. total residential land area in base year in hectares
7. total residential land area in current year in hectares
8. total housing units in base year
9. total housing units in current year
10. commercial land area in base year in hectares
11. commercial land area in current year in hectares
12. industrial land area in base year in hectares
13. industrial land area in current year in hectares
14. institutional land area in base year in hectares
15. institutional land area in current year in hectares
16. vacant land area in base year
17. vacant land area in current year
18. vacant land with infrastructure in base year
19. vacant land with infrastructure in year
20. change in urbanized land, base-current year in hectares
21. change in residential land area, base-current year
22. change in total housing units, base-current year
23. change in commercial land area, base-current year
24. change in industrial land area, base-current year
25. change in institutional land area, base-current year
26. change in vacant land area, base-current year
27. change in vacant land with infrastructure, base-current year
28. population in base year
29. change in population, base-current year
30. population density in base-current year
31. change in population density in base-current year

Baseline data on land-use changes, infrastructure availability, and population by geographic zone over time can be used to arrive at a detailed assessment of the spatial patterns of urban development in a metropolitan area. The data can be tabulated from land-use surveys, aerial photographs, or satellite images.

Land value information

The next step in collecting data is to assemble land price information by zone and year. This information is available from a variety of sources. Many countries levy property taxes and therefore compile information on land value assessments. Although in many instances these assessments lag or understate the market, they may provide a usable measure of land price inflation. In cases where private land value information is also available, it can be used to verify the public land value assessments.

Land value information can also be directly collected from interviews with real estate brokers. For example, in both Jakarta and Karachi, approximately HX) real estate brokers working in either the formal or informal sectors were interviewed to obtain land value information on plot prices. In all cases only experienced brokers were surveyed. Annex A presents a description of the Jakarta broker survey. The general approach used in the survey is as follows:

- A survey questionnaire was set up containing a series of questions designed to help brokers appraise the current probable selling price of several specific types of residential plots (for example, a 120-square-meter plot located on a collector street). The a ppraisal process was repeated for plots with different types of land tenure and levels of infrastructure. The appraisals covered only those neighbor- hoods in which the broker worked. Once the appraisals were completed, the brokers were asked to estimate the probable selling prices of the previously appraised plots for 1980, 1985, and 1987 in Karachi and 1987, 1988, and 1989 in Jakarta. All prices were tabulated in terms of price per square meter and adjusted to constant price levels.
- Since the objective of the land price data base was to comprehensively cover the metropolitan area's active land markets, interviews were scheduled in approximately 100 neighborhoods. Within each neighborhood, at least three brokers were interviewed. For each type of plot appraised, the median value was to be included in the data base. Within each neighborhood, median values of between three and nine types of parcels were tabulated for each year.

A variety of methods were used to identify brokers. Membership lists of professional organizations were used for brokers in the formal sectors and advice from village headmen and residents for informal brokers.

The results of each interview were tabulated on a questionnaire form. The information recorded on each form was computer-coded using Lotus 1-2-3.The coding was verified for accuracy.

The land price data were organized according to zone and combined with additional information on land use and population.

In most cases, data on land values (based on appraisals) can be tabulated by type of land. All land values should be expressed in constant prices. For example, a comprehensive collection of values for serviced and un-serviced residential, commercial, and industrial land might include the following variables for each zone, in addition to the variables listed above (continuing the same sequence of numbers):

32. median land value (per square meter) for serviced residential plots located on side streets, base year
33. median land value (per square meter) for serviced residential plots located on side streets, current year
34. change in median land value (per square meter) for serviced residential plots located on side streets, base-current year
35. median land value (per square meter) for unserviced residential plots located on side streets, base year
36. median land value (per square meter) for unserviced residential plots located on side streets, current year
37. change in median land value (per square meter) for unserviced residential plots located on side streets, base-current year
38. median land value (per square meter) for serviced commercial plots located on main streets, base year
39. median land value (per square meter) for serviced commercial plots located on main streets, current year
40. change in median land value (per square meter) for serviced commercial plots located on main streets, base-current year
41. median land value (per square meter) for serviced industrial plots located on main streets, base year
42. median land value (per square meter) for serviced industrial plots located on main streets, current year
43. change in median land value (per square meter) for serviced industrial plots located on main streets, base-current year
44. median land value (per square meter) for unserviced parcels located on side streets, base year
45. median land value (per square meter) for unserviced parcels located on side streets, current year
46. change in median land value (per square meter) for unserviced parcels located on side streets, base-current year

It may not be possible to tabulate information on all of these variables, but this list is offered as an example of what might be collected. Once the land value information has been coded into the spreadsheet, patterns and trends of land values over time and space can be calculated. This information can be used to determine where land values are increasing fastest and also where land is priced low enough to make the construction of low- and moderate-cost housing feasible.

Design Layout of Spreadsheet Data Base

With the delineation of land and housing market study zones, a data base system should be established for coding data. The data base should be developed on a microcomputer, using a Spreadsheet. Basic information for each zone should include: 1) zone identification number; 2) size of zone in hectares or square kilometers; and 3) an "x" and "y" coordinate for locating each zone. The spreadsheet data base should be stored on a hard disk and frequently "backed up" on a diskette in case the file is inadvertently erased.

Once the initial spreadsheet file is created, the basic land use, population and demographic and land value information can be added. Tabulations can be made of which zones experienced the greatest population increase between the two years and what share of the metropolitan area's total population increase took place in central city, inner suburban and peripheral areas. Such calculations generate useful information for identifying growth areas in the metropolitan region. Population density patterns and their change over time can be recorded as well.

Using Aerial and Satellite Images

Since governments in most metropolitan areas do not compile detailed information regarding changes in housing stock or land use by small area, it is necessary to interpret and tabulate aerial photographic surveys. Ideally, two aerial surveys that closely correspond with the time interval of the assembled demographic data listed above should be used for the housing and land-use analysis. From the field surveys of the metropolitan area and preliminary assessments of the aerial surveys, a list of housing types, including both informal and formal housing development, should be compiled for detailed tabulation, and it should differentiate slums and squatter settlements, land subdivisions, formal private housing developments, and public housing projects. Nonresidential uses, including industrial areas, commercial districts, and institutional uses can also be tabulated.

If aerial photographs are not available; an effort should be made to acquire satellite images. Satellite images can be obtained for less than US$2,000. SPOT images have been available since 1986, and offer good resolution (10 meters in panchromatic mode). Combined with a thorough ground survey, SPOT images can be used to develop land-use typologies for assessing land-use and urban development patterns.

Tabulating Housing, Commercial, and Industrial Uses

Once the typology has been established, tabulations of housing by type of unit should be made for each zone. For example, using aerial photographic interpretation, it may be possible to differentiate the following types of housing (for satellite images, the level of differentiation will be much coarser):

- informal housing settlements
- public sector housing projects
- formal private sector low-density housing estates
- formal private sector medium-density housing estates
- formal private sector high-density housing estates.

For each category of housing, the number of habitable units should be estimated for the base and current-year aerial photographs or satellite images. A comparison of the tabulations provides a clear picture of changes in the housing stock over the period. Calculations of absolute changes in the type of housing and change in housing by zone and by type will identify the specific patterns of housing supply dynamics.

Although trends of past housing construction provide a partial assessment of future housing activity, a separate projection of housing demand is a more accurate method of gauging the futu re. Projection models of regional housing demand, such as the USAID system, can more fully incorporate the demographic factors that shape housing demand. With consistent projections of future housing needs, land requirements for residential development can be deter- mi ned.

Assessing Land Conversion Trends

The rate of land conversion within each zone over time can easily be determined using either aerial photographic survey or satellite image information. By calculating the area converted from agricultural to residential and other urban uses and correlating it with housing unit changes or changes in commercial and industrial employment, an estimate can be made of the land required to support urban growth. This information can in tum be used to estimate annual requirements for land.

Estimating Current and Future Developable Land Supply

The most critical element of the assessment is the estimate of the current and future supply of developable land. Developable land is defined as land that has reasonable access to roads and other critical infrastructure systems, such as water and electricity, and is not constrained by physical impediments such as steep slopes or by governmental limitations on development. Which lands are potentially developable can be determined by examining parcels for physical constraints, governmental policies, and the location of current infrastructure. must Additional assessments should be made of the potential for the redevelopment of urban areas. Although difficult to gauge precisely, redevelopment potential can be measured by determining past redevelopment activity and extrapolating into the near future. Depending on the type of infrastructure and the cost required to extend services, land located within 1/2 to 1 kilometer of existing infrastructure should be classified as developable, assuming there are no physical and governmental constraints. The potential supply of serviced land can be estimated by combining this information with land-use data on vacant parcels.

Future supply conditions are estimated by assessing and mapping proposed infrastructure. If a parcel is expected to have access to road and water systems within the next five years and has no other constraints, it should be classified as developable in the future estimates.

In determining land supply, it is extremely important to consider vacant and underutilized parcels in built-up areas. Although many vacant parcels do not have road access, or are not well suited for development, their location and potential for infill construction make them important sites to

Using LMAs for Strategic Planning

Many governments formulate their plans for future development withou t a firm understanding of how their city is growing. As a starting point, it is useful to assess the current performance of the local land market using a technique such as the LMA. This will help authorities set an agenda for making the metropolitan area's land and housing markets more efficient.