

## **Property values in Kigali city (draft)**

### **Introduction**

Rwanda is the only African country that recently completed a country-wide land regularization exercise. The benefits of this effort on land-related investment, female empowerment and functioning of land markets are well documented. While the speed of program implementation precluded a rigorous evaluation of household-level impacts in urban settings, the program is believed to have generated social benefits in terms of creating opportunities for more rational planning, thereby increasing land values and the scope for market transactions. To study associated effects, this paper, which is accompanied by a second one on land taxation, uses registry information to compare land prices as the extent to which prices are truthfully reported explores determinants of subjective land values, in particular the extent to which being affected by master planning in various ways affects land prices.

### **Data and Methodology**

The main data used for this analysis originate from a household survey of resident property owners carried out by the World Bank Research Department, in partnership with the Rwanda National Resource Authority (RNRA), in Kigali City from January to May 2016 aimed at complementing the existing impact evaluations of the Land Tenure Regularization program in rural areas. The focus of this survey was to capture the functioning and dynamics of land markets in Kigali city.

For sampling purposes, we combined data from two sources; namely: (i) list of villages in Kigali city with urban-rural classification, as defined by the National Institute of Statistics of Rwanda (NISIR), and (ii) list of parcels in each village from the Land Administration Information System database of RNRA that has information, among others, on ownership type, current land use and date of land transaction. Information from these two sources is used to stratify the sample geographically, and also create a size variable for the selection primary sampling units (PSUs) within each stratum. By capturing different prevailing conditions across Kigali city, the geographic stratification would allow us to conduct separate subgroup analysis.

As can be seen in Figure 1, the villages are grouped into three strata. The first stratum is central Kigali, referred as “urban” Kigali, (RED shade) that consists of urban villages with agricultural land less than 35% of residential land, i.e., equal to the minimum ratio of agricultural land to residential land in the villages located in rural Kigali, as defined by NISIR. The second stratum is referred as “peri-urban” Kigali (BLUE shade) that consists of urban villages with their agricultural land covering more than 35% of their residential land. The last stratum consists of rural Kigali (GREEN shade), as originally classified by NISIR. Accordingly, 52.5%, 15% and 33.5% of the total 1,155 villages (enumeration areas) are classified as urban,

peri-urban, and rural Kigali, respectively. Given 68%, 20% and 13% of residential parcels are located in urban, peri-urban and rural Kigali, the total sample size of 250 villages were allocated a sampling fraction of 50% (125 villages) to urban Kigali, 30% (75 villages) to peri-urban Kigali and 20% (50 villages) to rural Kigali. The villages in each stratum were then selected using probability proportional to size (PPS) sampling, the size variable being the number of residential parcels in urban and peri-urban areas and the number of residential and agricultural parcels in rural areas.<sup>1</sup>

Following a complete listing of all the parcels with building structures in the 250 selected EAs, 12 resident landowners (and 3 replacements) were randomly chosen to be interviewed in each of the EAs. Non-response was relatively low for a data collection exercise in an urban setting, with a total of 2,856 households (95.2% of the sample size) who completed the questionnaire in full. Out of these 2,856, 261 households were replacement households (9.6% of the final data size). Overall, 85.6% of the originally sampled households, excluding replacements, were interviewed. Figure 2 reports the localization of the residence of interviewed households. The questionnaire consisted of modules on household characteristics, land and property characteristics (including GPS coordinates of the parcel location), legal knowledge and access to credit among others. Of particular interest, for this study, is the hypothetical question on the amount that households are willing to accept if they were to sell and rent out their property at the time of the survey.

For this study, the geo referenced household survey data was complemented by the 2014 Establishment Census data collected by the NISR. The Establishment Census captures information on economic activities, number of employed and size of all operating establishments that have a fixed location countrywide. Nonetheless, as establishments were not geo-referenced, the information was aggregated at the cell level to generate community level indicator variables. Georeferenced location of schools from NISR, health series from the Ministry of Health, tarred roads and electricity grids are used to construct variables to measure access to public services and basic infrastructures.

## **Descriptive Statistics**

Table 1 presents the main characteristics of surveyed households by stratum. Overall, 26% of the sampled households are female headed, which is consistent with national statistics. The average household is comprised of 4.9 members, with slightly smaller household size in rural Kigali. Household heads are significantly younger in peri-urban and rural areas than those living in the center of Kigali (46 years vs. 51 years). As expected, with 5 years, the highest level of education of the head of the household in rural Kigali is significantly lower than peri-urban Kigali (about 7 years) and urban Kigali (9 years). More importantly,

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<sup>1</sup> We oversampled villages in peri-urban and rural areas compared to the proportion of residential parcels. Given that large proportion of parcels in rural Kigali are used for both residential and agricultural purposes (even if registered as agricultural land), the use of both residential and agricultural parcels as a size variable in this area is quite reasonable.

while about a third and a fifth of household heads in urban Kigali had completed high school and university level education, respectively, these figures are significantly lower in peri-urban Kigali (23% and 11% of the household heads having secondary and university education, respectively) and rural Kigali ( 11% and 3% of the household heads having secondary and university education, respectively). This will have implications on their activity choice and sources of livelihood. The data on weekly time-use reveals that household heads spend **13 hours working as a paid employee, 6 hours on own business, and 13 hours on own farm**. With heads spending 25 hours per week (62 hours per week for all household members), own farm work is the mainstay in the rural areas of Kigali city. On the other hand, paid employment is higher in urban and peri-urban Kigali (15 and 17 hours, respectively) than rural Kigali (about 6 hours per week). The household level figures are consistent with that of the head of the household (24 and 27 hours per week in urban and peri-urban Kigali vs. 8 hours per week in rural Kigali). With an **average travel time of half an hour** to reach their workplace, irrespective of the location of the household among the three strata, travel time for paid employees (heads only) seems reasonable by the standards of other East African cities. Traffic is still manageable compared to Nairobi for example where the average time to commute to work is 49 mins (World Bank, 2016). However, travel cost to workplace is higher in more urbanized areas (554, 400 and 227 RWF per one-way trip in urban, peri-urban and rural Kigali, respectively) which is perhaps a reflection of the choice of mode transportation across different parts of the city.

Table 2 reports the main characteristics of the sampled residential parcels disaggregated by stratum. Average parcel size is 929 sqm and it is substantially smaller in **urban EAs (536 sqm)** than in **peri-urban and rural EAs (1113 sqm and 1618 sqm, respectively)**. Consistent with spatial dynamics of cities, the share of built-up area is the highest in central Kigali (63%) compared to that of peri-urban and rural villages located within the perimeter of Kigali city (52% and 27%, respectively). Besides the number of habitable rooms (including service quarters) are relatively higher in urban areas (6.5 rooms) than in peri-urban (6 rooms) and rural areas (4.5 rooms). Self-reported property values (including land values) significantly decline from the center to the periphery of the city, i.e., RWF 49, 33 and 17 million in urban, peri-urban and rural areas, respectively. Land market activities are common particularly in the urban and rural areas of Kigali with about 75% and 68% of the parcels being acquired through purchase while intergenerational transfers are widely practiced in the rural part of Kigali with 61% of the parcels being acquired through inheritance.

Although Rwanda is one of the densely populated countries in Africa, most dwellings in Kigali city are either free-standing (83%) or attached houses (16%). Choice of building materials, which are important factors in determining value of properties, vary across locations. Mud bricks/tree trunks with cement are the most widely used materials for exterior wall (66%, 76% and 55% in urban, peri-urban and rural areas,

respectively) in Kigali city. While oven fired bricks or cement blocks are almost exclusively used in urban (0.24%) and peri-urban (0.13%) Kigali, exterior walls with mud bricks or tree trunks with mud are common in rural Kigali (29%). Most of the residential houses have cement or clay floors in urban (94%) and peri-urban (81%) areas, but the bulk majority of them have earthen floors in rural (61%) Kigali.

Preferences to amenities often reflect the value owners assign to their homes. There is substantial spatial variation in access to water and electricity coverage in Kigali city. Access to water and electricity does vary substantially depending on the type of areas of residence. Although only 5% of the sampled households reported to have piped water inside their dwellings, three-fourth of the houses in urban, half of them in rural and about a tenth of them in rural Kigali have access to piped water in their yard. Flush toilets are rare with only 18%, 9% and 1% of the dwellings respectively in urban, peri-urban and rural areas of Kigali fitted with such facilities. Most households are connected to the main electricity supplier, ESWA network (83%), but only 42% of the households receive electricity from this source in rural Kigali. Similarly, garbage collection, whether governmental or private, is available for 73%, 31% and 3% of households in urban, peri-urban and rural zones of Kigali.

Data on access to public services, infrastructure and job opportunities, reported in the bottom panel of table 2, show substantial spatial variation across Kigali city. As expected, households located in central Kigali have better access to services in their neighborhoods compared to households located in peri-urban and rural areas. Distance to tarred roads (ranging from 0.25 km to roughly 5 km) and high voltage electricity line (ranging from 0.04 km to 1.7 km) increases significantly when one moves away from central Kigali towards that of the peripheries of the city. Number of primary schools (ranging from 20 to 2) and health centers (ranging from 4 to 0.5) within 2 km radius also show steady decline as we radially move from the center to the peripheral areas of the city. Job opportunities, proxied by number of business establishments or their employees, are higher in urban and peri-urban areas of the city (Figure 3). Although from the surface mixed use of residential parcels seem relatively important in peri-urban (16%) and rural areas of Kigali (36%) than the central business district (3%), details on the type of businesses show that agricultural related activities are by far the predominant ones (91%).

Consistent with the current land tenure system in Rwanda, almost all the parcels are under leasehold tenure arrangement. Despite the recent completion of the first-time registration and regularization program in the country, 9%, 22% and 30% of residential landowners from urban, peri-urban and rural areas of Kigali, respectively; reported that they do not have land certificates to certify their ownership rights of their property. Half of the households with no legal documents claim that their certificates are not yet ready, while about 16% stated that they do not possess the certificate for their land because of the fact that they have not yet paid the registration fees. This raises concerns about informality of transactions that should be

addressed in a separate analysis. Despite this observed gap, the level of perceived tenure security is very high with 95% of our sampled households reporting zero likelihood of encountering any private land-related disputes in the next 5 years (this figure is slightly lower in peri-urban areas possibly due upcoming new developments in this area).

The Kigali masterplan has been a flagship project of the Kigali City Hall and will guide the spatial development of the city through optimal land use. Officially launched in 2013, it defines type of activities in detail by zones for each of the three districts that form Kigali city (see Figure 4). Given its implementation (actual and planned) can affect landowners' choices and preferences, it will be an important aspect of land pricing (and self-estimation of land prices) in the city. Figures reported in table 3, however, suggest that **only 27% of the households know about the existence of the Masterplan itself**. Level of awareness are much higher in urban and peri-urban areas (28% and 33%, respectively) than in rural areas (15%). **Among households who knows about the existence of the masterplan itself, only 34% know what is planned for their neighborhood and 32% of them thought that they would be able to meet the requirement of the plan** at the time of interview. In fact, overlaying the masterplan zones with the sampled residential parcels show that 56% of them are located in residential areas and 12% of them in agricultural areas. The rest of the parcels are located either on commercial, industrial or recreational areas. Strict compliance with the masterplan may thus require some adjustments by the property owners.

Indeed, the implementation of the masterplan is a concern for those who are aware of the requirements. About 58% of them expresses some level of fear that they would lose their land as a result of the implementation of the masterplan. With 76% reporting to lose their land, the level of perceived insecurity due to the implementation of the master plan is the highest in the peri-urban areas of Kigali city.

## **Empirical strategy**

The empirical approach follows {Rosen's 1974} theoretical framework for the identification and estimation of hedonic price models. The approach involves a two-step procedure to recover the marginal value of various attributes for heterogeneous individuals. The first step estimates the self-assessed sale and rental values of properties using a standard hedonic method. The value of a housing property depends on a bundle of physical attributes and neighborhood or community characteristics {Bajari and Kahn, 2005; Nelson, 1978; Lall and Lundberg, 2008}, i.e.,

$$V = V(Z, D, N), \quad (1)$$

where  $V$  is the self-reported sale value of residential properties;  $Z$  is a vector of physical housing characteristics that consists of parcel area, number of buildings or rooms, and dummy variables that capture

main exterior wall and floor materials, existence of flush toilet, measures of tenure security (possession of lease certificate and the likelihood of future land-related private disputes), whether the residential property is used for commercial or other purposes (mixed use or not), measures that capture access to amenities and services (i.e., whether the house is connected to water, electricity distribution from ESWA and benefit from private/government garbage collection);  $D$  includes a set of variables that capture proximity to public series and job centers (distance to the nearest tarred road, to the CBD (Kigali tower) and to the nearest high voltage line); and  $N$  is a vector of neighborhood characteristics including numbers of primary schools and health centers within 2 km radius and also the number of jobs in the cell as a proxy for economic activity/availability of employment. The estimated coefficients on the observed characteristics represent marginal hedonic prices of a housing unit  $i$  that depends on the choice of the functional form of  $V(\cdot)$ . The implicit (subjective) price for an individual attribute,  $z_i$ , associated to a housing unit  $i$  is thus computed as

$$\hat{v}_i(z) = \partial V / \partial z_i, \quad (2)$$

and then the second step of the empirical procedure estimates the marginal willingness to accept using the implicit price,  $\hat{v}_i(z)$ , as endogenous variable on household level characteristics such as gender, age, education level and migration history of the head of household as well as family size and total value of assets as a proxy for wealth.

A nonlinear hedonic price function is required in the first-stage to avoid a situation of constant implicit price,  $\hat{v}_i(z)$ , functions that are independent of the quantity of the attributes that would be traded {Witte, Sumka and Erekson, 1979}. Semi- and non-parametric kernel and high-order polynomial regression methods are the most widely employed procedures in the empirical literature for recovering flexible marginal attribute prices {Bajari and Kahn, 2005; Lall and Lundberg, 2008; Bishop and Timmins, 2011}. In this paper, for ease of exposition, we use a third degree polynomial of continuous variables to estimate the marginal value of various attributes.<sup>2</sup> The specification in log-linear takes the following form

$$\begin{aligned} \log V_i = & \beta_0 + \beta_1 \log AREA_i + \beta_2 (\log AREA_i)^2 + \beta_3 (\log AREA_i)^3 + \beta_4 FREE_i + \beta_5 BLDGS_i + \\ & \beta_6 (BLDGS_i)^2 + \beta_7 (BLDGS_i)^3 + \beta_8 ROOMS_i + \beta_9 (ROOMS_i)^2 + \beta_{10} (ROOMS_i)^3 + \\ & \beta_{11} WCEM_i + \beta_{12} FCEM_i + \beta_{13} FLUSHT_i + \beta_{14} WATER_i + \beta_{15} ELEC_i + \beta_{16} GARB_i + \\ & \beta_{17} CERT_i + \beta_{18} NOCONFLICT_i + \beta_{19} MUSE_i + \beta_{20} \log DCBD_i + \beta_{21} (\log DCBD_i)^{23} + \\ & \beta_{22} (\log DCBD_i)^3 + \beta_{23} \log DROAD_i + \beta_{24} (\log DROAD_i)^{23} + \beta_{25} (\log DROAD_i)^3 + \beta_{26} \log DLV_i \\ & + \beta_{27} (\log DLV_i)^{23} + \beta_{28} (\log DLV_i)^3 + \beta_{29} NSCHOOLS_i + \beta_{30} (NSCHOOLS_i)^2 + \\ & \beta_{31} (NSCHOOLS_i)^3 + \beta_{32} NHEALTH_i + \beta_{33} (NHEALTH_i)^2 + \beta_{34} (NHEALTH_i)^3 + \\ & \beta_{35} NJOBS_i + \beta_{36} (NJOBS_i)^2 + \beta_{37} (NHEALTHNJOB_i)^3 + \varepsilon_i \end{aligned} \quad (3)$$

<sup>2</sup> It is important to note that our dataset does not support beyond a third degree polynomial specification.

where

$V_i$  = self-reported sale or rental value of property  $i$   
 $AREA$  = parcel area in square meters  
 $FREE$  = Freestanding house  
 $BLDGS$  = number of building  
 $ROOMS$  = number of habitable rooms  
 $WCEM$  = Cement wall  
 $FCEM$  = Cement floor  
 $FLUSHT$  = property has flush toilet system  
 $WATER$  = property has access to piped water supply  
 $ELEC$  = Electricity from ESWA  
 $GARB$  = Government/private firm garbage collection  
 $CERT$  = Lease certificate  
 $NOCONFLICT$  = Null likelihood of conflict  
 $MUSE$  = mixed use property dummy (commercial/agricultural-residence use)  
 $DCBD$  = distance to CBD (Kigali tower) in kilometers  
 $DROAD$  = distance to the nearest asphalt road in meters  
 $DVL$  = distance to the nearest high voltage line in meters  
 $NSCHOOLS$  = number of primary schools located in a 2km radius  
 $NHEALTH$  = number of health centers located in a 2km radius  
 $NJOBS$  = number in the cell  
 $\varepsilon_i$  = residual error term

## Results

The results of the third degree polynomial hedonic function for households' self-estimated property values are reported in Table 4. The first two columns present the estimated elasticities for continuous variables or semi-elasticities for categorical variables (col. 1) and the marginal values (col. 2) computed at the mean value of the attributes for the pooled sample. Columns (3) and (4), (5) and (6) and (7) and (8) show the estimated parameters for the urban, peri-urban and rural subgroups, respectively.

The signs of the estimated coefficients of property and housing characteristics are as a priori expected. Parcel size is significantly positively correlated with self-reported property values. **The marginal value of an extra square meter steadily decreases from about RWF 33,900 in urban, to RWF 12,600 RWF in peri-urban, to just 2,700 RWF in rural areas.** The denser the neighborhood, and the smaller the parcels, the higher the self-reported value associated to an extra living space. While the number of building within a parcel has a negative and significant relationship with self-estimated value of properties, the number of

rooms has the opposite effects.<sup>3</sup> An extra room is likely to add about RWF 4 million at the margin to the self-reported value of a property regardless of its location across the city of Kigali. The quality of building materials (having cement exterior wall) and access to better amenities (having flush toilet and piped water within the compound) are positively associated with self-reported value of properties, albeit, the magnitude slightly varies across space.

Land tenure formalization is positively associated with self-reported property values of residential parcels, but the estimated coefficient is statistically significant only in the case of rural areas of Kigali city. Possession of land certificate, all other factors remaining constant, is likely to increase the self-reported value of properties by RWF 4.4 million in rural Kigali. Having the lease contract and land certificate do not seem to add statistically significant value in the urban and peri-urban parts of Kigali city. Besides, although the measure of perceived land tenure security (i.e., no likelihood of facing land-related disputes) is positively associated with subjective property values, its estimated coefficient is marginally significant only in the case of the pooled sample.

Given the very high level of electricity connectivity in the urban and peri-urban parts of Kigali, it is not surprising to find insignificant coefficients for the variables that are used to measure access to electricity (i.e., direct connection to the major supplier and distance to the nearest high voltage line). However, these variables significantly affect the self-reported values of properties in rural Kigali. While having direct connection to electricity is positively associated, distance to the nearest high voltage line, used as a proxy for the reliability of the service, has a negative relationship with property values in rural Kigali. Access to garbage collection service by a private or government firm seems to matter only in peri-urban areas. Although there is sufficient variation in access to this service in central Kigali, it is almost non-existent in rural areas.

Better physical connectivity, proxied by the distance of the property to a tarred road, is positively associated with self-reported property values in both urban and peri-urban areas. An extra meter away from the nearest tarred road is likely to reduce the self-reported value of properties by RWF 24,200 and 5,800 in urban and peri-urban areas, respectively. The positive and statistically coefficient of distance to tarred road in rural areas seems an anomaly. Given tarred roads almost non-existent in rural Kigali (on average about 5 km), there is a need to explore other options (say, other types of roads) to capture connectivity in this area. The interpretation of the positive and statistically significant coefficient of the distance to the CBD (Kigali city tower) is less clear. There is a need to explore further if there are multiple business centers that are relevant for different neighborhoods. However, it seems to have the expected sign in peri-urban and rural areas

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<sup>3</sup> There might be a problem of multicollinearity given that number of rooms are positively associated with the number of buildings within the parcel.



even if it is not statistically significantly different from zero. The results are mixed for access to schools and health services.

Access to local job opportunities, proxied by number of formal and informal workers in establishments located with the cell of residence (extracted from the 2014 establishment census), is positively associated with self-reported value of residential properties, and its marginal value increases as one moves radially away from the center of the city. While residents of urban Kigali in our sample value an additional 100 jobs at RWF 623,000, it increases to RWF 985,000 in peri-urban areas and RWF 3.415 million in rural Kigali. In terms property values, these marginal values are equivalent to **1.3%**, **3.1%** and **20.1%** in urban, peri-urban and rural areas of Kigali, respectively. This implies that as overall economic activities shrink, local opportunities become more important. This result is robust to the choice of alternative measures of economic activity such as the sum of jobs from the census in both the cell of residence and all neighboring cells, or the number of firms established in the cell of residence (see appendix tables A1 and A2). Mixed use of land, which translate into the ability to generate income within the property, is surprisingly not statistically significant in determining the self-reported price of properties, even in rural areas. Given that the most important activity is agricultural related, the effect might be fully captured by parcel area.

The results that control for masterplan zones are given in table 5. The first set of regressions (cols. 1-3) include all the main zones (residential, commercial, commercial mixed, industrial, recreational, agriculture and protected areas). Overall, we do not find systematic relationship between self-reported property values and planned land uses proposed under the masterplan. The only exception is the case of peri-urban areas where residing in proposed commercial area is likely to increase self-reported value while commercial mixed use the reverse effect. One, however, needs to be cautious as descriptive statistics clearly show very low level of landowners' knowledge of either the masterplan itself or the detailed planning at the local level. The second set of regressions (cols. 4-6) control for proposed heights of residential areas. The results are not consistently the same across strata. While designated low-rise residential blocks in peri-urban areas are positively associated with subjective property values (14%), medium-rise residential blocks are the ones that are positively associated with property values in central Kigali (24%) and rural Kigali (58%).

**Table 1: Household main characteristics**

	Total	Urban	PeriUrban		Rural	
Female headed household	0.26	0.29	0.23	***	0.24	
Size of household	4.92	5.05	4.95		4.55	***
Age of head of household	48.52	50.85	46.49	***	45.74	
Head is married	0.56	0.56	0.57		0.56	
Head never moved from current place of residence	0.59	0.62	0.68	***	0.40	***
Head moved from other province	0.21	0.22	0.21		0.19	
Head moved from another country	0.12	0.10	0.17	***	0.05	***
No. years of schooling, head	7.80	9.26	7.39	***	4.89	***
Head has prim educ	0.43	0.33	0.47	***	0.59	***
Head has vocational educ	0.07	0.08	0.06	**	0.05	
Head has sec educ	0.25	0.31	0.23	***	0.11	***
Head has univ educ	0.14	0.20	0.11	***	0.03	***
weekly hours working as a paid employee, head	13.44	14.56	16.81	**	6.14	***
weekly hours working on own business, head	5.97	6.79	6.40		3.43	***
weekly hours working on own farm, head	12.81	10.36	8.29	***	24.88	***
weekly hours working as a paid employee, total hh	21.29	23.80	26.76	**	7.74	***
weekly hours working on own business, total hh	9.85	11.29	10.83		5.05	***
weekly hours working on own farm, total hh	42.06	41.80	27.69	***	62.48	***
Total time spent (one way) to wage employment in mins, head	28.67	27.73	30.12		28.35	
Total amount spent (one way) to wage employment in RWF, head	459	554	400	**	227	*
Total value of assets (excl. land)	4020992.00	4731654.00	5463524.00		332691.80	
no. obs.	2853	1431	824		598	

Note: Tstatsperformed urban vs peri-urban; peri-urban vs. rural. \*\*\*, \*\*, \* significant at 1, 5, 10% respectively

**Table 2: parcel and dwelling characteristics, tenure security, land use and access to services**

	Total	Urban	Peri-Urban		Rural	
<b>Land and dwelling characteristics</b>						
Parcel size, sqm	929	536	1113	***	1618	
Sale price of land, today (self estimated)	3.75e+07	4.86e+07	3.30e+07	***	1.73e+07	***
Rental price (self estimated)	14800000	25600000	6026466		851990	*
% of parcel built	0.52	0.63	0.52	***	0.27	***
Year of acquisition	1999	1997	2003	***	1998	***
Purchased	0.64	0.75	0.68	***	0.31	***
Inheritance	0.30	0.21	0.23		0.61	***
Government allocation	0.05	0.03	0.07	***	0.06	
Walked-in	0.00	0.00	0.01		0.01	
Free-standing house	0.83	0.80	0.83	**	0.91	***
Attached house	0.16	0.19	0.16	*	0.09	***
Flat	0.01	0.01	0.00		0.00	*
No. of buildings	1.64	1.72	1.73		1.33	***
No. of rooms	6.02	6.69	5.96	***	4.53	***
Exterior wall: mud bricks/tree trunks with cement	0.66	0.66	0.76	???	0.55	???
Exterior wall: oven fired bricks/cement blocks	0.17	0.24	0.13	???	0.05	???
Exterior wall: mud bricks/tree trunks with mud	0.10	0.04	0.06		0.29	**
Floor: cement or clay	0.78	0.94	0.81	**	0.37	***
Floor: beaten earth	0.21	0.05	0.18	***	0.61	***
toilet: flush	0.12	0.18	0.09	***	0.01	***
<b>Land documents and tenure security</b>						
type of tenure: leasehold	1.00	1.00	1.00		1.00	
has a lease contract and land certificate	0.83	0.91	0.78	***	0.70	***
reason for not having a land certificate:						
land dispute	0.06	0.10	0.04	**	0.04	
located in wetland	0.04	0.10	0.01	***	0.01	
title was not picked	0.12	0.16	0.10		0.11	
not yet ready	0.53	0.49	0.59	*	0.49	*
hasn't pay registration fees	0.16	0.09	0.17	**	0.21	
other	0.09	0.05	0.09		0.14	
Length of lease	35.98	20.51	37.79	***	80.96	***
Likely of private conflict in the next 5 years: not at all	0.94	0.95	0.92	***	0.95	**
<b>Land use and type of activities</b>						
Use: residential only	0.87	0.97	0.84	***	0.64	***
Use: mixed	0.13	0.03	0.16	***	0.36	***
Main business:						
agriculture	0.91	0.50	0.91	***	0.98	***
manufacture	0.00	0.00	0.00		0.00	
Cottage and handicraft	0.00	0.00	0.00		0.00	
whole sale	0.01	0.03	0.00	*	0.00	
retail	0.09	0.56	0.08	***	0.02	***
services	0.01	0.03	0.01		0.00	
<b>Access to services and economic activities</b>						
water piped to the dwelling or the yard	0.58	0.80	0.53	***	0.11	***
electricity from EWSA	0.83	0.97	0.89	***	0.42	***
garbage collection by gov/private firm	0.46	0.73	0.31	***	0.03	***
Distance to the closest tared road, in m	1382.09	236.03	931.90	***	4744.14	***

Distance to the closest high voltage line, in m	409.33	42.88	90.67	***	1724.80	***
Distance to the CBD, in km	8.03	4.48	10.09	***	13.71	***
# of primary schools within 2km	12.79	19.66	8.69	***	1.99	***
# of health centres within 2km	2.01	2.96	1.52	***	0.41	***
no. of enterprises in the cell	282.60	333.58	344.62		75.13	***
number of jobs (all) in cell, in 100	10.36	14.85	8.49	***	2.18	***
number of jobs (formal) in cell, in 100	4.60	7.44	2.52	***	0.66	***
number of jobs (informal) in cell, in 100	4.12	4.81	4.98		1.29	***
Number of jobs (all) in cell and all neighboring cells	68.77	98.48	53.51	***	18.73	***
	2853	1431	824		598	

**Table 3: Kigali Masterplan - household knowledge**

	<b>Total</b>	<b>Urban</b>	<b>PeriUrban</b>		<b>Rural</b>	
<b>Household knowledge</b>						
Aware of Kigali City Masterplan	0.27	0.28	0.33	**	0.15	***
Aware of plan of Kigali City Masterplan for neighborhood	0.34	0.34	0.39		0.19	***
Likelihood to lose land as a result of MP implementation:						
<i>not at all</i>	0.42	0.50	0.24	***	0.58	***
<i>somewhat likely</i>	0.24	0.22	0.26		0.28	
<i>likely</i>	0.19	0.14	0.29	***	0.13	***
<i>very likely</i>	0.11	0.09	0.16	**	0.01	***
<i>for sure</i>	0.04	0.04	0.06		0.00	**
Parcels meets Masterplan requirements	0.32	0.37	0.23	***	0.54	***
Could afford changes to meet Masterplan requirements	0.15	0.25	0.07	***	0.00	
Would consider selling to meet Masterplan requirements elsewhere	0.37	0.23	0.54	***	0.06	***
if yes, would sell immediately	0.30	0.16	0.37	**	0.00	
if yes, would sell when city authority asks me to comply	0.44	0.53	0.40		0.00	
if yes, would sell when district authority asks me to comply	0.23	0.24	0.22		1.00	
if yes, would sell when sector authority asks me to comply	0.03	0.08	0.01	**	0.00	
Any neighbor lost land as a result of Masterplan implementation	0.06	0.04	0.09	***	0.02	**
<b>Masterplan zoning of surveyed parcels</b>						
residential (all)	0.56	0.66	0.58	***	0.28	***
low rise residential	0.41	0.51	0.37	***	0.23	***
medium rise residential	0.14	0.14	0.21	***	0.05	***
high rise residential	0.00	0.01	0.00		0.00	
commercial	0.07	0.10	0.05	***	0.04	
mixed commercial	0.05	0.07	0.03	***	0.01	***
industrial	0.02	0.00	0.05	***	0.03	**
recreational	0.05	0.07	0.04	***	0.05	
agriculture	0.12	0.02	0.04	***	0.49	***
protected area	0.07	0.08	0.05	**	0.06	
	2853	1431	824		598	

**Table 4: Hedonic Estimates, Self estimated property values**

	All		Urban		Peri-urban		Rural	
	<i>elasticities</i>	<i>marginal values at mean</i>	<i>elasticities</i>	<i>marginal values at mean</i>	<i>elasticities</i>	<i>marginal values at mean</i>	<i>elasticities</i>	<i>marginal values at mean</i>
Ln size, sqm	0.331*** (0.022)	13,267.270*** (901.070)	0.373*** (0.037)	33,908.256*** (3,337.816)	0.403*** (0.042)	11,639.636*** (1,209.610)	0.251*** (0.043)	2,690.452*** (459.180)
Free-standing house	0.101* (0.053)	3,729,914.574* (1,959,215.867)	0.177** (0.071)	8,537,851.392** (3,403,270.038)	-0.109 (0.095)	-3,445,655.835 (3,005,957.041)	0.068 (0.156)	1,147,892.807 (2,649,074.048)
No. of buildings	-0.164*** (0.047)	-6,039,246.933*** (1,713,642.037)	-0.105* (0.059)	-5,046,576.991* (2,857,485.718)	-0.245*** (0.081)	-7,788,023.976*** (2,561,929.723)	-0.596* (0.311)	-10,126,227.251* (5,284,852.537)
No. of rooms	0.119*** (0.012)	4,391,263.573*** (431,876.475)	0.081*** (0.015)	3,883,899.230*** (709,769.001)	0.124*** (0.020)	3,922,591.377*** (630,573.800)	0.212*** (0.037)	3,602,724.020*** (626,249.399)
exterior wall: cement blocks	0.363*** (0.084)	13,352,576.759*** (3,086,285.138)	0.228** (0.108)	10,978,870.189** (5,174,860.064)	0.453*** (0.163)	14,386,834.948*** (5,188,778.881)	0.423 (0.272)	7,187,910.070 (4,625,715.898)
floor: cement	0.076 (0.047)	2,794,575.334 (1,742,948.338)	-0.057 (0.069)	-2,729,925.833 (3,301,282.595)	0.070 (0.083)	2,233,031.892 (2,641,195.948)	0.296*** (0.107)	5,021,584.449*** (1,808,167.285)
toilet: flush	0.466*** (0.069)	17,148,071.120*** (2,547,730.053)	0.453*** (0.083)	21,773,149.891*** (4,013,505.830)	0.292** (0.138)	9,271,149.657** (4,383,440.944)	0.947** (0.416)	16,075,970.042** (7,058,129.053)
Water pipe in the residence/on the plot	0.433*** (0.051)	15,949,773.137*** (1,881,083.123)	0.404*** (0.075)	19,448,361.452*** (3,592,201.101)	0.441*** (0.084)	14,010,828.653*** (2,667,822.488)	0.356** (0.158)	6,039,099.182** (2,689,642.191)
electricity from EWSA	0.362*** (0.071)	13,316,082.841*** (2,625,398.225)	0.269 (0.165)	12,946,993.664 (7,937,987.878)	0.173 (0.117)	5,502,507.629 (3,718,523.682)	0.398*** (0.116)	6,759,828.026*** (1,965,957.383)
garbage collection by gov/private firm	0.001 (0.048)	20,149.136 (1,754,723.864)	-0.061 (0.063)	-2,947,852.095 (3,011,483.818)	0.163** (0.080)	5,181,554.166** (2,530,463.398)	-0.240 (0.271)	-4,083,032.930 (4,603,300.666)
Has lease contract and land certificate	0.157*** (0.052)	5,792,938.406*** (1,921,873.787)	0.148 (0.091)	7,097,687.098 (4,397,053.571)	0.096 (0.088)	3,034,342.386 (2,779,779.614)	0.257*** (0.096)	4,362,067.528*** (1,629,290.563)
Likely of private conflict in the next 5 years: not at all	0.146* (0.078)	5,364,122.227* (2,861,517.808)	0.073 (0.119)	3,496,008.376 (5,742,893.066)	0.121 (0.123)	3,828,256.159 (3,890,484.522)	0.285 (0.194)	4,844,102.510 (3,296,307.592)
Land use: mixed	-0.064 (0.061)	-2,337,635.612 (2,234,457.563)	-0.268 (0.176)	-12,909,006.534 (8,489,265.318)	-0.122 (0.097)	-3,873,616.009 (3,072,000.732)	0.148 (0.091)	2,511,558.441 (1,539,131.650)
Ln. distance to the CBD, in km	0.069 (0.050)	316,576.830 (229,081.385)	0.195*** (0.067)	2,081,184.823*** (716,039.927)	-0.106 (0.112)	-333,362.310 (351,768.012)	-0.087 (0.328)	-107,155.961 (405,767.777)
Ln. Distance to the nearest tarred road, in m	-0.027 (0.026)	-718.082 (688.501)	-0.119*** (0.033)	-24,225.948*** (6,752.645)	-0.171*** (0.059)	-5,808.623*** (1,997.199)	0.403*** (0.131)	1,449.567*** (470.468)
Ln. Distance to the nearest voltage line, in m	-0.033** (0.016)	-2,928.749** (1,447.813)	0.003 (0.026)	3,268.143 (28,697.572)	-0.016 (0.027)	-5,552.110 (9,570.644)	-0.179** (0.087)	-1,768.218** (859.112)
# of primary schools within 2km	0.009 (0.006)	319,946.298 (229,895.076)	0.016*** (0.005)	765,632.946*** (234,636.528)	-0.004 (0.012)	-127,271.291 (381,012.515)	-0.102** (0.050)	-1,725,907.120** (843,974.460)
# of health centres within 2km	0.008 (0.026)	302,547.003 (968,141.261)	-0.038 (0.032)	-1,827,463.904 (1,522,763.403)	-0.049 (0.052)	-1,541,073.859 (1,637,674.758)	0.502** (0.237)	8,526,776.782** (4,027,082.130)
number of jobs (all) in cell, in hundreds	0.012** (0.005)	425,116.705** (200,279.389)	0.013** (0.006)	622,916.035** (265,419.469)	0.031** (0.013)	985,237.111** (399,394.005)	0.201*** (0.059)	3,415,239.476*** (1,009,532.726)
urban	0.270*** (0.103)	9,949,606.865*** (3,783,459.426)						
peri-urban	0.083 (0.085)	3,059,259.313 (3,120,340.638)						
R2	0.438		0.343		0.460		0.3913	
Number of observations		2,718		1,362		777		579

note: .01 - \*\*\*; .05 - \*\*; .1 - \*;

Dependent variables: log of land value or log of monthly rent - hypothetical

**Table 5: Hedonic Estimates - including Materplan zoning**

	urban	peri-urban	rural	urban	peri-urban	rural
Ln.size sqm	0.377*** (0.037)	0.396*** (0.042)	0.265*** (0.044)	0.373*** (0.037)	0.407*** (0.042)	0.262*** (0.043)
Free-standing house	0.182** (0.071)	-0.097 (0.096)	0.024 (0.158)	0.184*** (0.071)	-0.112 (0.095)	0.042 (0.155)
No. of buildings	-0.096 (0.059)	0.246*** (0.080)	-0.558* (0.313)	-0.095 (0.059)	0.242*** (0.081)	-0.587* (0.309)
No. of rooms	0.077*** (0.015)	0.123*** (0.020)	0.205*** (0.037)	0.079*** (0.015)	0.125*** (0.020)	0.199*** (0.037)
exterior wall: cement blocks	0.214** (0.108)	0.464*** (0.164)	0.357 (0.278)	0.201* (0.107)	0.436*** (0.164)	0.451 (0.274)
floor: cement	-0.055 (0.069)	0.084 (0.083)	0.293*** (0.108)	-0.061 (0.068)	0.058 (0.083)	0.292*** (0.106)
toilet: flush	0.437*** (0.084)	0.289** (0.137)	0.901** (0.423)	0.430*** (0.083)	0.280** (0.138)	1.004** (0.414)
Water pipe in the residence/on the plot	0.412*** (0.076)	0.403*** (0.085)	0.321** (0.161)	0.419*** (0.075)	0.399*** (0.085)	0.311** (0.158)
electricity from EWSA	0.239 (0.166)	0.176 (0.117)	0.381*** (0.118)	0.220 (0.165)	0.166 (0.117)	0.393*** (0.116)
garbage collection by gov/private firm	-0.070 (0.063)	0.168** (0.080)	-0.280 (0.277)	-0.082 (0.063)	0.164** (0.080)	-0.314 (0.273)
Has lease contract and land certificate	0.147 (0.092)	0.082 (0.088)	0.239** (0.097)	0.152* (0.091)	0.087 (0.088)	0.256*** (0.096)
Likely of private conflict in the next 5 years: not at all	0.086 (0.120)	0.117 (0.122)	0.327* (0.196)	0.063 (0.119)	0.109 (0.123)	0.312 (0.193)
Land use: mixed	-0.254 (0.177)	-0.120 (0.097)	0.167* (0.093)	-0.266 (0.176)	-0.137 (0.097)	0.186** (0.092)
Ln. distance to the CBD, in km	0.183** (0.076)	-0.027 (0.117)	-0.149 (0.338)	0.191** (0.075)	-0.044 (0.116)	-0.264 (0.333)
Ln. Distance to the nearest tarred road, in m	- 0.107*** (0.034)	- 0.192*** (0.060)	0.371*** (0.142)	- 0.111*** (0.034)	- 0.188*** (0.060)	- 0.340** (0.135)
Ln. Distance to the nearest voltage line, in m	0.002 (0.027)	-0.012 (0.028)	-0.153* (0.089)	-0.007 (0.026)	-0.008 (0.028)	-0.104 (0.091)
# of primary schools within 2km	0.016 (0.012)	-0.009 (0.021)	-0.109 (0.072)	0.013 (0.011)	-0.017 (0.020)	-0.102 (0.070)
# of secondary schools within 2km	-0.006 (0.019)	0.013 (0.037)	-0.019 (0.094)	-0.005 (0.018)	0.020 (0.036)	-0.042 (0.091)
# of health centres within 2km	-0.023 (0.033)	-0.045 (0.060)	0.700*** (0.259)	-0.015 (0.033)	-0.063 (0.059)	0.531** (0.239)
number of jobs (all) in cell, in hundreds	0.011** (0.006)	0.030** (0.013)	0.232*** (0.065)	0.013** (0.006)	0.032** (0.013)	0.197*** (0.063)
MP Zone: commercial mixed	-0.076 (0.237)	-0.482** (0.245)	0.470 (0.792)			
MP Zone: commercial	0.090 (0.231)	-0.040 (0.179)	0.394 (0.329)			
MP Zone: industrial	-0.432 (0.715)	0.023 (0.185)	-0.371 (0.322)			
MP Zone: Recreational	-0.214 (0.233)	0.225 (0.205)	0.105 (0.296)			
MP Zone: agriculture	0.115 (0.297)	0.331* (0.197)	-0.078 (0.228)			
MP Zone: protected area	-0.055 (0.236)	-0.126 (0.181)	-0.072 (0.280)			
MP Zone: residential, all	-0.018	0.149	0.071			

	(0.211)	(0.099)	(0.221)			
MP Zone: residential low rise				-0.029 (0.063)	0.143* (0.081)	0.008 (0.107)
MP Zone: residential medium rise				0.239*** (0.088)	0.142 (0.097)	0.583*** (0.211)
MP Zone: residential high rise				-0.025 (0.351)	0.499 (0.655)	
R2	0.352	0.475	0.406	0.352	0.468	0.408
Number of observations	1,362	777	579	1,362	777	579

note: .01 - \*\*\*; .05 - \*\*; .1 - \*;

Dependent variables: log of land value or log of monthly rent - hypothetical



**Table A1: Hedonic Estimates: Self estimated rental values (elasticities)**

	all	urban	peri-urban	rural
Ln. size, sqm	0.212*** (0.024)	0.293*** (0.039)	0.142*** (0.043)	0.164*** (0.047)
Free-standing house	0.095* (0.056)	0.107 (0.074)	0.017 (0.096)	0.164 (0.169)
No. of buildings	-0.138*** (0.049)	-0.049 (0.062)	-0.295*** (0.081)	-0.659* (0.339)
No. of rooms	0.154*** (0.012)	0.111*** (0.015)	0.154*** (0.020)	0.233*** (0.040)
exterior wall: cement blocks	0.485*** (0.088)	0.503*** (0.114)	0.323** (0.163)	0.353 (0.298)
floor: cement	0.131*** (0.050)	-0.011 (0.072)	0.144* (0.085)	0.433*** (0.116)
toilet: flush	0.722*** (0.072)	0.638*** (0.087)	0.704*** (0.137)	0.720 (0.456)
Water pipe in the residence/on the plot	0.440*** (0.054)	0.501*** (0.079)	0.411*** (0.086)	-0.049 (0.173)
electricity from EWSA	0.533*** (0.075)	0.695*** (0.176)	0.649*** (0.120)	0.311** (0.126)
garbage collection by gov/private firm	0.111** (0.050)	0.074 (0.066)	0.189** (0.081)	0.346 (0.290)
Has lease contract and land certificate	0.054 (0.055)	0.042 (0.097)	0.094 (0.089)	0.031 (0.105)
Likely of private conflict in the next 5 years: not at all	-0.065 (0.081)	0.092 (0.126)	-0.551*** (0.123)	0.552*** (0.211)
Land use: mixed	0.006 (0.064)	-0.003 (0.185)	0.156 (0.098)	-0.021 (0.099)
Ln. distance to the CBD, in km	0.004 (0.053)	0.063 (0.070)	-0.301*** (0.113)	0.790** (0.364)
Ln. Distance to the nearest tarred road, in m	-0.051* (0.027)	-0.078** (0.035)	-0.283*** (0.060)	0.119 (0.144)
Ln. Distance to the nearest voltage line, in m	-0.042** (0.017)	-0.011 (0.027)	-0.005 (0.028)	-0.184* (0.097)
# of primary schools within 2km	0.008 (0.007)	0.001 (0.005)	-0.026** (0.012)	0.125** (0.054)
# of health centres within 2km	-0.010 (0.028)	-0.004 (0.033)	-0.029 (0.052)	-0.456* (0.258)
number of jobs (all) in cell, in hundreds	0.002 (0.006)	0.006 (0.006)	0.018 (0.013)	0.109* (0.065)
urban	0.604*** (0.108)			
peri-urban	0.384*** (0.089)			
R2	0.527	0.366	0.493	0.390
Number of observations	2,777	1,395	792	590

note: .01 - \*\*\*; .05 - \*\*; .1 - \*;

Dependent variables: log of land value or log of monthly rent - hypothetical

**Table A2: Robustness test: access to jobs**

	urban	peri-urban	rural	urban	peri-urban	rural
Ln. size in sqm	0.367*** (0.037)	0.398*** (0.042)	0.256*** (0.043)	0.379*** (0.037)	0.398*** (0.042)	0.254*** (0.043)
Free-standing house	0.185*** (0.071)	-0.130 (0.095)	0.058 (0.157)	0.187*** (0.071)	-0.159* (0.094)	0.054 (0.157)
No. of buildings	-0.102* (0.059)	-0.230*** (0.081)	-0.592* (0.312)	-0.099* (0.059)	-0.231*** (0.080)	-0.649** (0.313)
No. of rooms	0.074*** (0.015)	0.124*** (0.020)	0.215*** (0.037)	0.078*** (0.015)	0.124*** (0.020)	0.220*** (0.037)
exterior wall: cement blocks	0.226** (0.108)	0.419** (0.164)	0.438 (0.272)	0.251** (0.107)	0.406** (0.162)	0.480* (0.272)
floor: cement	-0.056 (0.069)	0.075 (0.083)	0.302*** (0.107)	-0.051 (0.068)	0.032 (0.083)	0.313*** (0.107)
toilet: flush	0.428*** (0.084)	0.303** (0.138)	0.920** (0.417)	0.440*** (0.083)	0.273** (0.137)	0.832** (0.419)
Water pipe in the residence/on the plot	0.434*** (0.075)	0.442*** (0.084)	0.324** (0.157)	0.418*** (0.075)	0.387*** (0.084)	0.276* (0.156)
electricity from EWSA	0.283* (0.166)	0.181 (0.117)	0.391*** (0.117)	0.260 (0.165)	0.175 (0.116)	0.383*** (0.116)
garbage collection by gov/private firm	-0.061 (0.063)	0.165** (0.080)	-0.269 (0.275)	-0.083 (0.062)	0.168** (0.079)	-0.310 (0.276)
Has lease contract and land certificate	0.144 (0.091)	0.085 (0.088)	0.263*** (0.096)	0.147 (0.091)	0.070 (0.087)	0.281*** (0.097)
Likely of private conflict in the next 5 years: not at all	0.075 (0.119)	0.131 (0.123)	0.368* (0.195)	0.077 (0.119)	0.134 (0.122)	0.443** (0.199)
Land use: mixed	-0.239 (0.177)	-0.147 (0.097)	0.113 (0.091)	-0.246 (0.176)	-0.163* (0.096)	0.134 (0.092)
Ln. distance to the CBD, in km	0.152** (0.074)	-0.022 (0.122)	-0.173 (0.332)	0.173** (0.077)	0.013 (0.133)	-0.272 (0.335)
Ln. Distance to the nearest tarred road, in m	-0.134*** (0.033)	-0.139** (0.060)	0.394*** (0.133)	-0.122*** (0.033)	-0.117** (0.058)	0.399*** (0.140)
Ln. Distance to the nearest voltage line, in m	0.006 (0.026)	-0.006 (0.027)	-0.205** (0.088)	-0.003 (0.026)	-0.030 (0.028)	-0.133 (0.087)
# of primary schools within 2km	-0.003 (0.011)	-0.006 (0.021)	-0.137** (0.067)	-0.002 (0.011)	-0.019 (0.019)	-0.126* (0.068)
# of secondary schools within 2km	0.016 (0.018)	0.019 (0.037)	0.008 (0.089)	0.030 (0.018)	0.047 (0.035)	0.001 (0.090)
# of health centres within 2km	-0.018 (0.032)	-0.052 (0.059)	0.653*** (0.239)	-0.043 (0.033)	-0.117* (0.060)	0.582** (0.236)
No. of establishments	-0.000 (0.000)	0.001** (0.000)	0.004** (0.002)			
number of jobs in cell and neighbouring cells, in hundreds				0.003*** (0.001)	0.008*** (0.002)	0.020* (0.011)
R2	0.344	0.463	0.393	0.348	0.472	0.393
Number of observations	1,362	777	579	1,362	777	579

note: .01 - \*\*\*; .05 - \*\*; .1 - \*;

Dependent variables: log of land value or log of monthly rent - hypothetical



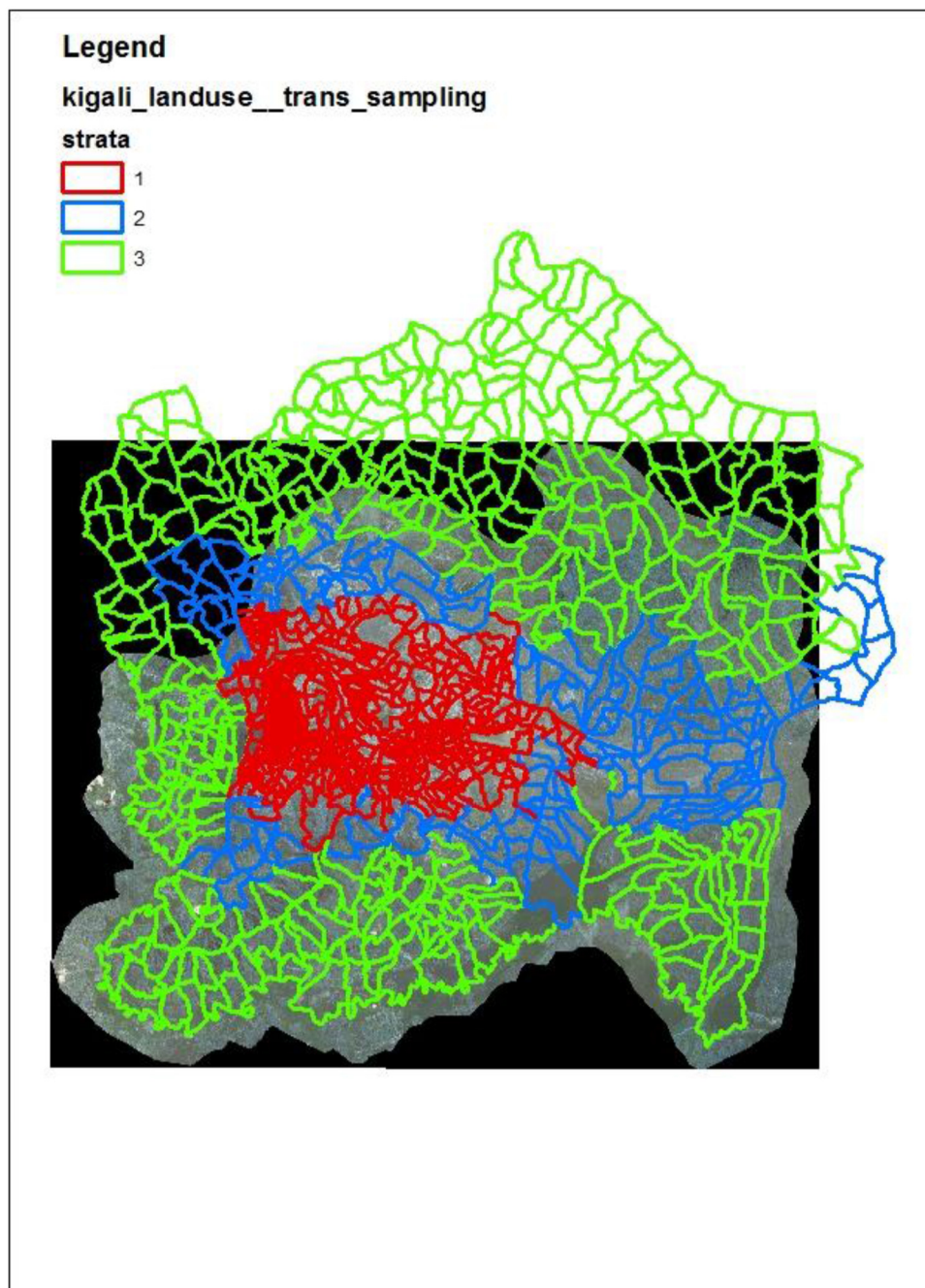


Figure 1: Map of villages by their respective stratum

Figure 2: location of residence of sampled households

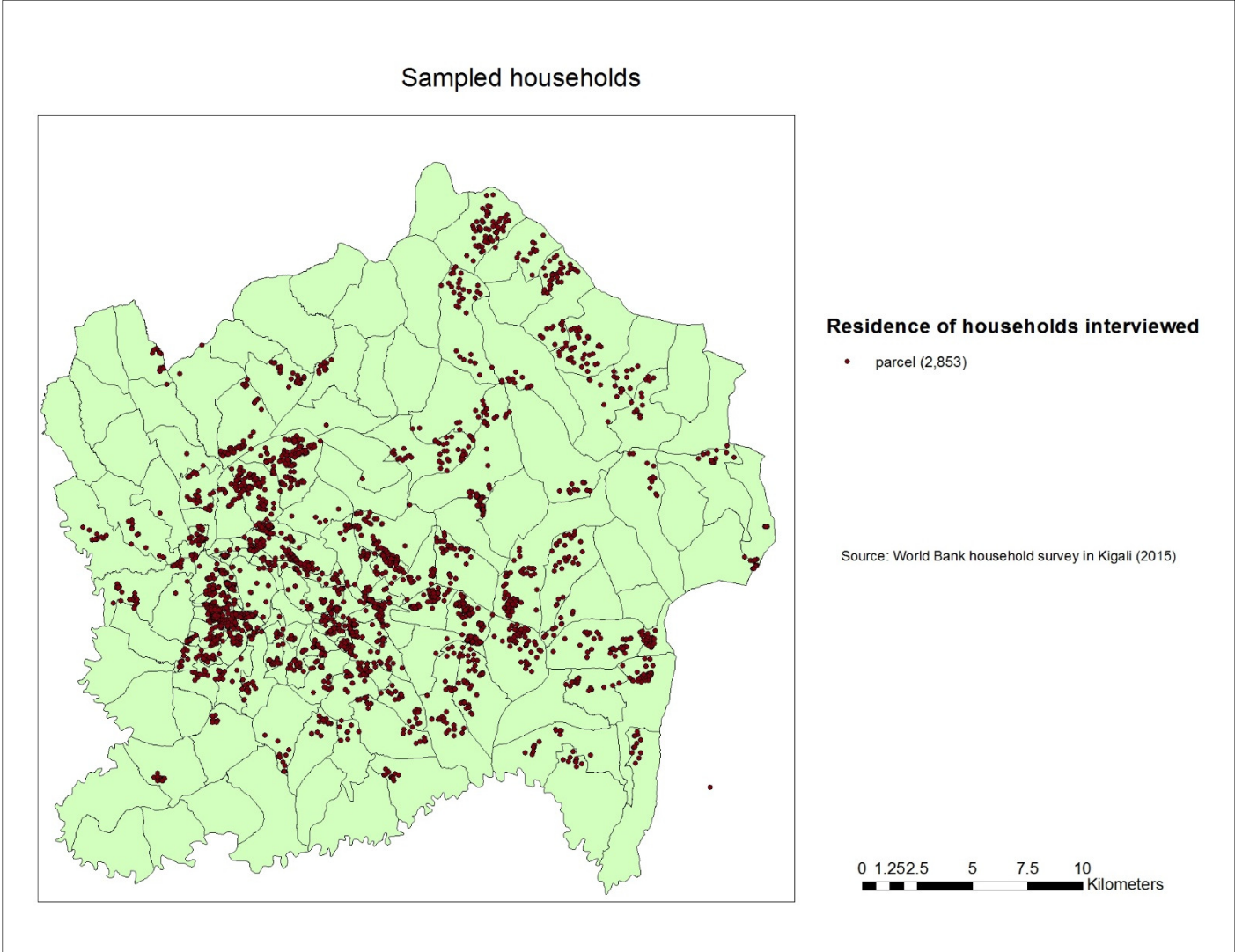


Figure 3: Number of jobs per cell

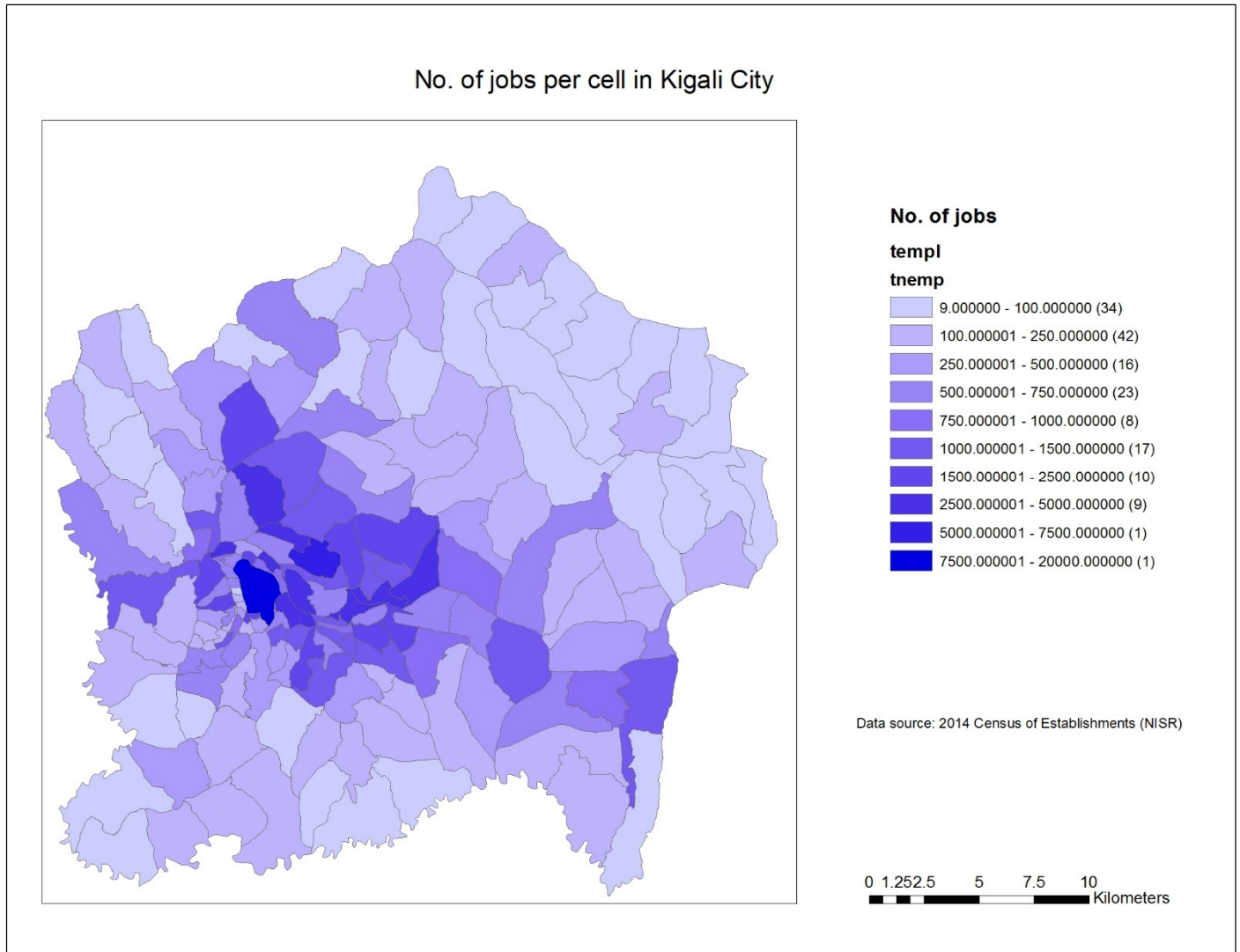




Figure 4: Kigali City Masterplan zoning

