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# The Relationship Between Topography of Area and Accessibility to Schools Case Study: *Ecole Primaire* Kibande, Mugano Sector in Nyamagabe District

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**ABSTRACT:** The present study assessed the relationship between topography of area and accessibility to schools. The research objectives were to analyse the geographical and topographical features surrounding Ecole Primaire (EP) Kibande, to assess the impact of topography on pupils' attendance, enrolment rates, punctuality, and dropout levels at EP Kibande and to propose realistic and context-specific recommendations for improving educational accessibility in hilly regions like Mugano Sector. Quantitative and qualitative descriptive research design were used, and while collecting data both questionnaires and interviews were applied. The population of the study was 444 participants. The findings were presented based on the research objectives. Based on geographical and topographical features surrounding EP Kibande, the findings indicated that 96% of participants said that their houses were located in a hilly or mountainous area near EP Kibande and the terrain between their home location and EP Kibande included steep slopes or valleys. Based on the impact of topography on pupils' attendance, enrolment rates, punctuality, and dropout levels at EP Kibande, the findings showed that 96% of participants said that the hilly terrain makes it difficult for their children to attend school regularly. Also, 99% said that their children have missed school due to difficult or unsafe routes caused by the topography. Based on the realistic and context-specific recommendations for improving educational accessibility in hilly regions like Mugano Sector, the findings showed that 99% said that improving footpaths and trails to schools would help pupils travel more safely and easily and 97% said that children-caregivers should help them to reach at school. All the research objectives were confirmed. The administration of the school through the distirct authorities was recommended to invest in rural education-access infrastructure by prioritizing the construction and maintenance of all-weather feeder roads, safe footpaths, and small bridges in hilly and hard-to-reach areas so that pupils can travel to school safely and consistently throughout the year.

**KEYWORDS***:* Topography of Area, Accessibility to Schools

## BACKGROUND

Geographical conditions continue to influence access to education even in countries with advanced economic and infrastructure systems. Studies such as Yao (2022) highlight that topographical factors such as mountains, hills, and settlement patterns can affect the spatial distribution of schools and the accessibility of education services. Research on territorial schooling in countries like Germany shows that remote and peripheral regions still experience challenges in ensuring equal educational access due to historical settlement patterns and infrastructure limitations. Similarly, studies in the United States indicated that rural areas often face longer travel distances, transportation difficulties, and limited connectivity to educational facilities. According to Thier (2021), terrain characteristics, road networks, and travel time remain important factors affecting school accessibility, even though many studies emphasized on socioeconomic conditions.

In many developing countries, physical geography creates even greater barriers to education. For instance, research in South Africa shows that hills, valleys, rivers, and poor rural road networks can make journeys to school long, difficult, and sometimes unsafe, especially during rainy seasons (Knight, 2021). Similar challenges are observed in Uganda, where mountainous terrain, swamps, and islands increase travel distances and limit access to schools, with a large proportion of pupils walking several kilometres each day (Hartter, 2019). In Rwanda, the country's steep hills

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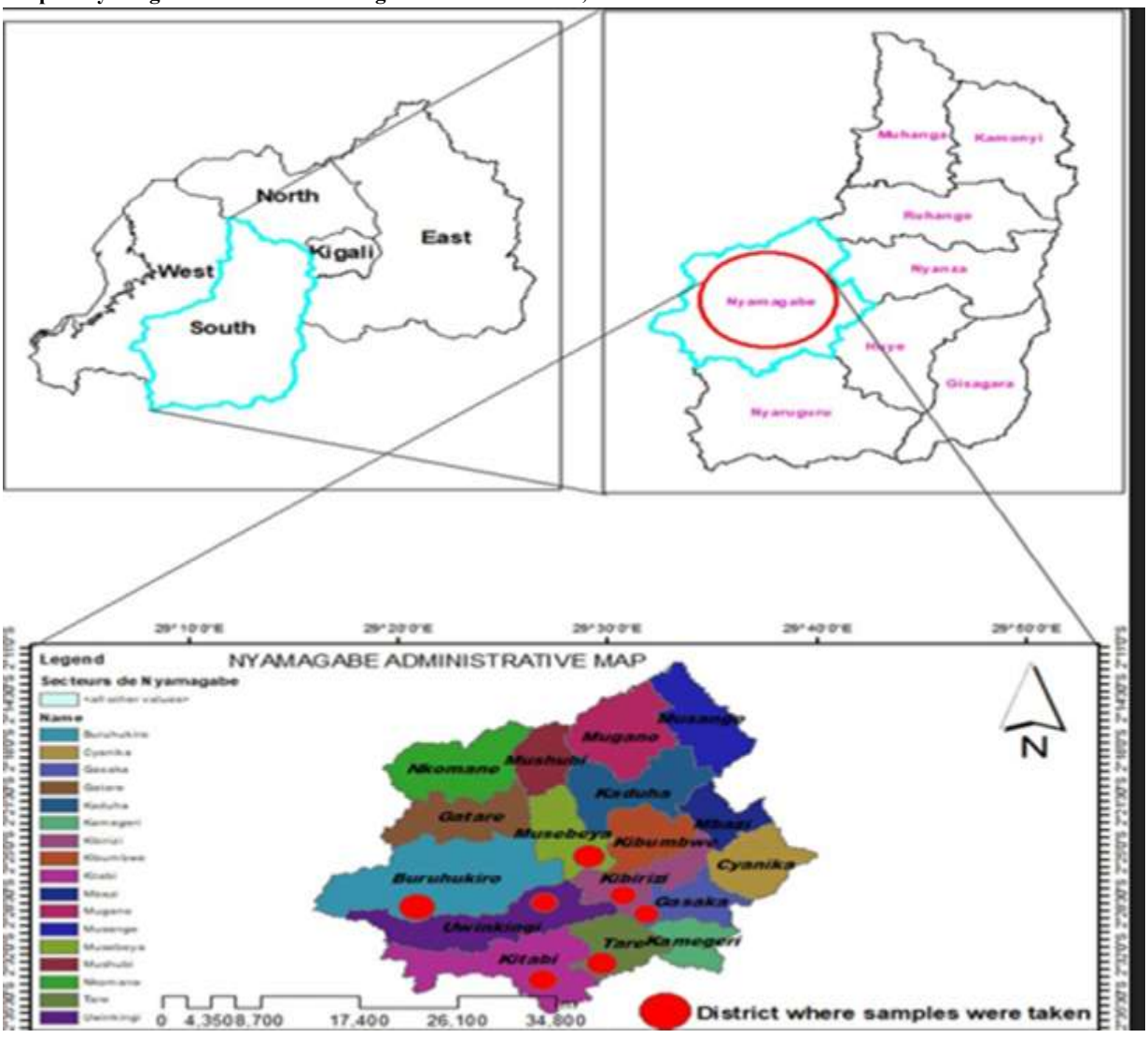
and deep valleys significantly affect school accessibility, particularly in rural districts. In areas such as Nyamagabe District, especially the highland Mugano Sector, difficult terrain makes travel to schools like *Ecole Primaire* Kibande time-consuming and challenging for students. These geographical barriers can contribute to irregular attendance, delayed enrolment, and higher dropout rates, highlighting the importance of considering topography when planning equitable access to education.

## MATERIALS AND METHODS

This study examined the relationship between topography and accessibility to schools in the hilly regions of Rwanda. The research was conducted at EP Kibande located in Mugano Sector within Nyamagabe District. The area is characterized by rugged high-altitude terrain of about 1,700 meters above sea level, steep slopes often exceeding 40%, volcanic acidic soils, and dispersed settlements connected mainly by narrow footpaths. A descriptive research design combining quantitative and qualitative approaches was used to collect and analyse data. The target population consisted of 444 participants including pupils, teachers, and the Sector Education Inspector (SEI). Probability sampling using simple random sampling was applied to select parents of pupils, while purposive sampling was used for teachers and the SEI. The sample size was determined using the Yamane formula with a 10% margin of errors, resulting in a total sample of 93 respondents.

Data were collected using questionnaires and interviews. Questionnaires were distributed to 81 parents of pupils to gather structured information related to school accessibility and travel conditions, while interviews were conducted with teachers and school staff to obtain detailed qualitative insights.

**Map of Nyamagabe District where Mugano Sector is located, Southern Province**




## RESULTS

The researchers presented the findings obtained in tables and while analysing and interpreting data, the researchers pointed out only the relevant features of results. In addition, the researchers discussed the results by comparing them with current and with similar studies done.

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**Table 1: Gender distribution of respondents**

| Gender | Frequency (F) | Percentage (%) |
|---|---|---|
| Male | 48 | 52 |
| Female | 45 | 48 |
| **Total** | **93** | **100** |

**Source: Primary data (2025)**

The table above demonstrated demographic characteristics of respondents based on their gender and the findings indicated that the majority of respondents 52% were males whereas 48% were females. The research was conducted on both males and females.

**Table 2: Age distribution of respondents**

| Age | Frequency (F) | Percentage (%) |
|---|---|---|
| 21-35 | 25 | 27 |
| 36-45 | 45 | 48 |
| <45 | 23 | 25 |
| **Total** | **93** | **100** |

**Source: Primary data (2025)**

The table 2 demonstrated demographic characteristics of respondents based on the age. The findings have shown that the majority of participants 48% were aged between 36-45 years, whereas 25% were aged more than 45 years. The respondents were mature enough to provide relevant data in the present study.

**Table 3: Educational level of respondents**

| Educational level | Frequency (F) | Percentage (%) |
|---|---|---|
| Advanced level certificate | 49 | 53 |
| Diploma | 23 | 25 |
| Bachelor degree | 21 | 22 |
| **Total** | **93** | **100** |

**Source: Primary data (2025)**

The table 3 demonstrated demographic characteristics of respondents based on their educational level and the findings indicated that the majority of the respondents about 53% have advanced level certificates, whereas 22% have bachelor degrees. The respondents were able to provide relevant information as they were well skilled.

The researchers presented the findings based on the research objectives that are to analyse the geographical and topographical features surrounding EP Kibande, to assess the impact of topography on pupils' attendance, enrolment rates, punctuality, and dropout levels at EP Kibande and to propose realistic and context-specific recommendations for improving educational accessibility in hilly regions like Mugano Sector.

**Table 4: The geographical and topographical features surrounding EP Kibande**

| Statement | Frequency(F) | Percentage(%) |
|---|---|---|
| Our home is located in a hilly or mountainous area near EP Kibande | 89 | 96 |
| The terrain between our home and EP Kibande includes steep slopes or valleys | 89 | 96 |
| My child(ren) must cross rivers, forests, or other natural barriers to reach school | 92 | 99 |
| My child walks more than 30 minutes to reach EP Kibande | 85 | 91 |
| During the rainy season, it becomes difficult or unsafe for my child to attend school | 93 | 100 |
| The hilly terrain causes my child to feel tired or unwell before arriving at school | 89 | 96 |

**Source: Primary data (2025)**

The table 4 presented the findings based on geographical and topographical features surrounding EP Kibande and the findings indicate that 91% said that their children walked more than 30 minutes to reach EP Kiband and the terrain between their home location and EP Kibande includes steep slopes or valleys, whereas 100% of the respondents said that during the rainy season, it became difficult or unsafe for their children to attend school.

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**Table 5: The impact of topography on pupils' attendance, enrolment rates, punctuality, and dropout levels at EP Kibande**

| Statement | Frequency (F) | Percentage(%) |
|---|---|---|
| The hilly terrain makes it difficult for my child to attend school regularly | 89 | 96 |
| My child has missed school due to difficult or unsafe routes caused by the topography | 92 | 99 |
| During the rainy season, attendance at EP Kibande drops significantly due to poor terrain conditions | 93 | 100 |
| Children often leave home very early to arrive on time due to the terrain challenges | 90 | 97 |
| Bad weather combined with poor terrain makes it hard for pupils to arrive at school on time | 93 | 100 |
| The steep terrain increases the risk of pupils quitting school, especially during difficult seasons | 88 | 95 |

**Source: Primary data (2025)**

The table 5 presented the findings based on the impact of topography on pupils' attendance, enrolment rates, punctuality, and dropout levels at EP Kibande and the findings indicated that 100% said that during the rainy season, attendance at EP Kibande drops significantly due to bad weather combined with poor terrain makes it hard for pupils to arrive at school on time, whereas 95% said that the steep terrain increases the risk of pupils quitting school, especially during difficult seasons.

**Table 6: The realistic and context-specific recommendations for improving educational accessibility in hilly regions like Mugano Sector**

| Statement | Frequency(F) | Percentage(%) |
|---|---|---|
| Improving footpaths and trails to schools would help pupils travel more safely and easily | 92 | 99 |
| Child caregivers should halp children to reach at school | 90 | 97 |
| The government should invest in solar-powered digital learning tools for pupils in remote areas | 89 | 96 |
| Schools in hilly regions should be equipped with ICT tools to support blended learning | 93 | 100 |
| Parents and local leaders should be involved in decisions about where schools are built | 93 | 100 |
| The government should prioritize hilly sectors like Mugano when planning educational infrastructure | 93 | 100 |

**Source: Primary data (2025)**

The table 6 presented the findings based on the realistic and context-specific recommendations for improving educational accessibility in hilly regions like Mugano Sector and the findings indicated that 96% said that the government should invest in solar-powered digital learning tools for pupils in remote areas, whereas 100% said that schools in hilly regions should be equipped with ICT tools to support blended learning, parents and local leaders should be involved in decisions about where schools are built, and the administration of the EP Kibande through the government should prioritize hilly sectors like Mugano when planning educational infrastructures.

Interview with school staff and SEI indicated that the geographical and topographical features surrounding EP Kibande significantly affect physical access to the school. The area is characterized by hilly terrain, uneven footpaths, and seasonal streams that become difficult to cross during the rainy season, often making the journey longer and more strenuous for learners and teachers. Steep slopes increase the risk of slips and falls, particularly for younger pupils, while the lack of all-weather roads means that motorized transport is rarely feasible, especially during rainy months. Staff noted that these conditions contribute to frequent lateness and absenteeism, as pupils from more distant households must navigate challenging landscapes that can become impassable after heavy rainfall. Despite these constraints, the community continues to rely on narrow footpaths, highlighting the need for improved infrastructure to ensure safer and more reliable access to EP Kibande.

According to school staff and SEI, the challenging topography around EP Kibande has a noticeable impact on pupils' attendance, enrolment, punctuality, and dropout levels. The steep hills, long walking distances, and slippery paths during the rainy season discourage regular attendance, with some learners missing school on days when the terrain becomes too hazardous. These difficult conditions also deter some parents from enrolling younger children who cannot safely navigate the routes, contributing to lower enrolment rates for early grades. Staff highlighted that pupils who do attend often arrive late, especially in the rain season when travel time increases, affecting punctuality and learning consistency. Over time, the cumulative strain of navigating such terrain leads some learners particularly those living the farthest away to drop out, as the daily journey becomes unsustainable for them or their families.

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School staff and SEI recommended several realistic, context-specific strategies to improve educational accessibility in hilly regions like Mugano Sector. They emphasized the need for community-supported improvement of footpaths, including clearing vegetation, reinforcing steep sections, and creating simple bridges or drainage channels to make routes safer during the rainy season. Respondents also suggested advocating for the gradual development of all-weather access roads to reduce isolation and enable transport during emergencies. Establishing satellite or closer sub-schools for early grade learners was highlighted as a practical way to reduce long walking distances for younger children. Staff further recommended organizing community escort groups during peak rainy periods to ensure safer travel, along with adjusting school schedules when severe weather makes punctuality difficult. Finally, they stressed the importance of continued collaboration between local leaders, parents, and education authorities to prioritize infrastructure and mobilize resources suited to the area's rugged terrain.

**DISCUSSION**

Based on geographical and topographical features surrounding EP Kibande, the findings indicated that 91% said that their children walk more than 30 minutes to reach EP Kibande. The findings also, indicated that 100% of the respondents said that during the rainy season, it becomes difficult or unsafe for their children to attend school, similar findings of De Lame (2020), who asserted that because of its primarily mountainous terrain, Rwanda is known as the Land of a Thousand Hills. Rolling hills, highlands, and steep valleys, particularly in the western, northern, and southern parts of the country, are its defining features. The elevation varies from about 1,000 meters in the eastern lowlands to over 4,000 meters in the northwest, with particularly difficult terrain found in places like the volcanic Virunga Mountains and the Congo-Nile divide. The location and design of infrastructure, including schools, are impacted by this rough terrain. Communities are dispersed throughout hills and valleys in many rural areas of Rwanda, frequently remote from major thoroughfares and public amenities.

Based on the impact of topography on pupil attendance, enrolment rates, punctuality, and dropout levels at EP Kibande, the findings indicated 100% said that during the rainy season, attendance at EP Kibande drops significantly due to poor terrain conditions, bad weather combined with poor terrain makes it hard for pupils to arrive at school on time, whereas 95% said that the steep terrain increases the risk of pupils quitting school, especially during difficult seasons.

According to Webb (2024), pupils' attendance was significantly impacted by topography, especially in areas with challenging terrain such as mountains or hills. Pupils in these places frequently have to travel lengthy and physically taxing distances to get to school, which may deter regular attendance. In rural and isolated areas, where schools may be far apart and walking is the only form of transportation, the problem is particularly noticeable. Pupils, particularly younger children and those with impairments, find it more difficult to attend school regularly due to the physical strain and longer commute caused by steep hills, restricted routes, and insecure surfaces.

Based on the realistic and context-specific recommendations for improving educational accessibility in hilly regions like Mugano Sector, the findings indicated that 96% said that the administration of EP Kibande through the government should invest in solar-powered digital learning tools for pupils in remote areas, whereas 100% said that schools in hilly regions should be equipped with ICT tools to support blended learning, parents and local leaders should be involved in decisions about where schools are built whereas, and the administration through the government should prioritize hilly sectors like Mugano when planning educational infrastructures. According to Nkurunziza (2021), reducing physical barriers and improving learning opportunities should be the main goals of measures to increase educational accessibility in Rwanda's mountainous regions. Pupils' communities can be shortened by constructing more dispersed schools near isolated regions. Travel will be easier and safer, particularly during the rainy season, if rural road networks and walkways are improved and safe and reasonably priced school transportation options are introduced.

Pupils from really remote locations can be supported by expanding boarding facilities. Additionally, in situations where physical attendance is difficult, utilizing technology to integrate digital and mobile learning platforms can offer flexible education. Last but not least, despite the difficult terrain, sustainable access to high-quality education can be ensured by funding teacher incentives to draw and keep skilled personnel in these areas and incorporating local people in school planning and upkeep.

This study provided valuable insights into the subject under investigation; however, several limitations should be acknowledged. First, the scope of the study was limited to a specific sample and context, which may restrict the generalizability of the findings to other populations or settings. In addition, the study relied on the available data and methods used during the research period, which may not capture all possible variables influencing the phenomenon being examined. These limitations may have affected the breadth and depth of the analysis, and therefore the results should be interpreted with caution.

Despite these limitations, the findings of this study contributed to the existing body of knowledge and provided a foundation for further investigation. Future researchers are encouraged to address the limitations identified in this study by expanding the sample size, exploring different contexts, and employing more diverse research methods or additional variables. By overcoming these weaknesses, future studies may provide a more comprehensive understanding of the topic and strengthen the validity and applicability of the research findings.

**CONCLUSION**

The present study assessed the relationship between topography of area and accessibility to schools. In conclusion, the study established that the hilly and uneven topography of Mugano Sector significantly affects accessibility to EP Kibande. Steep slopes, long walking distances, and poor road conditions were found to negatively influence pupils' attendance and punctuality. The challenging terrain also contributes to lower enrolment rates and increased dropout levels, particularly among younger learners. These findings highlighted a clear link between geographical features and educational participation.

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