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Original Research Article

Estimating A Contribution Coefficient Factor On Land Parcel To Achieve The People's Welfare And Equitable Reallocation Of Land: A Case Study Of Kabeza Site Of Kicukiro District, Kigali City, Rwanda.

Jean Pierre Habiyaremye[1, 2*], Cush Ngonzo Luwesi[3, 4*], Ugwuoti Amos Iloabuchi[5, 6*]

1 Central Christian University Of Malawi, Department Head Of Land Surveying And Geo-Informatics. 2*PhD Candidate, Francophone Africa Campus, Université Privée Africaine Franco-Arabe, Curacao, The Netherlands. 3 Director Of Postgraduate Studies, Francophone Africa Campus, Ballsbridge University, Curacao, The Netherlands. 4*Full Professor, Environment And Economic Policy, Crrebac School Of Water, University Of Kinshasa, DR Congo. 5 Department Of Geoinformatics And Surveying, University Of Nigeria Nsukka. 6*PhD Hydrographic Surveying

Email address:
ccunmw@gmail.com

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Abstract

The process of land reallocation involves the assembly of all properties belonging to different landowners in a certain area, followed by a new subdivision of land into parcels and redistribution of the land to the same landowners, based on the share of each one's land in the whole area.

To reduce conflicts, data collected from the field and the topographic survey showed that the existing situation is not well planned on the standard and indicates that the new design is well planned compared to the existing living.

From data analysis, there is no significant relationship between land reallocation and social equity/ welfare. Land reallocation as it is specifically to redistribution of the land to the initial landowners where Calculation of the contribution coefficient of landowners for the value of land occupied by public facilities, i.e. roads, canals, etc. was focused in this research and the formula has developed by Author of this Thesis to calculate Contribution Coefficient Factor (CCF) for each land.

However, there are still some serious concerns about the newly designed plan in this area. The conventional approach must be adopted to solve the problem with many conflicting criteria and constraints by applying developed formula.

1. Introduction

The process of land reallocation involves the assembly of all properties belonging to different landowners in a certain area, followed by a new subdivision of land into parcels and redistribution of the land to the same landowners based on the share (in terms of the area and value of each one's land as a percentage of the whole area) (Sonnenberg, 2002). The urban upgrading component is integrated by an 'Urban Communities subcomponent' that promotes the use of community-driven development approaches. As such, it aims to support the strengthening of the legal framework governing community-based organizations and the formalization of their links with local governments, as well as building the capacity of community-based organizations for organization and management, self-regulation, and active participation in decision-making and service delivery (Community-Driven Development in Urban Upgrading, 2004).

The issues related to land reallocation have aroused special attention from economists and policymakers. Some of the existing literature focused on land reallocation policies associated with the land tenure system and the effects these policies have on land security (Liu, 1998; Brandt et al., 2002; Tan et al., 2006). Liu et al. (1998) used village-level data to analyze the frequency of land reallocation and its differences across villages. Brandt et al. (2002) concluded that land tenure security is influenced by land reallocation through its magnitude and frequency. Tan et al. (2006) use land reallocation as one sub-group of independent variables to find the determinants of land fragmentation.

Compensation has been planned for those who will not be accommodated in the upgrading plan. After upgrading, those who no longer have access to any land in the settlement may be unhappy, and conflicts related to the smaller land parcels than were held before and conflicts relating to the sharing of land from a former parcel to a new parcel held by another may arise. Shifting land between households in most cases is not voluntary at the household level but is a potential instrument to achieve an efficient allocation of land resources. This project focused on estimating a contribution coefficient factor on land parcels to achieve the people's welfare and equitable reallocation of land at the Kabeza site to allocate each landholder a common share of the total area and make sure that each former landholder acquires a parcel in the new plan of the Kabeza Site. This research is based on the following null hypothesis (Ho): "There is no significant relationship between land reallocation and social equity or welfare.".

2. State of the Art

Research about automating the land reallocation process began in the Netherlands at the end of the 1960s, a decade that was characterized by the establishment of large-scale computers, i.e., mainframes. In the early 1970s, a computer support system called LIN was introduced, focusing on supporting the administrative problem of land reallocation. In particular, LIN was a registration system able to store the original cadastral details before land consolidation, the intermediate design steps, and the final design. Therefore, LIN could not actually directly support the decision-making process of land reallocation (Rosman and Sonnenberg, 1998).

Temporary land reallocation involves the determination of the placement of the landowners in the blocks, i.e., the land distribution process as defined in this research. Five basic criteria are taken into account in this process: existing buildings, wells, etc., in the parcels before consolidation; the existing location of a parcel; the landowners' preferences; the existence of a dominant soil class in a block; and the existence of a parcel whose value is higher than the mean of all the parcels of a specific area. Every criterion is assigned a weight based on its quality and importance. The model determines the list of landowners who will be allocated land in each block and the approximate position of the new parcels (Demetris Demetriou, 2014).

3. Materials and Methods

3.1. Research design

This study's methodological design encompasses one major objective and hypothesis, which were tested using the differentiation of land reallocation and social equity/welfare techniques and the estimation of a contribution coefficient factor as portrayed in Table 1.

Table 1. Suggested methodology for the study

Objectives	Hypotheses	Methodology	Statistics
To estimate a contribution coefficient factor on each parcel to achieve the people's welfare and equitable reallocation of land	Ho (Null hypothesis): There is no significant relationship between land reallocation and social equity/ welfare	Differentiation of land reallocation and social equity/ welfare	-Chi-square test of the difference between land reallocation and social equity/ welfare -Estimate of a contribution coefficient factor

3.2. Presentation of the Study Area

With an area estimated at 116.32 ha, Kabeza Site is located in Kicukiro District, Gahanga Sector, and Karembure Cell, covering around 75% of the total area of Kabeza Village and 26% of the total area of Mubuga Village within Kigali City. It is delineated by coordinates X = 509021.575m and Y = 4775632.714m as the coordinate system of ITRF_2005, at 2.40 km away from Nyanza Bus Parking and 1.5km away from Agakiriro of Gahanga, and also in the neighborhood of a school called G.S. Karembure at its north.

3.3. Sampling methods and techniques

The target population for this study included all residents of the site, with a total population of 550 residents (NISR, 2012). The study used a simple random sampling technique to select the participants for the study.

The following Slovin's formula (Equation 1) for sample size calculation has been adopted in this study:

$$n = \frac{N}{1+N(e)^2}, \qquad \text{(Equation 1)}$$

Where n is the sample size, N is the population size and e is margin error,

$$n = \frac{550}{1+550(e)^2} = 521.327, \qquad \text{(Equation 2)}$$

Hence, approximately 522 people were interviewed in this study out of a population of 550, using a margin of error of 0.01 or 1% at a 99% confidence level.

3.4. Data collection techniques and instruments

3.4.1. Types of data and techniques of data collection

To carry out this observational study project, the researcher collected both primary and secondary data and computerized data using the trilateration technique and relevant instruments. The following table shows activities, techniques, and instruments used during fieldwork.

Table 2. Field work technique and instruments

Activities	Techniques	Instruments
❖ Site reconnaissance ❖ Detailed topographic Survey ❖ Systematic boundary parcel resurvey	Trilateration	DGNSS Receiver, Panger, Hammer, Total station
❖ Meetings with Land Owners	-	-

Source: Primary data, 2023

Topographic data has been collected from the field to enable an accurate understanding of the topography of the area. Ground point control (GPC) is conducted using a DGNSS receiver and a Total station. Interesting points revealed the existing natural occurrences and manmade features.

3.5. Data analysis techniques

For land reallocation, it is specifically the redistribution of the land to the initial land owners, The calculation of the contribution coefficient of landowners for the value of land occupied by public facilities (i.e., roads, canals, etc.) was focused on in this project, and the following formula was developed

by the author in order to calculate the contribution coefficient factor (**CCF**) for each land as follows:

$$CCF = \left(\frac{TEP - TNP}{TPP} * 100\right) + PD, \quad \text{(Equation 3)}$$

Where **CCF** – Contribution Coefficient factor on each parcel, **TisP** is the total area of the existing parcel before planning (the initial parcel or site area) except the built-up area and existing infrastructure, TNP**PP** is the total area of the proposed plot except the infrastructure area occupied, and **PD** is the percentage of the total area destroyed by the new proposed public infrastructure within the area.

4. Results and Discussion

4.1. Assessment and prediction of the existing land use and land cover at Kabeza Site

Most of the existing parcels in this area have no access to roads or other infrastructure. Some parcels are bigger than 300 m^2, and others are less than 300 m^2 refer to the land titles provided by the National Land Authority. This site has been planned as the low-density residential densification zone (R1A) in the Kigali master plan.

Table 3: Existing land use Land cover

LAND USE LAND COVER	Area (ha)	%
Residential	13.52	11.62
Forest	1.56	1.34
Water tank	0.098	0.09
Commercial	1.81	1.56
Agriculture	96.0956	82.61
Transportation	3.24	2.79
Total	**116.32**	**100%**

Source: Primary data, 2023

4. 2. Predicting land use and land cover at the Kabeza site

The prediction of land use and land cover in the study area after the production of a design will show that residential, forest, water tank, agriculture, and transportation are present. Predicted land use, land cover, and the commercial zone will be removed from the site because of the Kigali master plan regulation zone (see table 4). This site is for single residential family units, but no need for a commercial zone must be integrated into this new design.

4.3. Making and replotting the new parcels within the Kabeza site

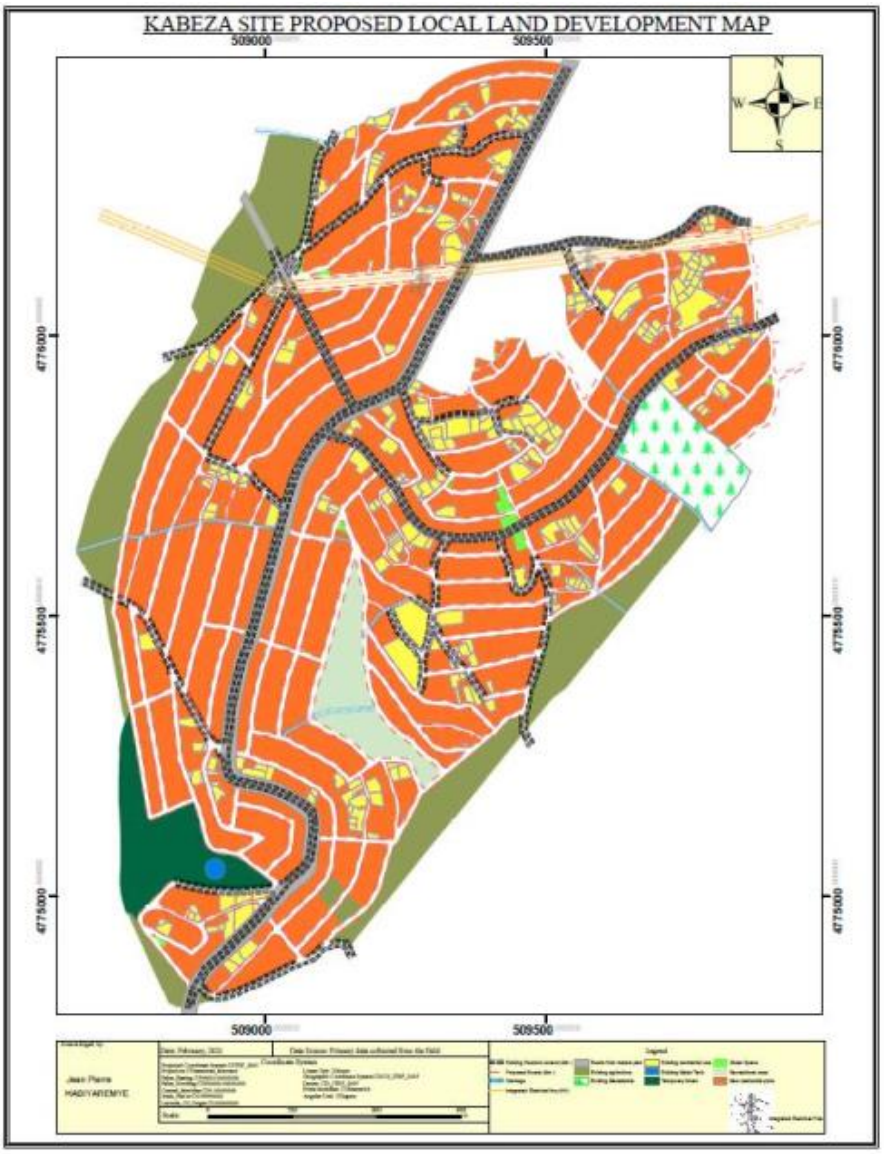

Figure 1: Local Land Upgraded Development Plan of the Site (Primary Data, 2023)

Regarding the zoning requirements from the Kigali City masterplan, this project has been made at 116.32 ha, with the plots having a width of 15m and a length of 20 m (15 m x 20 m). Because of the shape and some obstacles of the existing buildings, all the planned plots have not been fitted with 300 sq m as required.

Table 4: Adjustment of upgraded urban development plan

UPGRADED LAND USE	Area (ha)	%
Existing upgraded residential plot	13.44	11.56
New residential plot	56.18	48.25
Agriculture	11.82	10.16
Forest	2.83	2.48
Open space	0.37	0.32
Sport and Leisure	2.48	2.13
Water tank	0.098	0.08
Upgraded Transportation	8.7	7.48
New Transportation	20.402	17.54
Total	**116.32**	**100%**

Source: Primary data, 2023

4.4. Estimating the contribution coefficient factor on each parcel to achieve the people's welfare and equitable reallocation of land

The current area has settled in an unplanned and disorganized format and hasn't adopted the urban planning structure. The area currently has a population of 550 residents in 125 households. Of 550 residents, 324 are men, 176 are women, and 50 are children; about 43 people are in category one of poor. After reallocating land, every resident will get a new plot according to the area of the existing parcel. Those who have a small parcel will need upholding and will contribute an equal share in terms of percentage. Financially, it will be shared commonly with the new plot, meaning that no one will lose its land in this project because of the design. The finished parcel of infrastructure will be reallocated to another place within the site on the land obtained from shared plots calculated from coefficient contribution factors.

A chi-square test of the difference between land reallocation and social equity and welfare has been done, and the findings are illustrated in the following table

:

Table 5: Land reallocated plots to the site resident

Social equity/welfare	Number of person	Land Reallocated (Number of plot)
Men	324	1103
Women	176	600
Children	50	170
Total	**550**	**1873**

Source: Primary data, 2023

From observed data using the Chi-Square test to check Null Hypothesis 3 by the significant relationship between land reallocation and social equity and welfare, the table below provides the observed cell totals, the expected cell total, and the chi-square statistic for each cell.

Results						
	Number of person	Land Reallocated (Number of plot)				*Row Totals*
Men	324 (323.92) [0.00]	1103 (1103.08) [0.00]				1427
Women	176 (176.15) [0.00]	600 (599.85) [0.00]				776
Children	50 (49.94) [0.00]	170 (170.06) [0.00]				220
Column Totals	550	1873				2423 (Grand Total)

Source: Primary data, 2023

The x^2 is 0.0003 and $p - value$ is 0.999859 which is greater than x^2 means 0.999859 larger than 0.003.

Kabeza Site project land distribution have made according to the Contribution Coefficient Factor on each parcel using the data shown in the following table:

Variables	**Values**
TEP	100.844ha
TNP	87.88ha
TPP	56.12ha
PD	3.63%

Source: Primary data, 2023

Then, $CCF = 26.73\%$ Says, 27%. Now Contribution Coefficient Factor is 27% that must be subtracted to each parcel, including public interest and land compensation of destroyed parcel in the designed plan.

4.5. Making and designing a land reallocation plan for Kabeza Site

The following steps were followed to make land reallocated:

1. Subdivision of the interested area in the plots where each new plot is enclosed by roads and proposing code to the new plots, streams, canals, and the external boundaries of the study area,
2. Calculation of the total area of the new subdivided plot,
3. Calculation of the contribution coefficient factor of landowners for the value of land occupied by public facilities, i.e., roads, canals, etc., using Equation 3
4. Calculation of the land area that should be allocated to each landowner after the subtraction of the land area calculated from the contribution coefficient factor
5. Definition of the number of plots that can be allocated to each landowner based on the total land area he or she has
6. Calculation of the initially available land (in terms of size) for reallocation in each block,

Reallocation of properties. As the iterative, trial-and-error process that proceeds within the site by considering the total land area subtracted by the contribution coefficient factor of the properties. And the following map has been provided:

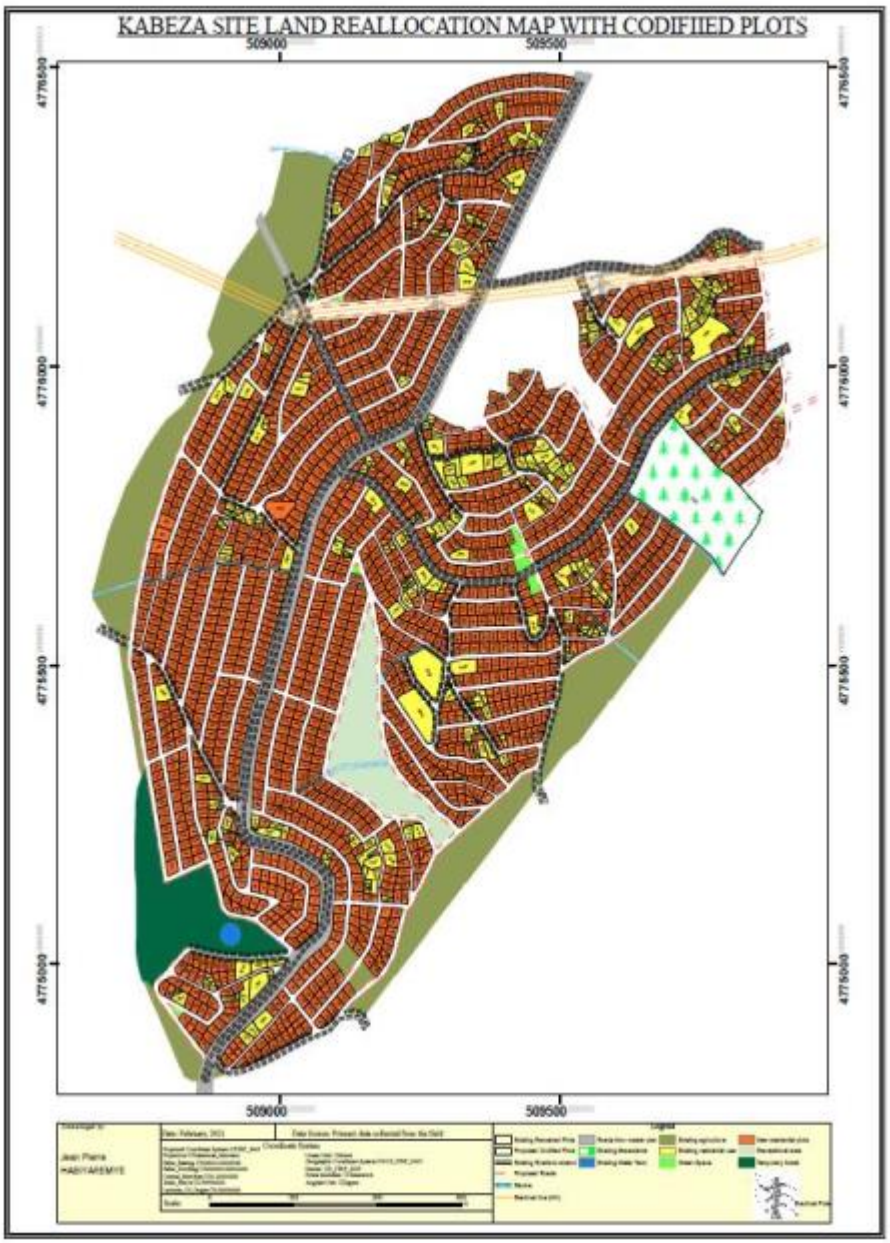

Figure 1 : Land Reallocation Plan Kabeza Site (Primary data, 2023)

After land reallocation, the owners will need the new land title fitted with the designed Local Land Urban development plan.

A researcher has checked if there is a relationship between land reallocation and urban development planning that will affect the contribution coefficient factor for ensuring proper implementation of this project after land reallocation.

Table 6: Land reallocation vs Urban development planning

LAND USE	Area of Land reallocation planning	Area occupied by Urban development planning (ha)
Residential plot	56.18	69.62
Agriculture	11.82	11.82
Forest	2.83	2.83
Open space	0	0.37
Sport and Leisure	2.48	2.48
Water tank	0	0.098
Transportation	0	29.102

Source: Primary data, 2023

The probit model for analyzing the relationship between land reallocation and urban development planning has used, and the finding shows that the Significance level is 0.0294 and is less than P, which is 0.9. Thus, the study fails to reject the Null hypothesis (Ho), stating that "There is no significant relationship between land reallocation and social equity/ welfare". Table 7 provides a summary of the general outcome of this study.

Table 7. The general outcome of the study hypothesis testing

Objectives	Hypotheses	Result	Comments
To estimate a contribution coefficient factor on each parcel to achieve the people's welfare and equitable reallocation of land	H0 (Null hypothesis): There is no significant relationship between land reallocation and social equity/ welfare	**CCF**= $\left(\frac{TEP-TNP}{TPP} * \mathbf{100}\right) + \boldsymbol{PD}$, CCF is 27%	Null hypothesis is not rejected

Source: Primary data, 2023

4.6. Discussion of the Study Results

Yomralioglu and Parker (1993) developed an interesting Geographic Information System-based land readjustment system for land reallocation in urban land consolidation projects, which is mainly based on the assignment of land market values to properties. It is a vector-based system that automates the land valuation, land subdivision, and distribution processes. Semlali (2001) used GIS and conventional programming to solve the problem of land reallocation and land distribution, which is split into two parts: the computed reallocation and the graphical reallocation. The process is carried out in three parts: the first part involves a computed redistribution using four methods depending upon the farmers' requirements, the administration's priorities, and the project constraints. The constraints used are the landowners' requirements, habitat, soil class, and the cadastral situation before land consolidation.

This study assists in estimating a contribution coefficient factor on land parcels to achieve the people's welfare and equitable reallocation of land. The findings assist site residents and policymakers in developing their sites using a formula developed by the author. The author carried out all technical details and prepared the map, analysis, and results discussion.

5. Conclusions and Recommendations

The main objective of this project is to estimate a contribution coefficient factor for each parcel to achieve the people's welfare and equitable reallocation of land within the Kabeza site in Kigali City, Kicukiro District, Gahanga Sector, and Karembure Cell. Local land development planning and reallocating planned plots as a way of getting solutions and achieving the goals of different problems arising within the site for the purpose of implementing the Kigali Smart City Master Plan 2020.

The data collected from the field and the topographic survey showed that the existing situation is not well planned according to the standard, which indicates that the new design is well planned compared to the existing one.

From data analysis and testing the hypothesis, there is no significant relationship between land reallocation and social equity or welfare. Existing parcels were 652 parcels without good planning for better living on the area of 116.32 hectares and having a water tank within the site. All new plots are 2168 plots, with 1873 plots for single-family residential in the residential extension; 295 plots remain as existing residential; and 14 plots of a total area of 4.22 ha will be totally affected by public utilities.

Based on these results, several recommendations have been formulated. For an adequate consideration of urban and rural design during the physical planning and design process, the following recommendations are proposed:

- The project implementers and partners, particularly the local government units overseeing the project sites, should pay particular attention to the growing income disparity and the exclusion of the poorest of the poor from the development process since this may lead to social disparities.
- institute the necessary processes to allow the inclusion of all the poor in community consultations and also their participation in community organizations and urban development.
- Identify measures to minimize the interventions' negative impacts on the poor and women.
- To follow the implementation of land reallocation by the site committee in collaboration with the government authority, especially the local government.

The following are considerations for the design of future similar projects:

1. The design, implementation, and maintenance of infrastructure should be integral to the project design and operations; infrastructure users, particularly the households that hold most of the benefits (i.e., transport operators), should be required to bear a larger share of facility maintenance and upkeep.
2. The packaging of all infrastructure within the project should be supported by interventions that ensure the inclusion of the poor and help enhance their capacities and capabilities. Some of these interventions are: provision of credit, microenterprise development services, agricultural technology transfer, social capital formation, and gender integration.
3. The conventional approach must be adopted to solve the problem with many conflicting criteria and constraints by applying basic calculations and decision-making.

In the end, the researcher developed a contribution coefficient factor as land that will share from every land to make this project successful and encourage other researchers to continue further research in a different region using this provided formula.

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