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# The Use of Geographic Information Systems (GIS) in Measuring the Accessibility to Educational Services in the Driouch province: A Geographical Approach for Planning

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**Abstract:** Education is considered the cornerstone of development and progress in any country, as achieving economic and human development becomes impossible without a strong focus on education, improving its quality, enhancing its appeal, and prioritizing it in national policies. Education has always been, and remains, of great importance for both developed countries and those on the path to growth. In this context, this study aims to highlight the educational challenges in the Driouch province, located in northeastern Morocco, by examining the evolution of student numbers, analyzing the spatial distribution of educational institutions, and assessing access to education using Geographic Information Systems (GIS). The study relied on field surveys and interviews with local residents and adopted a descriptive-analytical approach, integrating cartographic work for spatial analysis to provide a comprehensive examination of the data. Based on this, the study reached several conclusions, including: a decline in student numbers in Driouch due to school dropout, an uneven spatial distribution of educational institutions that exacerbates the education crisis, and that access to educational services remains very limited, especially for secondary education.

To overcome the challenges related to the education sector in our field and ensure equity in access to these services, we propose a set of recommendations, including the construction of more educational institutions, particularly high schools, providing favorable conditions for schooling, revising the current school map, and universalizing preschool education, among others.

**Keywords:** Education, Planning and Social Development, Human Development, Driouch Province, Geographic Information Systems.

# توظيف نظم المعلومات الجغرافية في قياس درجة الولوجية للخدمات التعليمية بإقليم الدريوش: مقاربة جغرافية في خدمة التخطيط

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**المستخلص:** يُعتبر التعليم حجر الزاوية للتنمية والتقدم في أي دولة، حيث إن تحقيق التنمية الاقتصادية والبشرية يصبح أمرا مستحيلا دون التركيز بشكل قوي على التعليم، وتحسين جودته، وتعزيز جاذبيته، وإعطائه الأولوية في السياسات الوطنية. فالتعليم كان، ولا يزال، يحظى بأهمية بالغة بالنسبة للدول المتقدمة وتلك السائرة في طريق النمو. في هذا السياق، تهدف هذه الدراسة إلى تسليط الضوء على التحديات التعليمية في إقليم الدريوش الواقع في شمال شرق المغرب، من خلال دراسة تطور أعداد التلاميذ، وتحليل التوزيع المجالي للمؤسسات التعليمية، وتقييم الولوجية إلى التعليم باستخدام نظم المعلومات الجغرافية (GIS). اعتمدت الدراسة على الدراسات الميدانية والمقابلات مع السكان المحليين، واتبعت منهجًا وصفيًا تحليليًا مع دمج العمل الكرطوغرافي للتحليل المجالي لتقديم تحليل شامل للمعطيات. بناء على ذلك توصلت الدراسة إلى عدة نتائج منها: أن عدد التلاميذ بإقليم الدريوش في تراجع بسبب الهدر المدرسي ثم إن التوزيع المجالي للمؤسسات التعليمية يظهر أنه توزيع غير متكافئ مما يزيد من مشكل أزمة التعليم كما توصلت أيضا الدراسة إلى أن درجة الولوجية للخدمات التعليمية لا زالت ضعيفة جدا خصوصا بالنسبة للتعليم الثانوي.

**الكلمات المفتاحية:** التعليم، التخطيط والتنمية الاجتماعية، التنمية البشرية، إقليم الدريوش، نظم المعلومات الجغرافية.

## 1. Introduction

The availability of services and the extent to which the population can access and obtain them is a crucial factor in studying the reality of territorial development. Educational services are essential for the development and well-being of the inhabitants of any city (Marques, et al, 2021), as they represent the cornerstone of individual and societal progress (Sharma, et al, 2022). Education is a fundamental right in nearly 135 countries; however, the lack of adequate access to educational services can make the realization of this basic right difficult (Sharma, et al, 2022). Therefore, achieving justice in education and its sustainable development must focus on enhancing the fairness of educational opportunities and their quality in the new era (Song et al, 2018).

Basic infrastructure associated with social services is considered the backbone of any developmental work. Development projects are of little use if they do not take into account the social, cultural, and health aspects of the community, as the settlement of populations in their areas is largely linked to the availability of these services and facilities. Therefore, development is now measured by the level of presence of these services; the stronger the presence of these services, the more comfortable the population will be, and vice versa (El kallouchi, 2024). These services can be considered as determinants of population stability in their area, as it is impossible to settle people in an area that lacks even the most basic services, such as healthcare, education, water, and electricity, for example.

Recognizing the crucial role of education, many countries have developed systems and policies aimed at achieving educational equity and ensuring that all individuals, regardless of their backgrounds, have the right to access quality educational opportunities. Planning school locations is vital to ensure that educational institutions are situated in optimal places, providing a suitable learning environment while maximizing student access to them (Ackah-Jnr, et Al, 2019). Therefore, schools should be kept away from undesirable land uses, such as factories and areas with heavy traffic, in order to reduce exposure to pollution, noise, and safety hazards (AlQuhtani, 2023). Especially as both urban and rural areas are experiencing significant growth in all aspects, including the education sector. This change requires proper planning and equitable distribution of educational facilities by the authorities to achieve justice, meet demand, and ensure the best possible benefit from them (Abdulkader, et Al, 2020). Therefore, spatial analysis of school distribution has become increasingly important in urban planning, geography, and environmental studies (C.Lubienski and J. Dougherty, 2009).

The unbalanced growth of the population and economic development has not only contributed to increasing geographic disparities but has also led to the emergence of several new forms of inequality, including limited access to quality healthcare, education, clean water and sanitation, transportation, and adequate infrastructure (Mishra, et Al, 2023).

This is particularly true for mountainous regions, characterized by steep and fragmented terrain, isolated from the outside world. Therefore, there appears to be an imbalance between Moroccan areas that have modern infrastructure and facilities with relatively adequate living conditions, and others where these conditions are completely absent. In light of this context, this article will attempt to list the various educational institutions that serve social functions in the region, highlighting their presence and the level of accessibility in terms of good planning for the educational map of the Driouch province.

### 2. Research Problem

The main research problem can be formulated as follows: To what extent can Geographic Information Systems (SIG) be used to measure the level of accessibility to educational services in the Driouch region? This central problem gives rise to a number of questions, such as: How are educational institutions distributed in this area? What challenges are hindering education? And what are the proposed solutions to overcome the current situation?

### 3. Objectives of the study

- Monitoring the development of the number of students in the Driouch region;
- Monitoring the spatial distribution of educational institutions in the Driouch region;
- Identifying levels of accessibility to educational services;
- Assisting decision-makers in planning the optimal distribution of schools.

### 4. Signifiance of the study

The study aims to analyze the spatial distribution of educational institutions in the Driouch province, considering that their availability in a way that meets the community's demands and needs will undoubtedly contribute to the development of the education

sector and reduce school dropout rates. Therefore, this study comes to offer scientific solutions and recommendations to improve the quality of education, alleviate the isolation of remote areas, and achieve economic and social development.

**5. Study methodology**

In this study, we employed the descriptive-analytical method by describing and analyzing the elements of the phenomenon and linking these elements together. Additionally, we used the statistical method, alongside field research, which involved distributing questionnaires and interviewing the local population. To generate data and extract results, we utilized modern geographic techniques, especially Geographic Information Systems (SIG).

In addition, we relied on the statistics provided by the Directorate of Education in the Driouch province, especially regarding the number of students and school dropout rates.

We focused on the number of students, the number of educational institutions, and the standard distance that students travel to reach the nearest institution in order to measure the level of access to educational services in the Driouch province.

**6. study area**

The area being studied is naturally bounded between the Nekour Valley to the west and the Kert Valley to the east. It opens to the Mediterranean coast to the north and connects to the Guercif Basin to the south. Geographically, as is well known by geographers, it belongs to the Eastern Rif region and is part of the Rif Mountain range. Administratively, it is considered a newly established region, having been separated from the Nador Province by Royal Decree No. 2.03.319 issued on June 11, 2009. It belongs to the Eastern region and is bordered by Nador Province to the east, Al-Hoceima Province to the west, guersif Province to the south, and Taza Province to the southwest. Thus, it is considered a transitional area between Nador and Al-Hoceima.

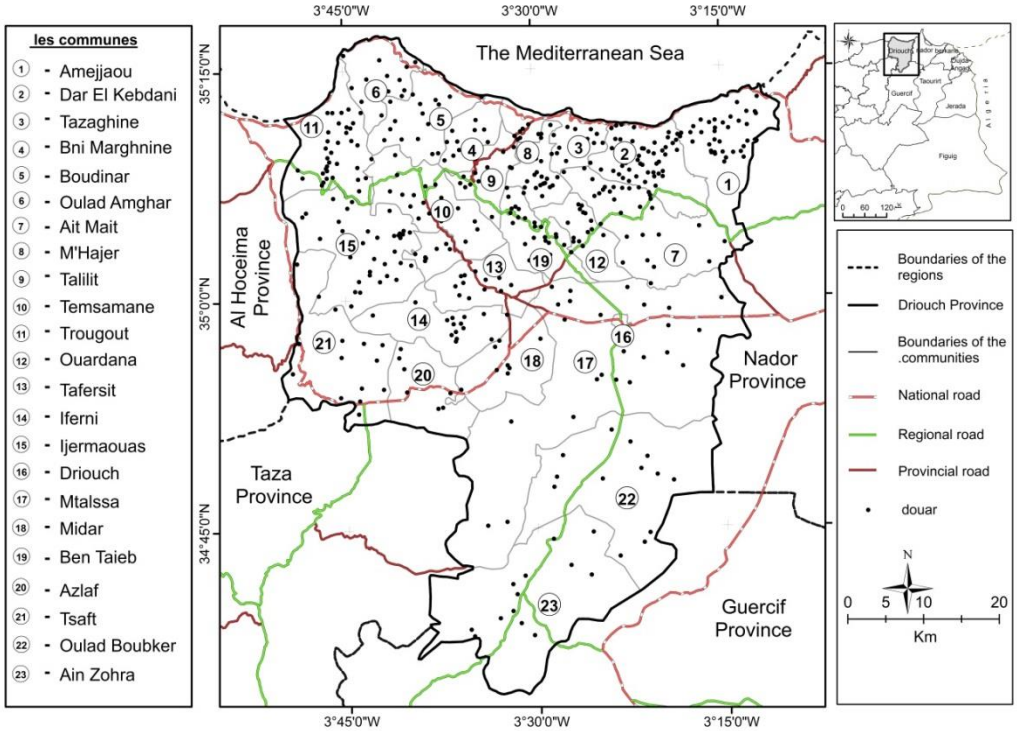


**Fig 1. Geographic location and administrative division of the study area**

**Source: Map of the administrative division of Morocco 2015, personal work.**

The total area of the study region is approximately 2,867 km², which represents 3.2% of the total area of the region and 0.40% of the national territory. It consists of two districts: the Driouch District and the Rif District, with eight administrative subdivisions, three urban centers, and 23 local communities, including three urban municipalities. According to the most recent official census in 2024, the total population is about 188,191 people (8.20% of the total population of the Eastern region). The population is distributed as follows:

46,054 urban residents, representing 24.47% of the total population of the region, and 142,137 rural residents, making up 75.53% of the total population of the region.

## 7. Results and Discussion

### 7.1. The Distribution of Students in the Driouch Province

Education is a strong indicator of the level of development in a region, and it is vital for the formation of human resources capable of assuming future responsibilities. It is a form of human investment for a better tomorrow (Bouhlal Abdessalam, 2013).

The total number of students during the 2023-2022 school year was 37,561, distributed across three educational stages: 63.5% in primary education, 24.31% in middle school, and 12.16% in secondary education. These percentages also vary based on the environment and gender. It is noted that 65.72% of the students come from rural areas, while 34.28% are from urban areas. In terms of gender, the percentage of male students exceeds that of female students, with 51.42% of male students and 48.58% of female students enrolled.

**Table 1. Distribution of Students by Educational Stages**

| Educational level | Urban | | rural | | total | Percentage % |
|---|---|---|---|---|---|---|
| | Males | Females | Males | Females | | |
| Primary | 3535 | 3237 | 8926 | 8166 | 23864 | 63.53 |
| secondary | 2125 | 1930 | 2702 | 2374 | 9131 | 24.31 |
| Qualification | 946 | 1102 | 1080 | 1438 | 4566 | 12.16 |

**Source: provincial Directorate of the Ministry of National Education in Driouch 2023**

### 7.2. Teacher Shortage in the Driouch Province

Human resources are the cornerstone for the progress and development of the education sector. In addition to their primary role in teaching and instruction, their functions also include guidance, mentoring, and raising awareness. Therefore, investing in human resources is considered a fundamental entry point for achieving development.

The total number of teaching staff during the 2022-2023 school year was 2,241 educators, distributed across the three educational stages. The primary education stage accounts for the largest share, with 1,318 teachers, representing 58.81% of the total teaching staff, of whom 81.10% work in rural areas. Next is the middle school stage, with 553 educators, 65% of whom teach in rural communities. Finally, the secondary education stage has 370 teachers, with 59.45% working in rural centers (such as krona, Tafersit, and kebdani).

**Table 2. Distribution of Teaching Staff in the Driouch Province for the 2022-2023 School Year**

| Educational level | Urban | | rural | | total | Percentage % |
|---|---|---|---|---|---|---|
| | Males | Females | Males | Females | | |
| Primary | 78 | 171 | 426 | 643 | 1318 | 58.81 |
| secondary | 90 | 103 | 159 | 201 | 553 | 24.68 |
| Qualification | 61 | 89 | 50 | 170 | 370 | 16.51 |

**Source: provincial Directorate of the Ministry of National Education in Driouch 2023**

Regarding the teacher-student ratios, it appears that, on average, each teacher supervises 34 students in urban areas and 23 students in rural areas at the primary education level. This ratio increases to 32 students per teacher at the middle school level, compared to 27 students in the Eastern region. At the secondary education level, the teacher-student ratio is 17 students per teacher. This indicates that both primary and middle schools are still facing overcrowding and a shortage of teaching staff, which has led many primary schools to combine two grade levels in one classroom due to the significant lack of educational staff. This, without a doubt, will negatively impact the learning outcomes of the students.

### 7.3. The number of educational schools in the Driouch province

The number of public educational institutions in the studied area reached 280 schools during the 2022-2023 school year, distributed as follows: 252 primary schools, including two private institutions; 17 middle schools; and 11 secondary schools. The majority of these institutions are concentrated in rural areas, as most of the communities in the region are rural. Regarding boarding schools and

girls' dormitories, there is a clear deficiency, as they are only concentrated in the urban centers of Driouch and Midar, which has led to a large number of students, particularly females, discontinuing their education once they complete primary school.

**Table 3. The number of educational schools in the Driouch province**

| Educational institutions | Urban | rural | total |
|---|---|---|---|
| **Primary institutions** | **18** | **234** | **252** |
| **Secondary institutions** | **5** | **12** | **17** |
| **Qualification Institutions** | **3** | **8** | **11** |

**Source: provincial Directorate of the Ministry of National Education in Driouch 2023**

It is also observed that, despite the relatively balanced distribution of primary schools across each rural community, there is a problem regarding the number of classrooms. Most primary schools have no more than three classrooms, and there is a clear deficiency in basic facilities such as electricity, water, and toilets. The same issue applies to middle and secondary schools, which also suffer from weak infrastructure, especially with the rapid increase in the number of students. This calls for expanding the educational offerings by establishing new schools, particularly middle and secondary schools, as well as renovating existing ones and equipping them with the necessary facilities to ensure appropriate working conditions for teachers and better enrollment conditions for students.

**7.4. Spatial Distribution of Educational Institutions and Accessibility Level**

The main objective of studying the distribution and spread of educational institutions across the entire territory of the western part of the eastern Rif is to measure the level of accessibility and then identify the directions of influence and areas of attraction. Educational institutions are considered a decisive factor in attracting populations and encouraging them to settle.

The distribution of public educational institutions is part of the general school map planned by the regional directorates of the Ministry of National Education. Therefore, their distribution and dispersion are influenced by multiple factors. While proximity to population centers is a decisive factor for establishing a school, natural elements (such as mountains and plains) and geographic isolation can be key factors in determining the location of the institution. Additionally, political conflicts between local elected officials and tribal affiliations may also play a major role in controlling this distribution.

- **Level of Accessibility to Primary Educational Institutions**

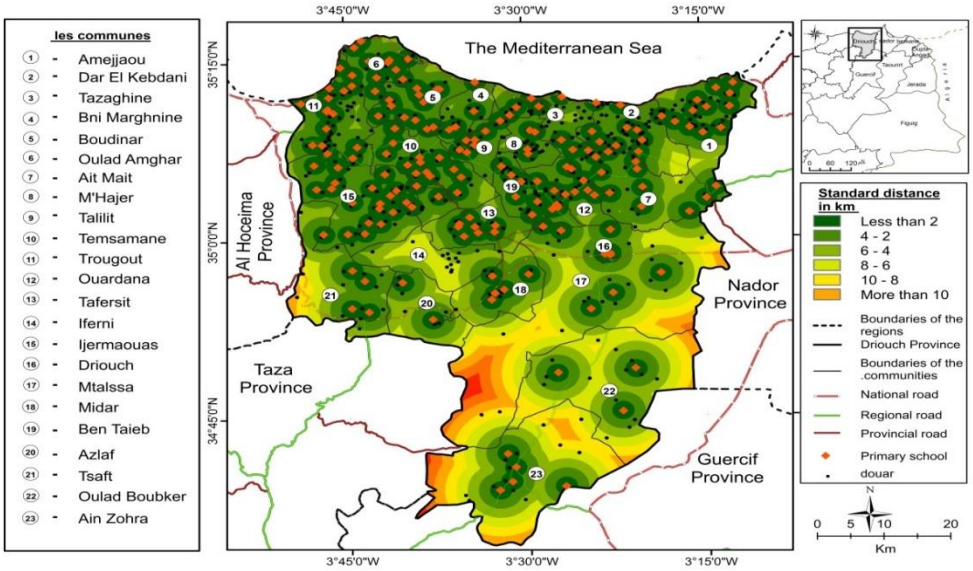


**Fig 2. Attraction areas and accessibility level of primary educational institutions in the Driouch Province**

**Source: Data from the Regional Directorate of Education in Driouch, use of Geographic Information Systems, personal work 2023.**

Based on the accessibility map for primary educational institutions and the results of the field study, the following conclusions can be drawn:

- 68.3% of students in the study area travel less than 2 km to reach the nearest primary school;
- 21.4% of students travel a distance between 2 and 4 km to reach the nearest school;

- 4.9% of students in some villages travel a distance between 4 and 6 km;
- 3.8% of students in some villages travel a distance between 6 and 8 km;
- 1.5% of the total students in the area travel a distance greater than 8 km to access the nearest primary school. This distance can exceed 10 km in some villages, as is the case with the communes of tsfat, Mtalssa, and Ain Zoura.
- **Level of Accessibility to Intermediate Educational Institutions**

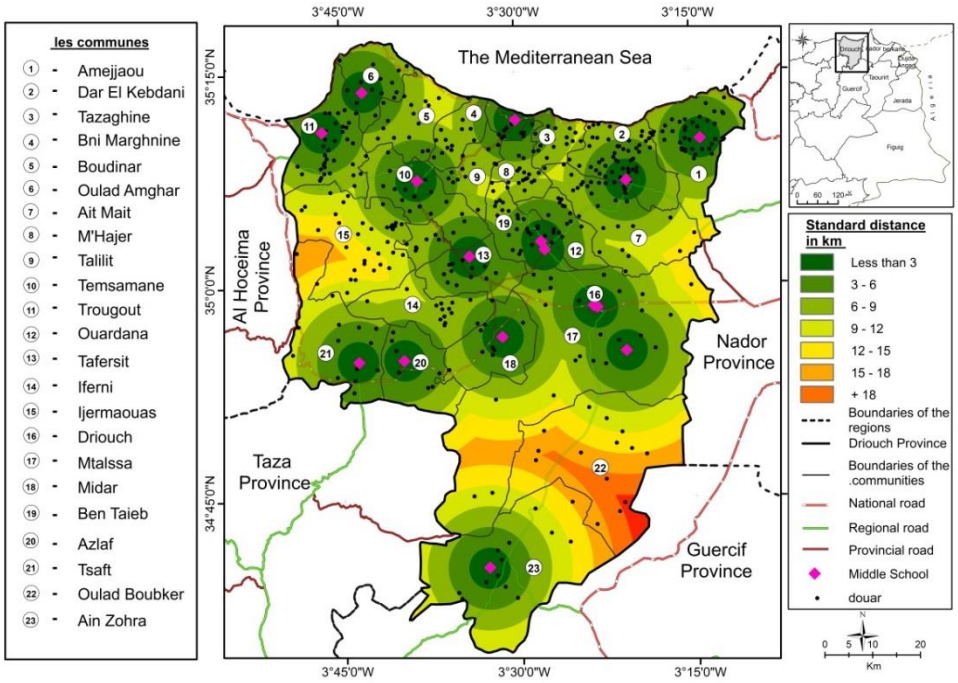


**Fig 3. Level of Accessibility to Intermediate Educational Institutions in Driouch**

**Source: Data from the Regional Directorate of Education in Driouch, use of Geographic Information Systems, personal work 2023.**

Based on the results of the field research and the use of Geographic Information Systems (GIS), the following findings were obtained as shown in Figure 3:

- 21% of students from rural areas travel less than 3 km to reach the nearest middle school.
- 34.2% of students travel between 3 and 6 km to reach the nearest middle school.
- 30.6% of students from some rural areas travel between 6 and 9 km.
- 9.6% of students from some rural areas travel between 9 and 12 km.
- 4.6% of students come from villages that are more than 12 km away from the nearest middle school.

- **Accessibility of Secondary Education Institutions**

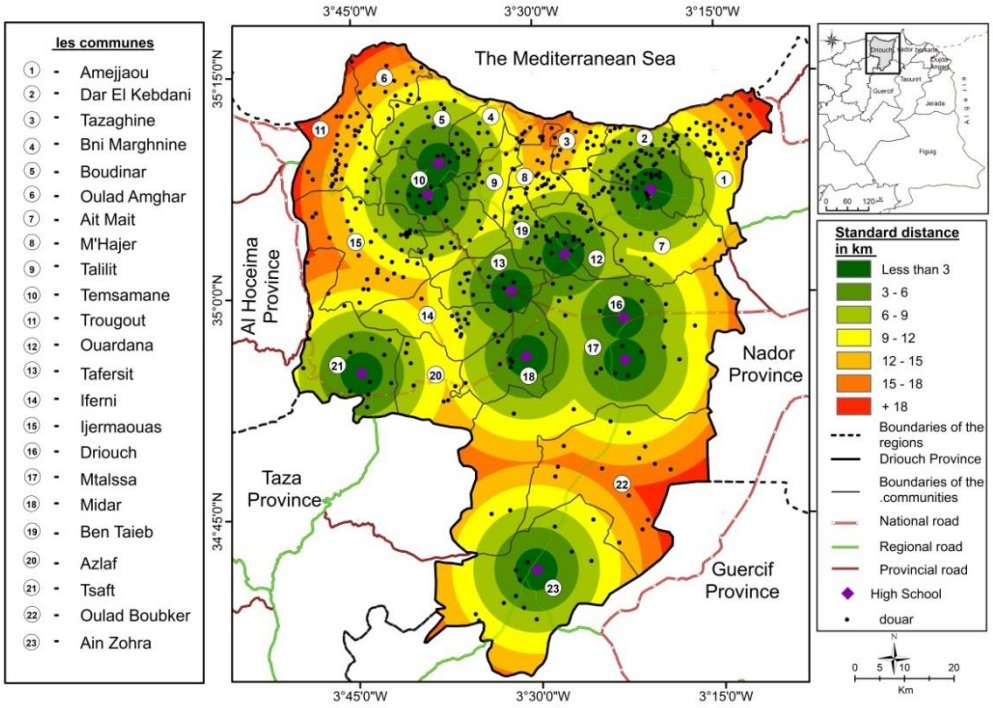


**Fig 4. Attraction areas and accessibility level of vocational educational institutions in the Driouch Province**

**Source: Data from the Regional Directorate of Education in Driouch, use of Geographic Information Systems, personal work 2023.**

As for the accessibility of secondary education institutions, the results were as follows:

- 10.7% of students from rural areas travel less than 3 km to reach the nearest public secondary school.
- 21.5% of students travel between 3 and 6 km to reach the nearest public secondary school.
- 32.1% of students from some rural areas travel between 6 and 9 km.
- 21% of students from some rural areas travel between 9 and 12 km.
- 23.7% of students come from villages that are more than 12 km away from the nearest secondary school, with some distances reaching up to 20 km or more, as in the case of Oulad Boubker and Mtalssa.

In general, primary schools are spread across most parts of the study area, meaning that each administrative unit benefits from at least three schools. However, their distribution presents a major issue, as they tend to be concentrated near densely populated areas, without taking into account the spatial dispersion of the rural population. As for middle schools and high schools, which represent a higher level of educational facilities, they are characterized by limited numbers and weak coverage. These schools are usually located in rural and urban centers, close to significant population clusters.

**7.5. School Dropout in the Driouch Province and Its Causes**

If the number of students in the Driouch province represents approximately 70% of the total children in the school-age group (6-14 years), this percentage remains low, especially in rural areas.

**Table 4. Distribution of the number of students who dropped out of school during the 2022-2023 school year**

| Educational level | urban | | rural | | total | Percentage% |
|---|---|---|---|---|---|---|
| | males | Females | males | Females | | |
| primary | 80 | 44 | 215 | 153 | 492 | 42.3 |
| secondary | 159 | 75 | 200 | 74 | 508 | 43.6 |
| qualifying | 62 | 33 | 40 | 28 | 163 | 14.02 |

**Source: provincial Directorate of the Ministry of National Education in Driouch 2023.**

From the data in the table, we can observe that school dropout in the rural areas of Driouch province is still ongoing. The total number of students who dropped out of school during the 2022-2023 school year was 1,163, including 43.68% at the middle school level, 42.30% at the primary level, and 14% at the secondary education level. This dropout rate is higher in rural areas, which alone accounted for 61% of the total dropouts, compared to 39% in urban areas. The dropout rate is also higher among male students, reaching 65%, compared to 35% for female students.

The low enrollment of children in schools can be explained by a number of socio-economic, cultural, and natural factors, as confirmed by field research. The most significant of these factors can be summarized as follows:

- Natural and Geographical Factors: Given that the Driouch province is characterized by a rugged terrain, it creates an environment that is not conducive to student access, particularly for children in remote areas. In some regions, schools are located more than 10 kilometers away from the villages, meaning that students must walk for an hour or more to reach them. This is the case for communities such as Ait Mait and Mtalssa.
- Lack of school cafeteria facilities in most educational institutions: Even when available, they provide meals to only a limited number of students, which leads many parents to refrain from sending their children to school.

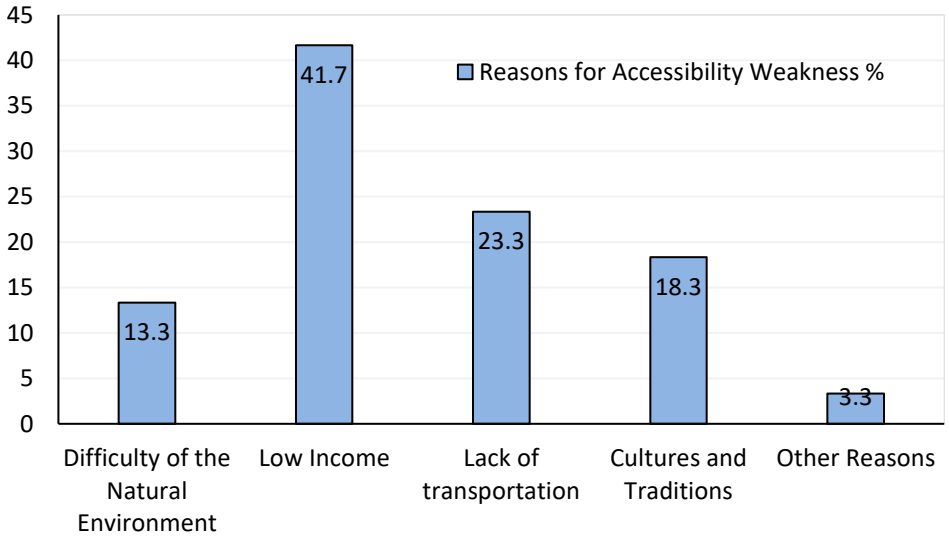


**Fig 5. Causes of School Dropout in the Driouch Province**

**Source: Prepared by the researchers, Fieldwork 2024.**

- Weak Boarding Facilities: In this regard, we observe a significant deficiency in girls' dormitories and boarding schools to accommodate students. This, without a doubt, contributes to accelerating the rate of school dropout.
- Lack of School Transportation: In the absence of free school transportation, students are forced to use informal transport services or bicycles, which lack basic safety standards, or to walk long distances to reach their schools.

**7.6. Recommendations and Proposals for Improving the Education Sector in the Driouch Province**

In order to overcome the challenges that hinder any real development in the region, it is essential to implement a practical and feasible strategy to support education in rural areas, with the involvement of all stakeholders in various educational fields (local communities, ministries, national and international organizations, civil society, and parent associations). Therefore, we propose the following measures to improve the state of the education sector in the Driouch province:

- Establishing New Educational Schools with Modern Specifications, Especially in Marginalized Rural Areas Suffering from Neglect and Isolation.
- Establishing Pre-school Education Classes in All School Units, Especially in Rural Areas That Lack Such Projects.
- Establishing New Boarding Sections in Secondary and Middle Schools, Expanding Capacity, and Improving the Quality of Services.

- Building Special Classes for Combating Illiteracy and Encouraging University Graduates to Contribute to Training and Mentorship.
- Establishing Housing for Educational and Administrative Staff in Rural Communities to Ensure Their Stability.
- Providing School Health Services for Students.
- Revising the Current School Map and Giving Special Attention to Rural Areas That Still Suffer from Shortages, Both in Terms of Schools and Classrooms, as Well as Educational and Administrative Staff.
- Relying on GIS (Geographic Information Systems) Specialists to Develop a Spatial Plan to Ensure the Proper Distribution and Coverage of Educational Institutions, Facilitating Accessibility.
- Establishing a University Institution in Driouch and Institutes for Applied and Technological Sciences.

## 8. Conclusions

It has become evident that the educational situation in the studied area is characterized by fragility and growing disparities, thus presenting a microcosm of the overall education situation in our country. Education in the area still faces numerous challenges related to marginalization and isolation, which have affected the region for decades. This has, in turn, reflected negatively on the general condition of the studied rural communities, including the education sector.

We also recorded, within this social indicator, that despite the relative progress observed in these communities over the past decade particularly in terms of the increase in the number of students, teachers, and primary educational institutions there is still a significant shortfall at the level of secondary education institutions. The poor distribution of these institutions, coupled with weak coverage of secondary schools and the absence of boarding schools and dormitories for female students in most communities, remain prominent issues.

Among the negative consequences of this situation are the rising rates of early school dropout, and the growing trend of rural families migrating to nearby towns and cities in search of better conditions that would allow their children to pursue their middle and secondary education.

The study also demonstrated the crucial role of Geographic Information Systems (SIG) in the effective planning of school distribution in the Driouch province. GIS can help decision-makers make accurate and well-informed choices to ensure a balanced distribution of educational institutions.

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