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Application of Planning Standards in Regulating Road Reserves (Case Study: Kisii Town in Kenya)

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ABSTRACT: An efficient road network remains among the topical issues in the international urban development forum. This is because roads link interrelated land uses in addition to connecting them with the contiguous metropolitan areas, thus a key contributing factor for an accelerated socio-economic uplift. To sustain this, planning standards that delimit urban road reserves are usually prepared and enforced through development control to ensure that roads are exclusively maintained for their intended purpose. This study, therefore, through a case study was undertaken in Kisii Town, Kenya investigates the extent to which the unauthorized developments on urban road reserves are regulated. It was steered by the public interest theory of regulation by targeting residential developments which were proportionately and randomly drawn from the seven residential neighbourhoods. Data were collected using a high-resolution satellite image and a questionnaire. Data analysis relied on GIS, t-test, logistic regression, and linear regression. Research findings demonstrated a statistically significant difference between the approved physical planning standards that are used in regulating road reserves and the extent of compliance by developers. Compliance generally declined by a mean of four metres, signifying that the County Government of Kisii did not undertake adequate development control. Non-compliance was mostly heightened by the developers' unawareness of the building plan approval process and that the buildings needed to be inspected during construction. This study deepens the international debate on development control by spatially and statistically illuminating how the extent of compliance with the planning standards that regulate road reserves may be empirically analyzed.

Keywords: *Road reserves, development control, planning standards, Kenya, Kisii Town.*

INTRODUCTION

Urban transportation infrastructure supports human activities by linking socioeconomic activities with urbanization and population growth (Wang et al., 2018). This nexus has attracted a growing body of literature as it provides an avenue for strategically reducing spatial disparities and inequalities, in consequence, a catalyst for spurring economic growth (Cigu et al., 2019). Transport infrastructure, with a particular reference to roads in urban areas, is subsequently regarded as one of the key tenets of economic prosperity. As such, it has a significant bearing in promoting sustainable development (Lenz et al., 2018; Sakhapova et al., 2015). This is because roads play an important role in promoting urban mobility that involves people and goods, in addition to providing access to a wide range of socioeconomic undertakings (Ng et al., 2018). It is hence accredited that although transport remains indispensable to the overall transformation of any nation, road transport remains central in the spatial development of the urban areas and their contiguous regions. Roads as part of transport infrastructure, for this reason, dictate the location and competitiveness of various land use, thus directly impacting on the quality of urban life (Owoputi & Kanyio, 2017). In this way, the condition and quality of roads influence the investment level, creation of employment opportunities, cost of production, and ease of access to the markets in urban areas. The argument (Banerjee et al., 2012) draws on the rationality that one can only benefit from a market if there is an ease of access to that market. This notion is upheld by the underpinning that the ancient development of infrastructures such as railways overlapped with the periods of fast economic transition in the United States, Japan, and Western Europe, a suggestion why road networks remain a principal index of development in urban areas (Rawat & Sharma, 1997). In Africa, roads are

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the dominant means of transportation infrastructure (Wasike, 2001) accounting for more than 80% of the goods traffic and 90% of passenger traffic (United Nations Economic and Social Council, 2009)

Turning into Kenya, to transition into an internationally competitive and middle-income country by 2030, its government launched Vision 2030 on 10th June 2008 (The Republic of Kenya, 2018). The vision, under the economic pillar, accorded the highest priority to the provision, maintenance, and management of quality road infrastructure. To accomplish this task, the government set a performance target of increasing the number of kilometres of urban roads from 200 kilometres (the baseline in 2008) to 100 kilometres by 2030. The intent was to ease congestion, reduce travel time and costs, and enhance connectivity. In the vision (Ngari, 2020), the roads sub-sector was hypothesized as the main driver that would guide the sectors that comprise the vision's mainstay such as tourism, manufacturing, and financial services. The need for improving the condition of roads is therefore imperative (Bulle, 2015) because road transport carries more than 80% of passengers in the country.

Roads in Kenya may, however, not effectively contribute to the projected socio-economic uplift if unauthorised developments on their planned reserves are not dissuaded through development control. To make evident the magnitude of this problem, recently (Matara, 2018), the Kenya Highways Authority (KENHA) demolished ten houses in the Nakuru's Kiamunyi estate where the owners had intruded on a road reserve by about 10 feet. In a related case in Kirinyaga County (Kamau, 2017), KENHA further censured the County Government of Kirinyaga for not doing enough to control the encroachment on road reserves by traders who had deliberately constructed temporary structures. The situation is not any different in Kisii Town, Kenya, where KENHA had earmarked to demolish several buildings which were illegally developed on the reserve of the Kisii – Nyamira highway, subsequently interfering with its planned expansion (Omboki, 2016). Similar challenges have likewise been reported in other key urban areas of Kenya such as Mombasa City (Ahmed, 2018), Kakamega Town (Shilitsa, 2019), and Kisumu City (Alal, 2019). Such initiatives are, however, not sustainable as they are usually undertaken on a case-by-case basis either when there is a need to construct a new road or expand the existing ones in response to the prevailing development needs of a region. As such, there is a general absence of information and consent regarding the extent to which developers in the Kenyan urban areas illegally encroach on planned road reserves, hence a gap in the county's planning and development control policy framework.

From the foregoing introduction, the current study examined if unauthorized developments on the planned urban road reserves in Kenya is controlled. To attain this, the scope covered Kisii Town to provide a case study where the County Government of Kisii (CGOK) is the planning authority according to the Physical and Land Use Planning Act (The Republic of Kenya, 2019). As justified by Zainal (2007), case studies permit the investigation and understanding of intricate subjects thus providing a robust research method that promotes holistic and in-depth investigation. As such (Krusenvik, 2016), internal validity is usually high, making these studies very valuable. The objective was further interrogated by the hypothesis that there is no significant difference between the approved planning standard used in regulating road reserves and the extent of compliance by residential developers in Kisii Town. The study further delves into the variables that significantly induce non-compliance with the recommended road reserves in Kisii Town.

In terms of scope, the study covered seven residential neighbourhoods in Kisii Town, namely: Jogoo, Egesa, Nyamataro, Nyanchwa, Daraja Mbili, Mwembe and Nyamage. It was undertaken between April and July 2020. To appropriately anchor the research problem, an in-depth literature review on building development control is undertaken in the next section. This links the current study with the existing body of knowledge and afterwards determine the emerging research gaps. It purposely explores if there have been any previous attempts in determining the regulation of unauthorised developments on road reserves.

Literature Review

The current body of literature confirms that the regulation of building development is hardly effective in most urban areas. For instance, after observing that most residential developments in Baghdad's city failed to comply with the existing building legislation, Saddee and Hameed (2019) maintained that the status quo was impelled by the level of awareness and income levels of the developers, a problem further instigated by insufficient development control. In a related study, Alnsour and Meaton (2009) examined the determinants of compliance with planning standards, a case of the city of the Old Salt, Jordan and established that some of the key drivers were household income and size, monetary facilities, culture adopted by the municipal administration, extent of surveillance and the ambiguity of the planning standards. They made a recommendation for stringent enforcement through an information system that would promote monitoring during the construction process.

The debate on whether the level of awareness on planning legislation and regulation may affect compliance is still drawing the attention of the international audience. A case in point is that of Arimah and Adeagbo (2000) who found out that although many households in the city of Ibadan, knew the planning standards, this did not certainly result in compliance. The violated building standards were on building coverage ratios, setbacks, size of rooms, change of use and provision of utilities. Offei-Nketiah et al., (2019) however argued that lack of awareness in most of the sub-Saharan Africa countries was a key driver of non-compliance. Other variables were inadequate funding, outdated legislation, and unwarranted delays in

approval, weak enforcement regime, and corruption. Additional drivers of non-compliance as identified in Accra-Tema city-region, Ghana, by Arku et al., (2016) included administrative bureaucracy and inefficiency, a perception that it is more expedient and less cheap to develop without authorization than with a building authorization, restraining, cumbersome, and outdated planning standards, cynicism regarding the permit of building system, general public indiscipline and lawlessness, disregard of the building permit application procedure and inadequate institutional coordination. The study, as a result, cast doubt on the suitability of the prevailing planning administration in sub-Saharan Africa.

The literature reviewed has so far confirmed a challenge in compliance with the recommended building standards. A further review is now undertaken to understand the nature of building planning standards not complied with by developers. In a quest to generate data on the levels of compliance with planning standards, Baiche and Ogden (2006) established that some of the key challenges in Wales and England were lack of wall and roof restraining straps, poorly fitted wall ties, missing damp proof course, and blockage of the air vent. These problems were impelled by inadequate site management and poor workmanship. Further related to housing characteristics, Atamewan (2019) found out that most dwelling units in Bayelsa State, Nigeria did not observe minimum standards such as the provision of spaces such as bedrooms, sitting rooms and bathrooms. Generally, there was a strong association between the households' socioeconomic status and their extent of compliance. In Old Salt, Jordan, Alnsour and Meaton (2009) established a substantial disregard of the plot areas, plot frontages, ventilation spaces, housing design, building materials, windows, colours and entrances of the houses. These problems arose as a consequence of inadequate monitoring. Among the recommendations made was for the need to reassess the current standards to determine if they should be reviewed or relaxed. Building contractors may also affect compliance with building standards. This was demonstrated in Cape Town by Windapo and Cattell (2010) in a survey targeting site managers who were working for firms in the buildings which were under construction. In this case, few contractors fully complied with the requirements as postulated in the applicable statutory documents. Non-compliance was more evident amongst the unqualified and less experienced firms which were not registered by the Construction Industry Development Board. In the Electronic City Phase-1, Karibasappa et al. (2016) scrutinized the extent to which the applicable building bye-laws were complied with by comparing observed values against the standard values. Results showed violation in the standards that regulate widths of roads, heights of the plinth, building heights, setbacks, ground coverage and plot ratio. Violations were caused by the high price of land and inadequate surveillance. A further study by Boob and Rao (2014) that examined if the local authorities of Yavatmal District, India, complied with the land subdivision development control rules established that most violations were on floor space index, road junctions and setbacks. They consequently suggested for the adoption of a 'zoning within the plot' to control the disregard of planning control standards hence providing a green belt zone on all sides of the plots during land subdivisions to prevent violation of setbacks.

In Kenya, a growing body of literature has also appraised compliance with building regulations. For instance, in Eldoret Town, Ngetich et al. (2014) established that although the Physical Planning Handbook recommended a least a 2.5m setback and a 3m building line, 12% of the developers violated the 3m building line in addition to a further 49% exceeding the recommended setbacks. This situation was intensified by the revelation that 38% of the developers who obtained development permits had built without compliance with the approval conditions, an indication that compliance with planning standards remained a challenge. Omollo (2020) further investigated if developers were complying with the planning standards used in regulating setbacks in Kisii Town. The outcome of his hypothesis showed high non-compliance owing to a gap in enforcement by the CGOK. In a related study in Kitengela Town, Wathome (2016) also established that most developers did not comply with the minimum standards that regulate building lines, setbacks, access roads and car parking space. Non-compliance was mostly caused by ineffective evaluation of planning permits, inadequate supervision and site inspections.

The foregoing literature review benefits the current study by not only highlighting some of the reasons why developers infrequently comply with the approved standards but by further giving an insight into why the standards are disregarded. However, although previous studies have given an account of these planning standards, a scarcity in the planning literature still exist on the extent to which unauthorized developments occasions on planned urban road reserves. The current study fills this emerging gap in knowledge by statistically and spatially determining the level to which the planning standards that are used in regulating urban road reserves are enforced. The paper further seeks to make progress in understanding the significant drivers of non-compliance with the planned urban road reserves.

MATERIALS AND METHODS

Background to the Study Area – A planning context

Kisii town, the study area (Figure 1), is spatially positioned in south-western Kenya, about 313 km from City of Nairobi, the administrative and commercial capital of Kenya. It serves as the administrative capital of Kisii County which is among the 47 counties established in the Republic of Kenya.

The town's population in 2019 was estimated at 112,417. It makes an ideal choice for a case study on the account of four underlying reasons. First, in the western region of Kenya, Kisii Town maintains the highest population density (2,862 persons per kilometre square). This is six-fold that of Kisumu

Fig. 1: Kisii Town in Kenya and Africa (Source: Maphill, 2020)

city (464 persons per kilometre square), Kenya's third-largest urban. Further, nationally, Kisii town remains the third highly densely populated urban centre after Kenya's capital, Nairobi City (4,514 persons per kilometre square), and Mombasa City, the second-largest urban area in Kenya (4,292 persons per kilometre square). Concerning population dynamics, it is also important to observe that the town's 2.7% yearly population growth rate surpasses the national annual rate of 2.6% (The Republic of Kenya, 2009). Apart from these, as shown in Figure 2, although the town covers 34 km2, only 4.35 km² (12.79%) is planned to suggest that much of the development occurs without a spatial plan. A combination of the outlined reasons and absence of a comprehensive spatial planning in the context inadequate development control by the CGOK has resulted in land conflicts such as those related to encroachment on road reserves.

Theoretical Context, Research Philosophy and Design

This study adopted the public interest theory of regulation (PITR) which according to Hantke-Domas (2003), to enhance social welfare, the theory justifies safeguarding the public interests. To contextualize the PITR as it relates to development

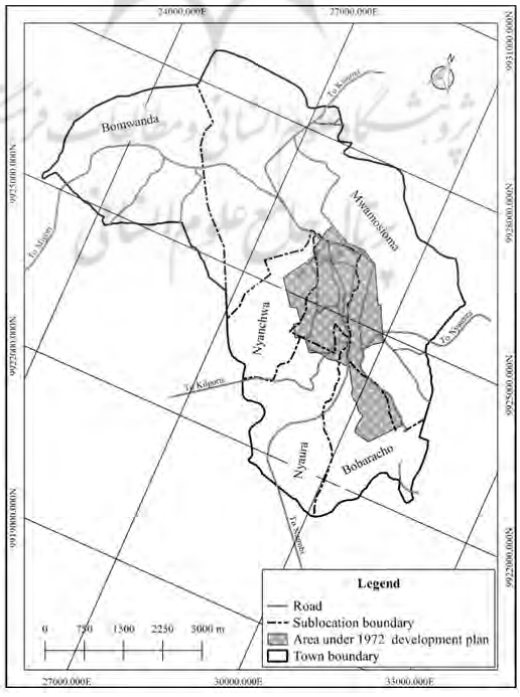

Fig. 2: The area covered by the development plan (Source: Omollo, 2018)

control, section 56 of the Physical and Land Use Planning Act (The Republic of Kenya, 2019) bestows upon the county governments in Kenya the responsibility for undertaking development control, a tact for attaining sustainable spatial development. The CGOK is, therefore, not an exception. Section 57 of the Act further prohibits carrying out development without development permit granted by the respective county executive committee member. These, without doubt, imply controlling unauthorized developments on road reserves. The study further aligned with the positivist research philosophy, characterized by inferential inquiry process in which the research approach entailed the collection of data and testing of hypothesis. This was accomplished through measurable field data that was physically collected through observations and thereafter analysed statistically. The focus was on reliability, suggesting that if the same study was undertaken by other researchers, they will obtain similar results. As observed by Leedy & Ormrod (2005), reliability is a truthful way of testing knowledge because positivists maintain that if different researchers examine the similar body of evidence, they should, without doubt, obtain similar results. The study adopted a concurrent triangulation design. According to Onwuegbuzie and Collins (2007), this design encompasses the collection, analysis and interpretation of both quantitative and qualitative data that examines the similar research problem. The qualitative data that was collected was further used to corroborate the quantitative findings on the envisaged variable relationships concerning compliance with the approved planning standards that the CGOK uses in regulating the use of road reserves within its jurisdiction.

Population, Sample Size and Sampling Design

An immediate challenge encountered was the lack of a sampling frame that could be used to determine the population of the study area. This was because the CGOK lacked a spatial database for referencing residential developments in Kisii Town. To overcome this challenge, a high-resolution satellite image (spatial resolution of 0.34-metre, Quick Bird 2) was acquired from the Regional Centre for Mapping of Resources for Development and subsequently integrated with the QGIS version 3.16.3 software to enable the digitization of all buildings. This resulted in digitized buildings with corresponding attribute tables. The next exercise involved segregating the boundary of each residential neighbourhood to ensure no overlap in the data collection. To safeguard that the delineated boundaries were accurate, a deliberate participatory mapping exercise that involved the area Assistant Chiefs was undertaken for one week. This was followed by a confirmatory ground-truthing to ensure that all the mapped buildings were residential. In the end, 7,430 residential buildings were positively mapped subsequently providing the needed sampling frame and study population.

Having established the study population, a Sample Size Determination Table that has been endorsed by Krejcie and Morgan (1970) was used in determining the sample size. It suggests that if the population (N) is in the range 7,000-7,999, the researcher should pick a sample (n) of 364. To additionally determine each neighbourhood's proportionate sample size, their mapped residential buildings were divided by all the residential buildings that were mapped in the study area (that is, 7,430), thereafter, the outcome was multiplied by 364, the target sample size. In this case, while Jogoo had 1,551 mapped developments with a proportional sample size of 76, in Mwembe, 1,105 of its developments were mapped with a resultant sample size of 54. Conversely, in Nyamage, 1,171 mapped developments had a sample size of 57. Turning to Nyanchwa, 673 of its residential developments resulted in a sample size of 33. Relating to Nyamataro, 808 residential developments which were positively mapped gave a sample size of 40. A similar sample size of 40 occasioned in Egesa which had 821 mapped residential buildings. Finally, in Daraja Mbili, 1,301 residential buildings which were correspondingly mapped returned a proportional sample size of 64.

Data Collection, Analysis, Test for Reliability, Validity and Normality

A semi-structured questionnaire that had an observational checklist was used to collect primary data such as the name of residential neighbourhoods, awareness of building plan approval process, obtaining a development permit, and whether the buildings were inspected during construction. The observation checklist was on the other hand used to collect data to determine if developments were complying with the standards that regulate the widths of access road reserves. While the first column was used to record the neighbourhood's name, the second column contained the corresponding recommended planning standard on the width of road reserve compared to the third column which recorded the observed extent of compliance with the recommended standard. The fourth column was used in recording the computed deviation (value of recommended standard less the observed extent of compliance). In this case, a negative deviation depicted non-compliance. The applicable standards for the road reserves per neighbourhood were obtained from the GCOK's Physical Planning Department and thereafter validated with the cadastral maps from the County Survey Office. The study adopted the definition of a road reserve as provided by the Victorian Road Management Act (2004) and illustrated in Figure 3. That is, a lawfully determined area where amenities like roads, pedestrian pathways, and allied features may be built for the use by the public, hence the whole area between boundaries illustrated on a cadastral plan.

Compliance was determined by measuring the extent to which a residential building had encroached a road reserve (in metres) and then comparing the results with the recommended planning standard/ width of the fronted road reserve. The recommended widths for road reserves in the seven residential neighbourhoods ranged between 9 and 40 metres. From this

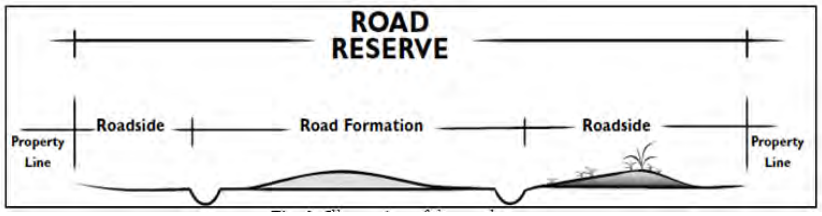

Fig. 3: Illustration of the road reserve (Source: Victorian Road Management Act, 2004)

point of reference, the current study investigates whether these road reserves were complied with by the sampled developers. To ensure that each developer had an equal chance of being sampled, a random number table generated by the Microsoft Excel software was used. Additionally, during data collection, if sampled developments were occupied by households who were not the property owners, the contacts of the landlords were obtained from the tenants and the landlord contacted for data collection at a later date. This ensured that the collected data, especially concerning issues such as whether a development permit was obtained, was not only accurate but also provided by the right respondents. Collected data were afterwards analyzed through descriptive and inferential statistics such as means, percentages, cross-tabulation, paired sample t-test, logistic regression and linear regression. The latter was used to test the research hypothesis. The test-retest method was employed to determine the research instruments reliability through a pilot survey undertaken in Nyamira Town, 25 km from Kisii Town. The survey targeted 36 residential developments (10% of the main sample size). Similar questionnaires were re-administered after two weeks and the results afterwards correlated using Pearson's Product Moment correlation coefficient. The study adopted construct and content validities where the questionnaire was given to two registered planners by the Physical Planners Registration Board of Kenya. While one examined if the tool measured the concept that was intended to be measured, the other examined if the questions fully represented what they aimed to measure. The questionnaires were then revised according to the results obtained from the tests for reliability and validity.

RESULTS AND DISCUSSIONS

This study examined the extent to which unauthorized developments on the urban road reserves in Kenya was controlled, a case study of Kisii Town. This section presents and discusses the results of the study. To accomplish this, it is structured into interrelated sections and subsections which caps by presenting the outcome of the research hypothesis along with the significant factors contributing to non-compliance with the planning standards that regulate the use of road reserves.

Tests for Reliability, Response Rate and Statistical Assumption

Test re-test reliability technique determines the internal validity of a test to confirm that the obtained pair of measurements are not just representative but also constant over time. As a norm (Rosaroso, 2015), reliability coefficients of 0.8 or above are considered to be within the acceptable threshold. Since the resultant Pearson product-moment correlation coefficient in the current study was 0.82, the questionnaire was considered suitable for the planned data collection. Regarding response rate, out of the 364 questionnaires that were administered, 290 were collected hence an 80% response. This surpassed the threshold of 50% that has been proposed by Mugenda and Mugenda (2003), in consequence providing credence for data analysis, reporting and drawing of conclusions. At the same time, the validity of the sample data was further ascertained by undertaking a test for normality to confirm whether the data had been drawn from a normally distributed. To attain this, the Shapiro-Wilk test was employed in investigating the assumption. From the test result, the sample was found to be approximately normally distributed since the ensuing p-value was greater than 0.05.

Controlling Unauthorized Developments on Road Reserves in Kisii Town

After determining the credence of the collected data in the previous subsection, this subsection now examines the extent to which unauthorized developments on road reserves in Kisii Town is controlled by the CGOK. Data analysis is structured per residential neighbourhood, that is Nyanchwa, Jogoo, Egesa, Nyamataro, Daraja Mbili, Mwembe and Nyamage.

Nyanchwa

Even though the recommended planning standard used in regulating road reserves in Nyanchwa was between 9metres and 40 metres, it was established that whereas 79% of developments were fronting the roads of widths varying between 4 metres and 6 metres, 18% and 13% correspondingly were abutting 9 metres to 18 metres wide access roads in comparison to 18% who abutted road reserves having widths greater than 18 metres. This suggests that a majority (79%) fronted roads with widths less than the minimum threshold of nine 9 metres, consequently depicting insufficient development control by the CGOK. These findings were also corroborated through a descriptive analysis which demonstrated that the observed compliance (M =7.71, SD = 5.70) with the planning standard was lower than the recommended planning standard

Table 1: Conformity with planned road reserves in Nyanchwa

	Paired Differences			T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean			
Mean width of recommended road reserve ***vs*** observed compliance	6.17	4.05	83.	7.46	23	.000

(M=13.87, SD = 9.16). Informed by this background, the study set to investigate if a significant difference arose between the recommended and observed widths of road reserves being abutted by the sampled building developments. Results are as summarized in Table 1.

Results exposed low compliance (M = 6.17, SD = 4.05) that was statistically significant, t (24) = 7.46, p = .00, confirming a variance between the approved planning standard and the observed compliance. This additionally suggested insufficient development control by the CGOK. Apart from statistical analysis, the study further undertook spatial analysis in Figure 4 to substantiate the magnitude of non-compliance. As demonstrated, it can be seen that several buildings are illegally developed on the 12 metres and 9-metre road reserves. The problem continues notwithstanding the statutory powers conferred upon the CGOK to control such developments.

Jogoo, Egesa, Nyamataro, and Daraja Mbili

Since the above neighbourhoods are situated in Mwamosioma sublocation, their conformity analysis was jointly undertaken. While land use in Jogoo, Egesa and Daraja Mbili is zoned as medium density, that of Nyamataro is, on the other hand, zoned as low density. Generally, in Jogoo, most of the road reserves (94.3%) have a width of 9 metres, the rest (2.9%) had respective widths of 22 metres and 40 metres. As regards, Egesa, Nyamataro, and Daraja Mbili, all sampled road reserves were 9 metres.

A preliminary descriptive analysis indicated all the residential developments that were sampled from the neighbourhoods encroached on the abutted road reserves. For example, the observed compliance in Jogoo (M = 6.20, SD = 1.506) rated below the appropriate physical planning standard. In the same way, the mean compliance that was observed in Nyamataro, Egesa and Daraja Mbili (M = 5.15, SD = 2.16; M = 6.78, SD = 1.52; and M = 5.06, SD = 1.54 respectively) all strayed from 9 metres, the approved spatial planning standard. An examination was afterwards undertaken in Table 7 to determine if the observed nonconformities were statistically significant.

It was found out that the observed widths of road reserves in Jogoo (M = 6.17, SD = 1.49) deviated from the recommended 9 metres, thus posting a statistically significant difference, -2.83, t (69) = -16.16, p = .000. A similar inclination prevailed in Nyamataro where the mean compliance was low (M = 5.16, SD = 2.17) with a difference that was statistically significant, -3.83, t (34) = -10.51, p=.000. Observed compliance was relatively low in Egesa (M = 6.77, SD = 1.50) with a difference that was

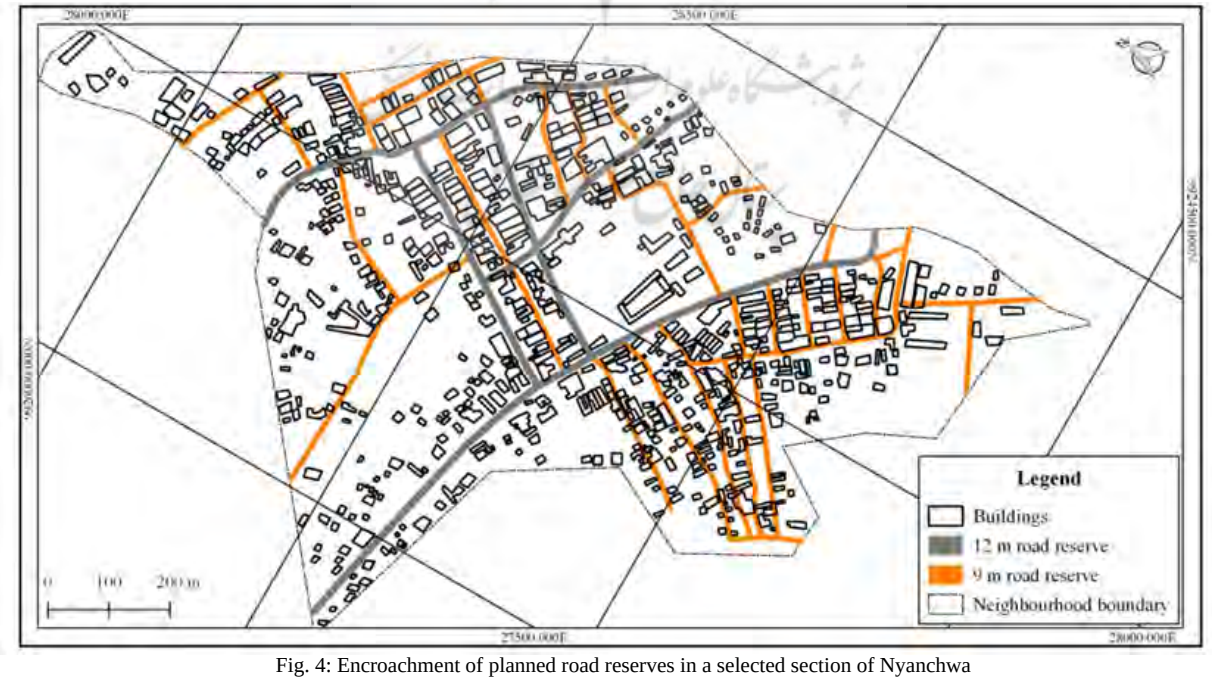

Fig. 4: Encroachment of planned road reserves in a selected section of Nyanchwa

Table 2: Compliance test in Jogoo, Nyamataro, Egesa and Daraja Mbili

Neighbourhood	Planning standard = 9 metres			
	t	F	Sig. (2-tailed)	Mean Difference
Jogoo	-16.16	69	.000	-2.83
Nyamataro	-10.50	34	.000	-3.84
Egesa	-2.84	30	.000	-2.22
Daraja Mbili	-20.56	59	.000	-3.96

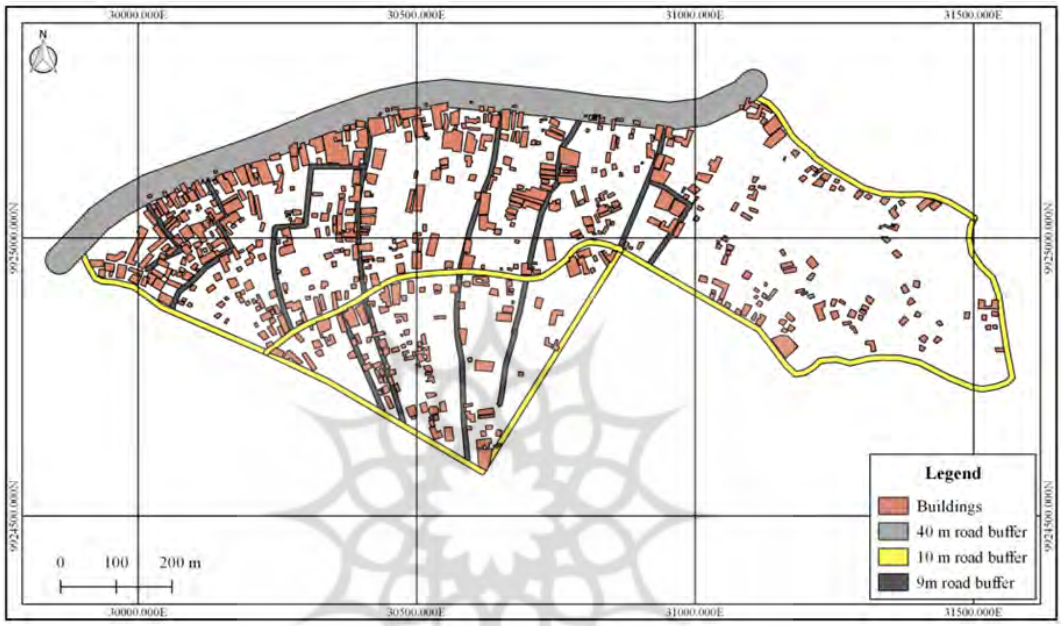

Fig.5: Encroachment of planned road reserves in a selected section in Jogoo

Fig. 6: A residential building demolished in Daraja Mbili for illegally being on a road reserve

further significant, -2.22, t (30) = -2.83, p =.000. The situation was not different where the observed compliance (M = 5.03, SD = 1.50) in Daraja Mbili was low, conforming a significant difference that was statically significant (-3.96, t (59) = -20.56, p = .000). In summary, the highest non-compliance by developers was registered in Daraja Mbili (-3.96).

To further put the research problem into perspective, an attempt was made to spatially demonstrate non-compliance (Figure 5) with road reserves by focusing on a section in Jogoo. This is because several residential developments in the neighbourhood hardly comply with planning standards. To ascertain this, buffers were created for the existing 40 metres, 10 metres and 9 metres roads to spatially demarcate their reserves and establish if developments abutting them were complying with their planning standards. It was, however, found out, this was among the standards that developers ignored as apparent by illegal developments on the affected road reserves.

Figure 6 further depicts the magnitude of the encroachment

on road reserves in Daraja Mbili. In this case, the CGOK had demolished part of the residential building because it was illegally developed on the fronting 9-metre road reserve. Regrettably, the exercise was selectively undertaken as evident by the failure to demolish other buildings which were also irregularly developed along the same road reserve.

Mwembe and Nyamage

Roads in the neighbourhoods are planned to promote access within their precincts and also provide a spatial linkage with the district, primary and local distributors. In this case, compliance with their approved minimum reserve of 9 metres is considered important in facilitating urban transportation. The current study, therefore, sought to determine if residential developments in the two neighbourhoods complied with the planning standard that is used to regulate the minimum widths of road reserves. Research findings showed that the observed mean (M = 5.02, SD = 2.09) in Mwembe fell below the recommended 9 meters. A similar observation was made in Nyamage with a mean (M = 5.10, SD = 1.18) that failed to comply with the appropriate standard of 9 metres. The modal frequency for the observed conformity in Mwembe was found to be 3 metres compared to 5 metres for Nyamage. Since 38% and 28% of roads in Mwembe had respective widths of 38% and 28%, this demonstrates that planning standard was highly disregarded by the developers. Generally, only 15% of the developments in the neighbourhood observed the 9 metres planning standard. Conversely, most roads in Nyamage had 4 and 6 metres road reserves, each validated by 33%, similarly confirming the magnitude of non-compliance. In this case, only 3% of the developments fronted roads which had reserves of 9 metres. As evident in Figure 7, the problem continues notwithstanding the existing legal framework.

Although the CGOK had demolished the above building for encroaching a planned road reserve, the building was redeveloped due to insufficient surveillance and enforcement. Having established that a majority of developers failed to comply with the standards used in regulating road reserves in Mwembe and Nyamage, a test was undertaken in Table 3 to further explore if observed deviations were by any chance statistically significant.

The mean compliance difference in Mwembe of -4.97 was highly significant, t (38) = -12.11, p = 0.00. The same occurred in Nyamage, t (28) = -19.04, p = 0.00, indicating that most developers disregarded the recommended spatial planning standards due to the limitations of the CGOK when it comes to undertaking development control.

The Outcome of the Research Hypothesis Testing

This study had a hypothesis that there is no significant difference between the recommended planning standards used to regulate the widths of road reserves in Kisii Town and compliance extent by residential developments. To attain this, it was tested in Table 4 using a paired sample t-test where the mean of the recommended planning standard was the first variable while the second variable was the extent of compliance as obtained through field measurements.

The test established a significant difference between the

Fig. 7: A residential development extending on a 9-metre-wide road reserve

Table 3: Conformity assessment in Mwembe and Nyamage neighbourhoods

Neighbourhood	Planning standard = 9meters			
	t	df	Sig. (2-tailed)	Mean Difference
Mwembe	-13.11	38.00	0.00	-4.97
Nyamage	-19.04	28.00	0.00	-4.91

Table 4: Outcome of hypothesis testing

	Paired Differences			t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean			
The recommended standard for road reserve versus observed compliance by developers	4.11	3.46	.211	20.23	289	.000

permitted planning standards (M=9.49, SD = 4.14) and level of developers' compliance, and this was significant (M = 5.39, SD = 2.46, t (9) = 20.23, p = .000. Since compliance pointedly declined by a mean of 4.11 metres, the null hypothesis was rejected with a 95% confidence level, a suggestion of insufficient development control by the CGOK. In the absence of any planning intervention, the problem is likely to undermine sustainable spatial development in Kisii Town. In summary, when it comes to compliance with the recommended planning standard on the minimum road reserve, Nyanchwa registered the highest average non-conformity (6.16 metres), followed by Mwembe (3.98 metres, Nyamage (3.90 metres), Egesa (3.84 metres), Jogoo (2.84 metres) and Nyamataro (2.23 metres).

These findings relate to that Karibasappa et al. (2016) who found out that 49% of buildings in Neeladri Nagar, Bangalore-560100, India did not comply with the recommended widths of access roads. The current study, however, adopted a triangulation of spatial and statistical analyses to empirically determine the extent to which the recommended road reserves were complied with by residential developments, consequently filling a gap in knowledge that hitherto existed in the literature of urban land use development control.

An Insight into the Determinants of Non-compliance with Planning Standards

Based on the outcome of hypothesis testing, the study sought to determine some of the underlying variables influencing non-compliance with road reserves in Kisii Town. Initial results demonstrated that 35% of the developers never obtained a statutory development permit from the CGOK. The 65% who alluded to have obtained permission may infer that the planning authority could have disregarded its standards by irregularly approving residential developments which were built on road reserves. At the same time, 35% of the respondents were unaware of the CGOK building plan approval process. As regards the requirement that buildings must be inspected during construction, 37% were unaware.

Enlightened by this background and by using logistic regression, the study investigated if a relationship existed between awareness of building plan approval process and obtaining of a development permit since both the independent variable and the dependent variable were binary. The Nagelkerke's R^2 of 0.536 suggested that 53.2% of the observed difference that was in the dependent variable was accounted for by the independent variable (awareness development plan approval process). The independent variable's influence on the logistic model together with its significance was computed in Table 5.

The statistical significance for the independent variable was determined by the Wald test. It can be seen in Table 5 that awareness of the building plan approval process significantly predicted if the development permit will be obtained because Exp (β) = 0.02. The model was therefore fit for further analysis. As a norm, Exp (β) shows the degree to which increasing the equivalent measure by a unit (a developer) is influencing the odds ratio, consequently construed concerning the change in odds. Given that Exp (β) = 0.02, developers who were unaware of the process were 98% less likely to get the permits for development than those who were aware of the approval process, a pointer why many buildings in Kisii Town are unlawfully developed on road reserves.

To maintain quality assurance, the Building Code, Local Government (Adoptive Bylaws) (Building) Order, 1968 (the Republic of Kenya, 1968), requires all buildings under construction in Kisii Town be inspected by the CGOK. However, research findings disclosed that 45% of the were never inspected, thus lacked a record on quality assurance. This may equally submit why Kisii Town continues to contend with unauthorized developments on road reserves, thus underpinning that the surveillance by the CGOK remained inadequate. Again, it can, on the other hand, be argued that the 55% of the developers who reported that their buildings were inspected notwithstanding their encroachment on the road reserves may draw attention to the fact that the planning authority might have deliberately disregard its planning standards for development control. Generally, most buildings which buildings had been

Table 5: Influence of awareness of plan approval on obtaining a development permit

	B	S.E.	Wald	df	Sig.	Exp(β)
Awareness of development plan approval process	-3.61	0.42	76.81	1.00	0.00	0.02
Constant	0.75	0.24	10.80	1.00	0.00	2.11

developed without a permit were from Nyamataro (46%), followed by Egesa (39%), Jogoo (36%), Nyanchwa (29%), Nyamage (27%), Daraja Mbili (22%), and Mwembe (13%).

From the foregoing, the study, through the backward selection model of the linear regression sought to determine a combination of variables that would significantly influence obtaining of development permit (dependent variable) consequently providing the basis for deterring unauthorized developments on road reserves. In general, the backward selection model starts with all potential variables loaded into the regression model. At each step, the independent variable that is the least significant is eliminated. The process continues until no non-significant independent variables remain in the model.

The independent variables in the current study included developers' awareness of the building plan approval process by the CGOK, developers' engagement of registered professionals, and developers' awareness of building inspection by the CGOK during construction. At the onset, three models were derived. The third model symbolised the most significant variables that were retained with a correlation coefficient, R = 0.67, and a corresponding coefficient of determination where R2, = 0.45 consequently a positive correlation between the independent and dependent variable, and that 44.90% of the difference in the dependent variable was accounted for by the retained independent variables in the third model as shown in Table 6.

Regarding the four variables that were at the beginning entered in model 1, in model 2, the variable, 'developers' engagement of registered professionals', was the first to be eliminated as it was the least significant. Subsequently, in model 3, the variable, 'Inspection during construction by the CGOK, was eliminated. The most significant variables that were finally retained in the third model were developers' awareness of the building plan approval process by the CGOK and developers' awareness of building inspection by the CGOK during construction. Analysis of Variance (ANOVA) for the retained variables was thus undertaken in Table 7to determine their statistical significance.

According to Table 7, given that the F-statistic (13.577) surpasses the F-critical (2.75), the two variables significantly predicted if developers would obtain a development permit (p = .000), suggesting that the model's coefficients were not equal to zero, therefore showing a good fit. The influence that each coefficient had in the model has further been examined in Table 8.

Table 8 makes it apparent that prior awareness by the developers regarding the plan approval process significantly predicts if they would obtain a development permit from the CGOK as the corresponding unstandardized coefficient (B) is positive since planning standards do not permit building construction on road reserves. As such, more enlightened developers are less likely to irregularly develop on road reserves owing to the predictable consequences that may be enforced by the planning authority. This is because they are likely to seek advice from the planning

Table 6: Model summary for the backward elimination of the independent variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.674[a]	.455	.447	.340	
2	.672[b]	.451	.445	.341	
3	.670[c]	.449	.445	.341	1.819

a) *Predictors*: (Constant): Inspection during construction by the CGOK, developers' awareness of the building plan approval process by the CGOK, developers' engagement of registered professionals, developers' awareness of building inspection by the CGOK during construction

b) *Predictors*: (Constant): Inspection during construction by the CGOK, developers' awareness of the building plan approval process by the CGOK, developers' awareness of building inspection by the CGOK during construction

c) *Predictors*: (Constant): Developers' awareness of the building plan approval process by the CGOK, developers' awareness of building inspection by the CGOK during construction

d) *Dependent variable*: Obtaining a development permit from the CGOK

Table 7: ANOVA for the significance of the independent variables in model 3

Model		Sum of Squares	df	Mean Square	F	.Sig
3	Regression	27.154	2	13.577	116.868	000.
	Residual	33.342	287	.116		
	Total	60.497	289			

Predictors: (Constant): Developers' awareness of the building plan approval process by the CGOK, developers' awareness of building inspection by the CGOK during construction

Dependent variable: Obtaining a development permit from the CGOK

Table 8: Coefficients for the independent variables in model 3

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	.764	.094		8.165	.000
	Developers' awareness of the building plan approval process by the CGOK,	.615	.042	.643	14.676	.000
	Developers' awareness of building inspection by the CGOK during construction	.101	.024	.184	4.190	.000
Dependent Variable: Obtaining a development permit from the CGOK						

authority through development permit. At the same time, an increase in the awareness by developers that buildings should be inspected during construction also predict if they will obtain a development permit because the value of the unstandardized coefficient (B) is positive. This is because inspections and surveillance raise the developers' awareness that they ought to comply with the enforceable planning standards. The two variables that would significantly determine if developers obtain a development permit, thus providing an avenue that would deter them from encroaching on road reserves, therefore, includes the extent of their awareness on building development plan approval process and that quality assurance inspection audits should be undertaken during the construction process by the CGOK. A regular advisory opinion by the CGOK to the developers is therefore theorized as a panacea for deterring future potential unauthorized developments on the planned road reserves in Kisii Town.

CONCLUSION

Planning standards that regulate road reserves are widely flouted by developers in Kisii Town, a status quo that continues regardless of the current legal framework that grants the CGOK the powers of development control. Non-compliance is mainly instigated by the developers' unawareness on the procedure to follow in obtaining development permits and inadequate surveillance audits. If the problem is not addressed promptly, Kisii Town will continue to experience problems such as lack of adequate land for expanding roads in tandem with the projected spatial planning objectives, inaccessibility to and within residential neighbourhoods, recurring conflicts between motorised and non-motorised transportation modes and inadequate wayleaves for establishing critical infrastructures such as water pipes, sewer lines and telecommunication networks. The study recommends that the CGOK should hasten to sensitize the town's residence on the benefits of development control rather than focusing on its perceived punitive measures. This should be accompanied by regular monitoring to ensure that they do not encroach on the road reserves. Concerning buildings that are already illegally located on the road reserves, the CGOK is lawfully encouraged to invoke the powers it has under the Physical and Land Use Planning Act (the Republic of Kenya, 2019) that requires a person who has commenced a development without a permit to reinstate the land to its original condition. According to the Act, the CGOK may alternatively restore such land to its original status and thereafter recover the restoration cost from the developer. This ultimately vindicates the application of the theory of regulatory compliance in controlling unauthorized developments on urban road reserves. Finally, in terms of implication, this study has demonstrated how compliance with the planning standards that regulate road reserves may be spatially and statistically determined, a gap that hitherto existed in the planning literature. It has further provided a piece of compelling evidence to the planning authorities on how compliance with road reserves may be spatially monitored through the integration of GIS and remote sensing.

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