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SPATIAL ANALYSIS OF THE GEOGRAPHICAL ACCESSIBILITY TO HEALTH INFRASTRUCTURES IN THE COMMUNE OF IFANGNI IN BENIN

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ABSTRACT
Access to health care is an essential part of an increasingly urbanized world, exposed to increasing risks as the population grows daily.
The study aims to inventory infrastructures to analyse their spatial accessibility.
The methodological approach used is exclusively based on the use of attribute and spatial data. The Thiessen polygon was generated to better understand the spatial coverage of health infrastructure in the Commune of Ifangni . The results obtained show that health infrastructures are unequally distributed over the territory of the municipality. In 2017, the municipality has 17 health care structures. The population travels an average of 10 km to the nearest health center. The north-east and west part of the Commune is almost devoid of health infrastructure. 81% of the communal area benefits from health care coverage at different levels. 9% of the area is well covered in health care, 30% is lowly covered and 42% is very lowly covered. These results highlight the need to take into account the "geographical accessibility" component in the projects and programs for the construction of health infrastructures in the area of the Commune.

KEYWORDS: Geographic Information System, spatial analysis, health center, geographical accessibility, Ifangni.

1.   INTRODUCTION
The population in African countries has increased from an average of 20% in 1975 to 42% in 2013 and will reach 50% by 2020 (Cities Alliance, 2007). In developing countries as a whole, this population is growing at a rate of 60 million people per year on average, or 163,000 people per day. (http: www.unhabitat.org). The poverty index in these countries is between 12% and 52%; and the proportion of the population without access to socio-community infrastructure (water point, health center, school, etc.) is between 3% and 58%.(UNDP, 2006). These demographic and poverty data are urgent challenges to improve the lives of 100 million slum dwellers by the year 2020, in accordance with the Millennium Development Goals MDG (UNDP, 2000). In Benin, as in most sub-Saharan African countries, access to health services is reserved for workers in the formal sector (mostly civil servants). There is no formal health insurance for the rest of the population, which is the poorest and often the most at risk of illness. Informal sector workers and a large majority of the formal sector (private and parastatal enterprises), which make up over 80% of the continent's working population (WHO, 2001), are thus in a situation of serious vulnerability. These African countries have some of the least favorable health indicators and life expectancy in the world (CIET, 2000). An operational definition of the concept of access becomes necessary. As Diechman (1997) appropriately points out, evidence of access is the use of services not just their presence. However, in many countries of the third world, particularly in rural areas, the increase in the use of services remains one of the biggest challenges of health planning (David, 2012). It is therefore necessary to question the geographical factors that condition access to health centers. The development and easy use of Geographic Information System (GIS), as well as the increasing availability of spatialized data, have promoted numerous studies on the creation of indicators. Often quantitative, these indicators assign a unique value (or category of values) corresponding to a quality of access for each spatial unit of the territory

(Raynaud, 2014). The present research on "Spatial analysis of geographical accessibility to health infrastructures" aims rather to apply GIS by taking a test environment: the Commune of Ifangni in southeastern Benin.

2.   ISSUE

Since the accession to independence, Benin, like many other developing States, has made major efforts to provide basic health coverage for the entire population. These efforts are aimed at improving the situation of health of the population, through the diffusion of preventive and curative care of the "modern" type. A health policy has therefore been set up, the aim of which is to enable all segments of the population to benefit from easy access to health care. Despite the construction efforts made by the state, the question of the accessibility of the population to health structures remains unresolved. In the Commune of Ifangni, the populations, especially those of the peripheral districts, are far from the health structures. The obvious consequence of this situation is that people struggle for several kilometers to get treatment. Yet access to care is considered as a condition of equity.

In light of this observation, three (03) fundamental questions arise:
- Which health infrastructures are available in the Commune of Ifangni?
- How are the health infrastructures spread over the area of the Commune of Ifangni?
- Is there a problem of geographical accessibility to these health infrastructures in the commune?

These are just as many questions as with GIS tools, answers will try to be given.
The general objective of this work is to study the geographical accessibility of health centers in the Commune of Ifangni.
It is specifically about:

- to list the health infrastructures of the Commune of Ifangni ;

- analyze the spatial distribution of health infrastructure in the Commune of Ifangni ;

- analyze the geographical accessibility of populations to health infrastructures.

3.   PRESENTATION OF THE STUDY AREA

The Commune of Ifangni is located in south-eastern Benin in the department of plateau between 6° 32" and 6° 44" north latitude and between 2 ° 39'40 "and 2 ° 46'40" east longitude (Figure 1).
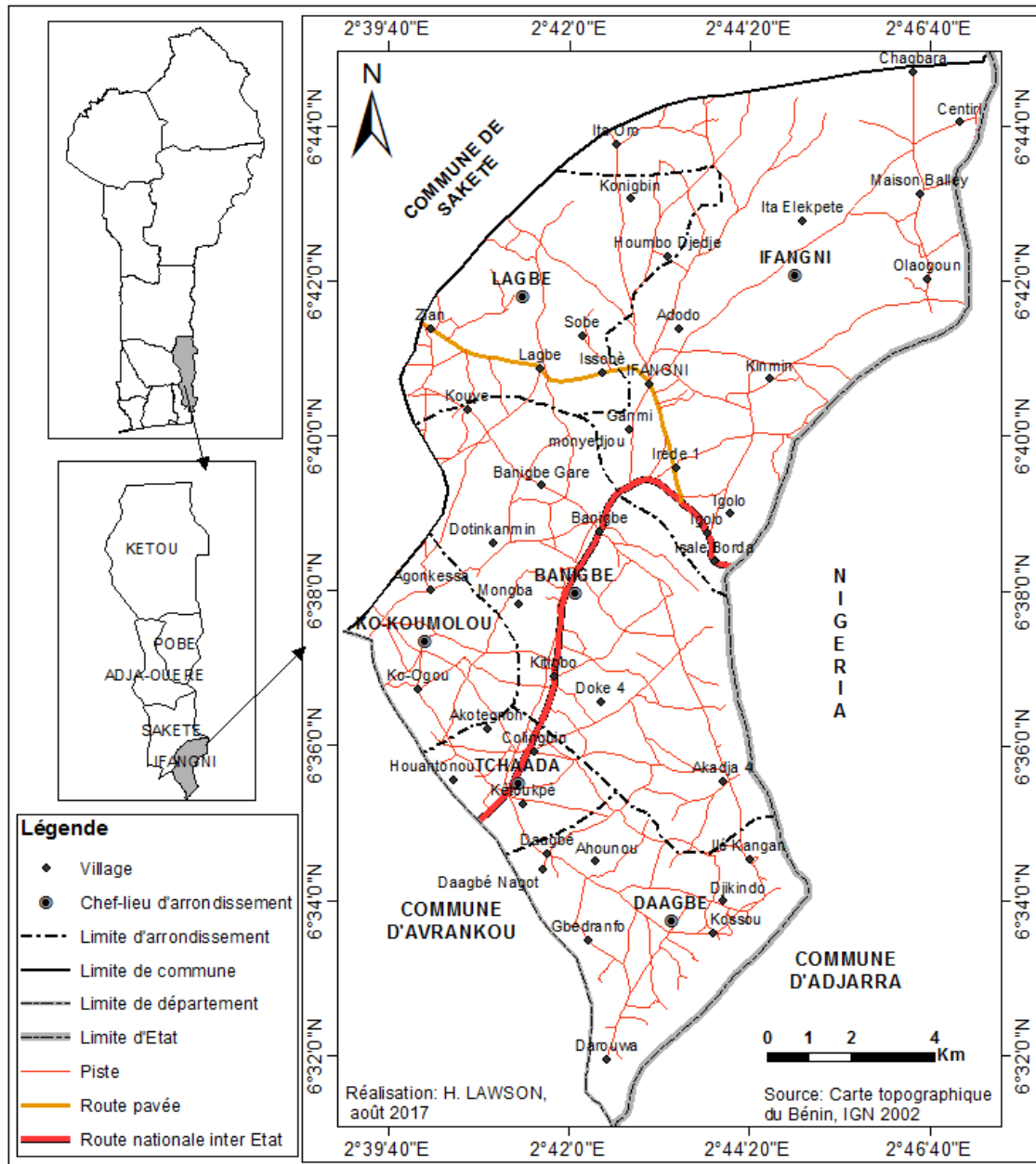
Figure 1: Geographic and administrative situation of the Commune of Ifangni.

Covering an area of 242 km²representing 0.21% of the national area surface, the Commune of Ifangni is one of the common law communes of the Republic of Benin. It has 33 administrative villages and 08 city districts in six districts namely: Ifangni-Center, Banigbe, Lagbe, Daagbe, Chad and Ko-Koumolou. With an annual growth rate of 2.8%, the Commune of Ifangni has 110,973 inhabitants (INSAE, 2015), or 57,849 women and 53,124 men, distributed in six (06) districts (Figure 2). The main activity in these districts is agriculture.
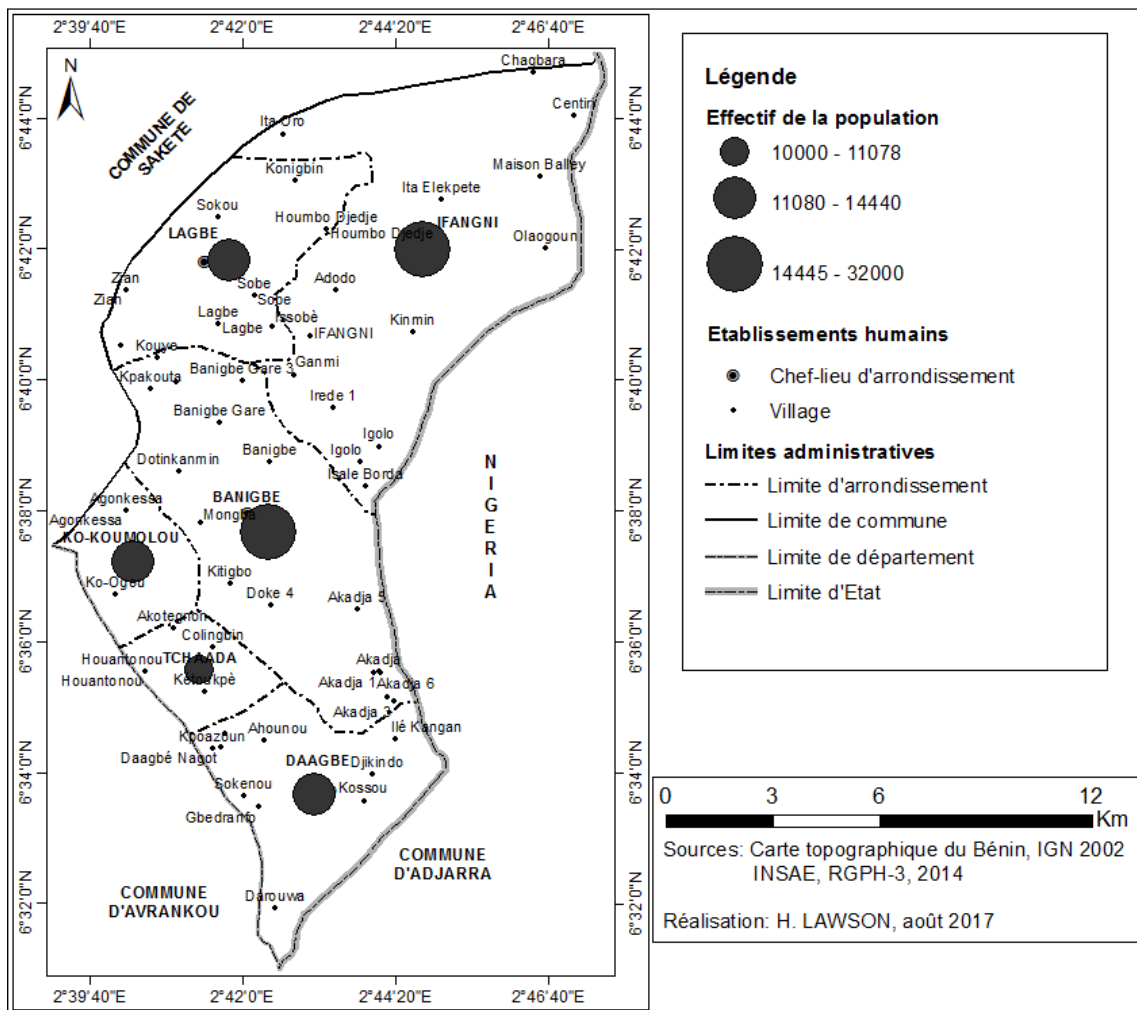
Figure 2: Spatial distribution of the population of the Commune of Ifangni in 2014

The pressure of the populations to live in the urban environment caused the high density.

4. MATERIALS AND METHODS

The methodology used to achieve the different objectives assigned to the study is summarized in Figure 3 below.
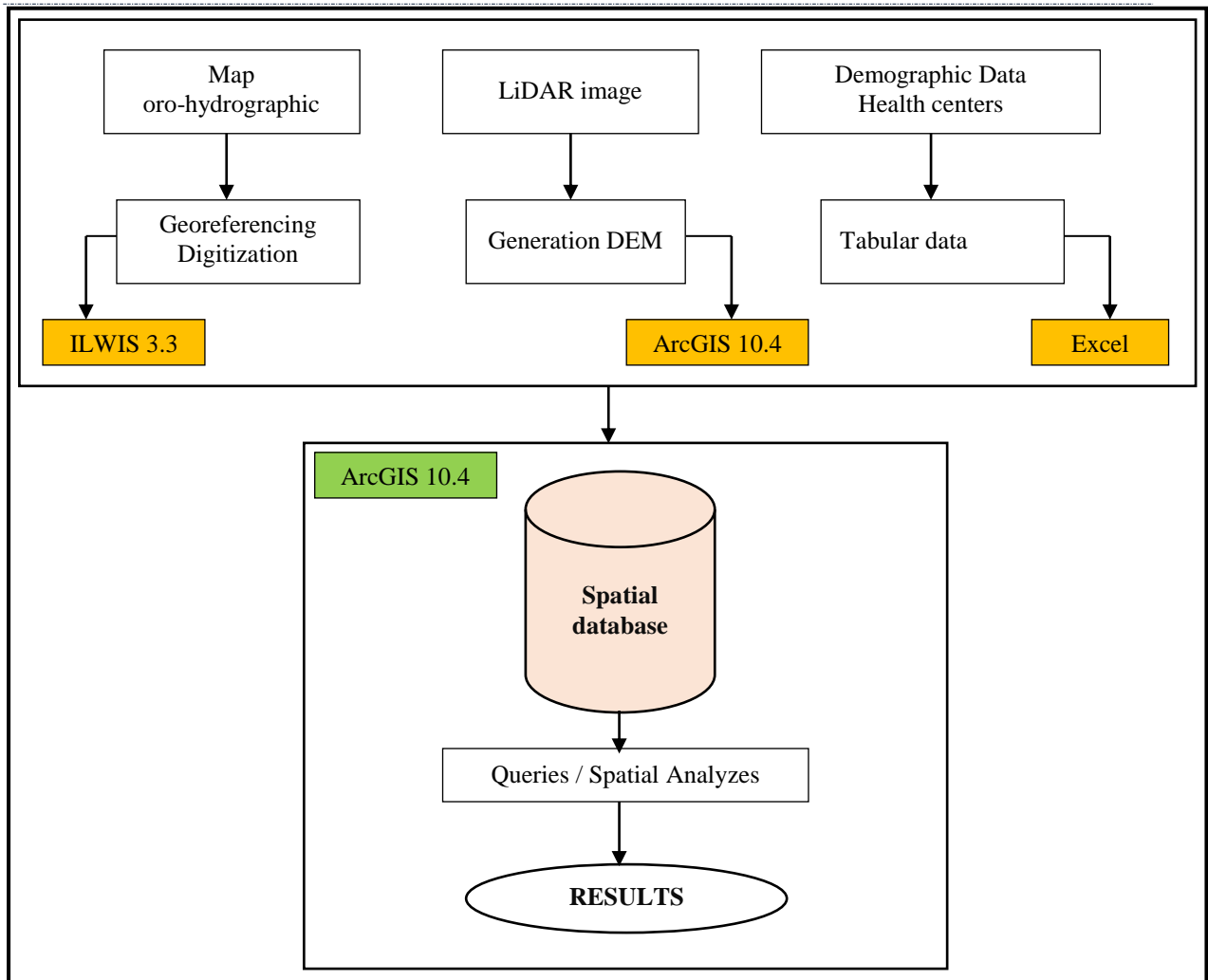
Figure 3: Synthesis of the methodological approach of the research.

5   RESULTS AND DISCUSSION

5.1   Results

The mapping of health infrastructures and accessibility factors are the results obtained. Figure 4 presents the situation of health centers in the Commune of Ifangni in 2017.
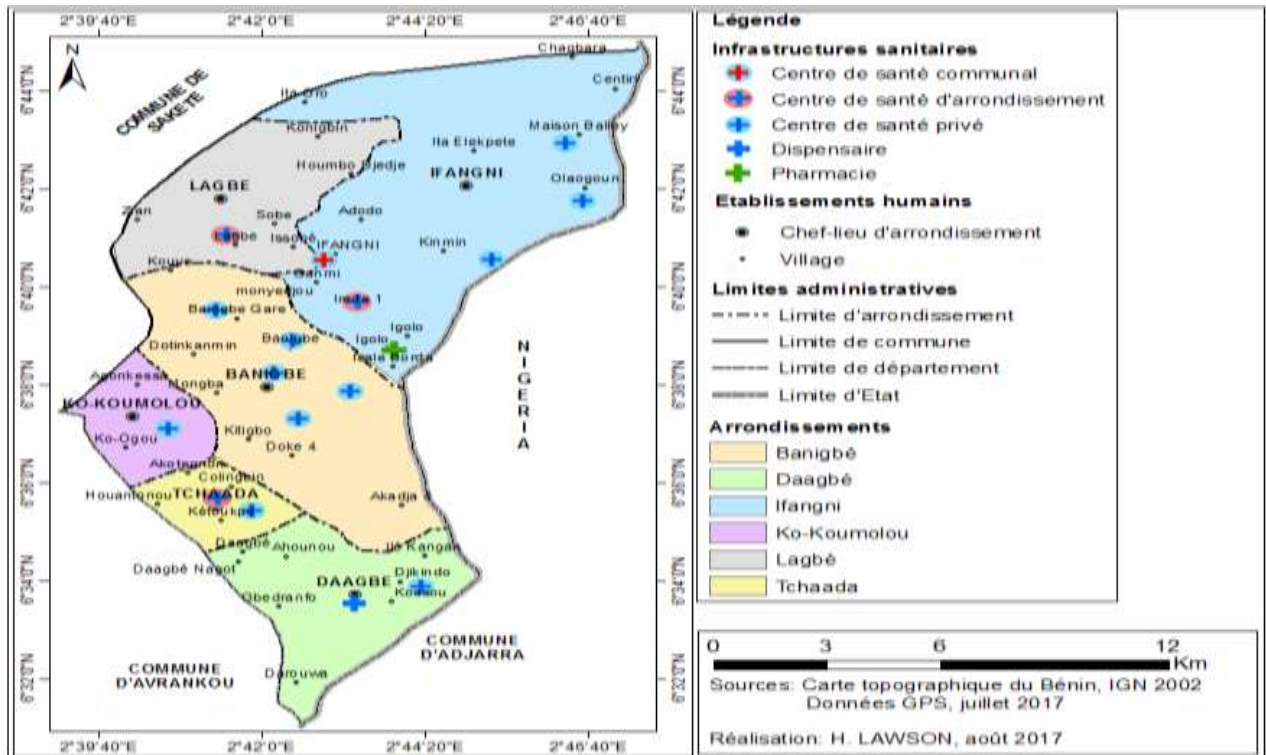
Figure 4: Spatial distribution of health centers located in the Commune of Ifangni in 2017.

To better appreciate the demographic factors related to the distribution of these infrastructures, the layers of the health infrastructures and population density were superimposed and are presented in Figure 5.
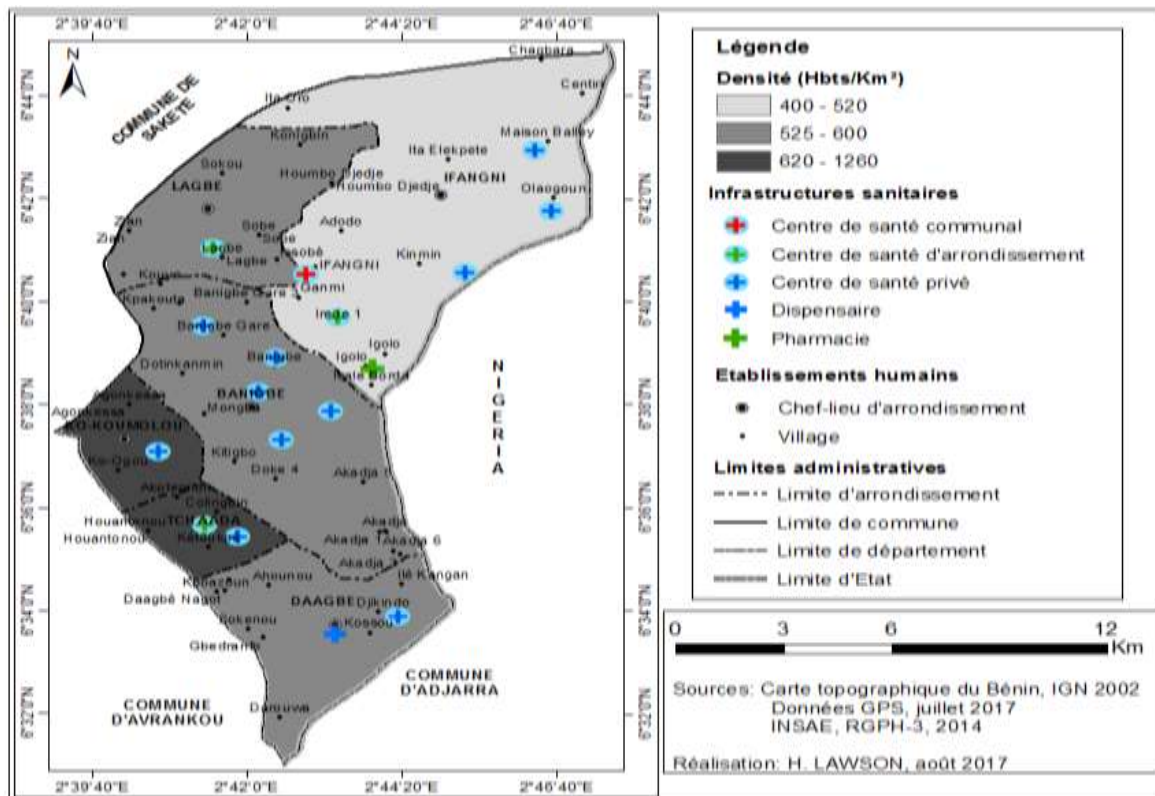
Figure 5: Relationship between health infrastructure and population density.

In order to show the area covered by each health center, a buffer zone (5 km) is built around the health centers. Figure 6 highlights the accessibility of health centers in terms of geographic coverage.
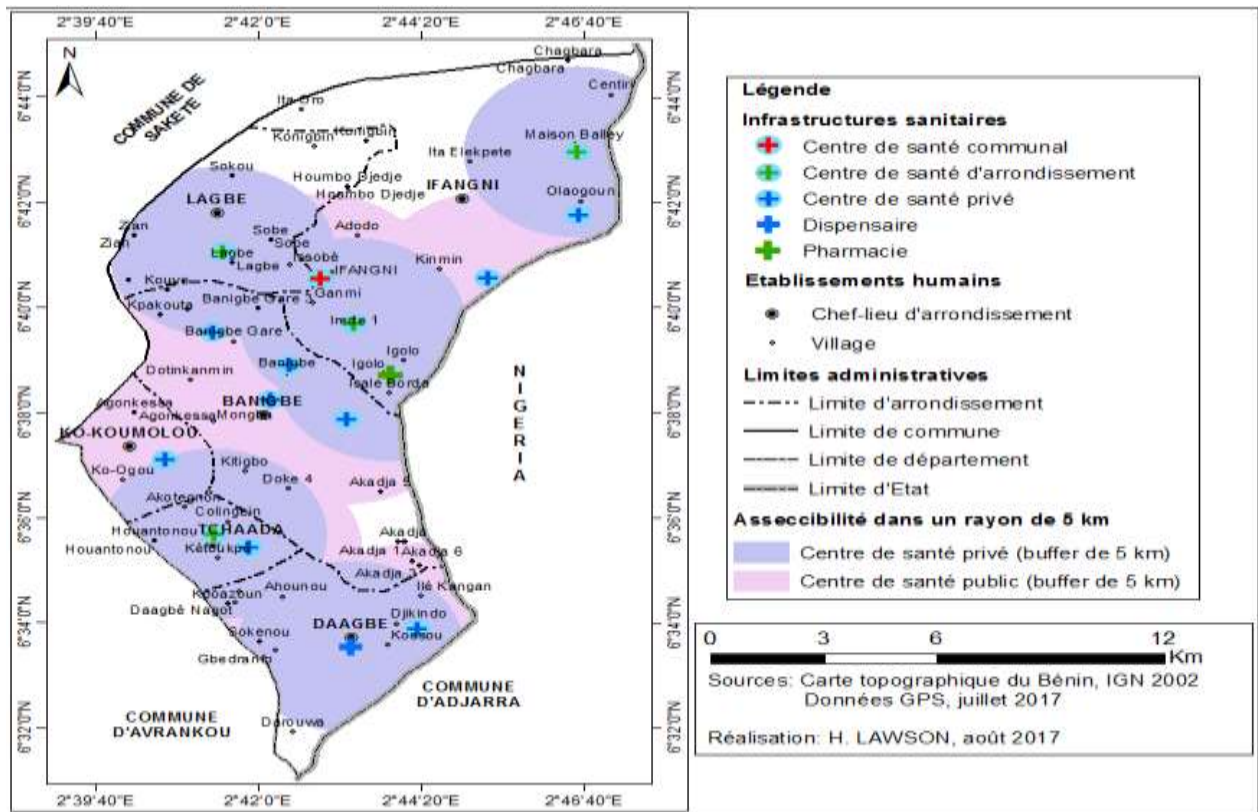
Figure 6: Geographic accessibility of health centers within a radius of 5 km (WHO standards).

To determine the spatial coverage of health infrastructures in the Commune of Ifangni, the Thiessen polygon was generated. This polygon made it possible to observe all health infrastructures close to one locality or another relative to the others. This technique of partitioning the geographical space in polygon made it possible to delimit the area of coverage of the health infrastructures. Figure 7 presents the result of this analysis.
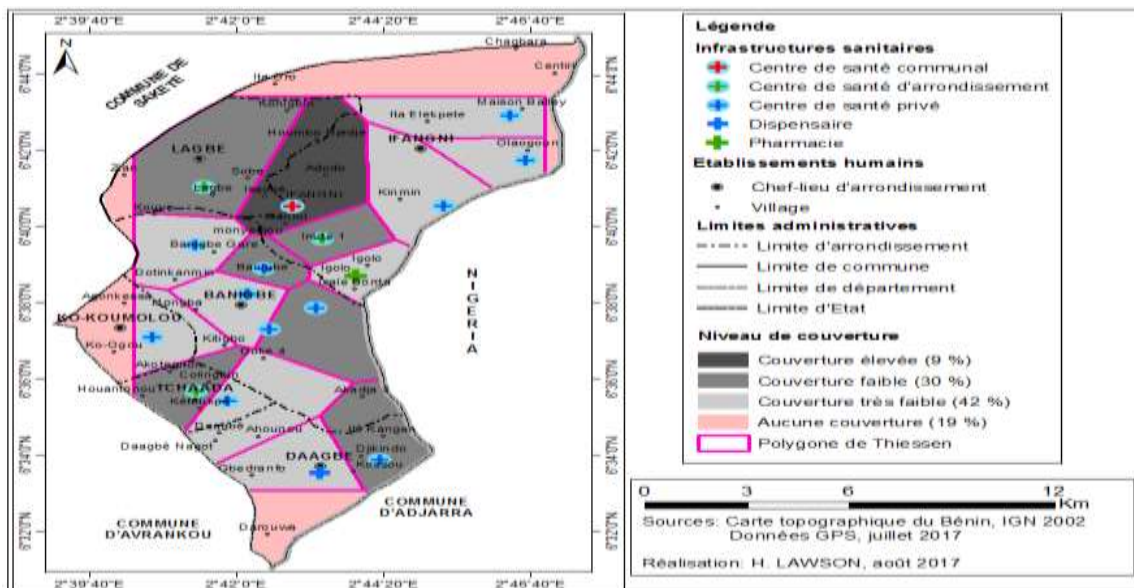

Figure 7: Spatial coverage of health centers.

These results are explained by the presence of marshes west of the Commune and the clay nature of the soil in the north, making access difficult in all seasons of the year. This polygon proves that the remaining areas to be filled in health centers are the northern, southern and western parts of the Commune taking into account the geographical space. Figure 8 below shows the distribution of health centers in the Commune according to Euclidean distances.
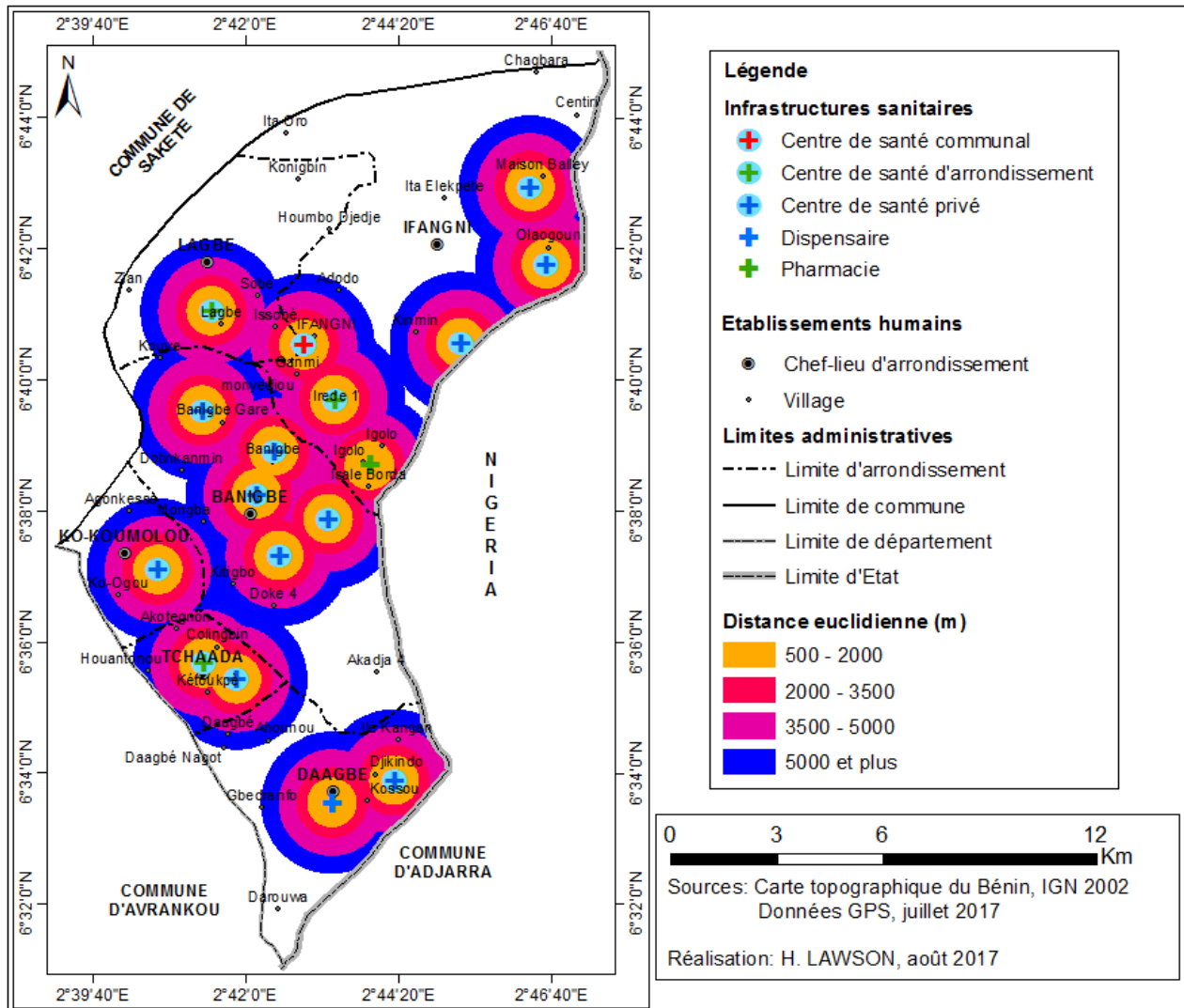

Figure 8: Spatial distribution of health centers by Euclidean distance

This figure could guide people in the choice of health centers for their treatment in case of diseases.
In addition, referring to Figure 9, which highlights the accessibility of health centers in relation to a main road, we can see that the boroughs of Banigbé, Lagbé and the western district of Ifangni are stand out once again from the other boroughs.
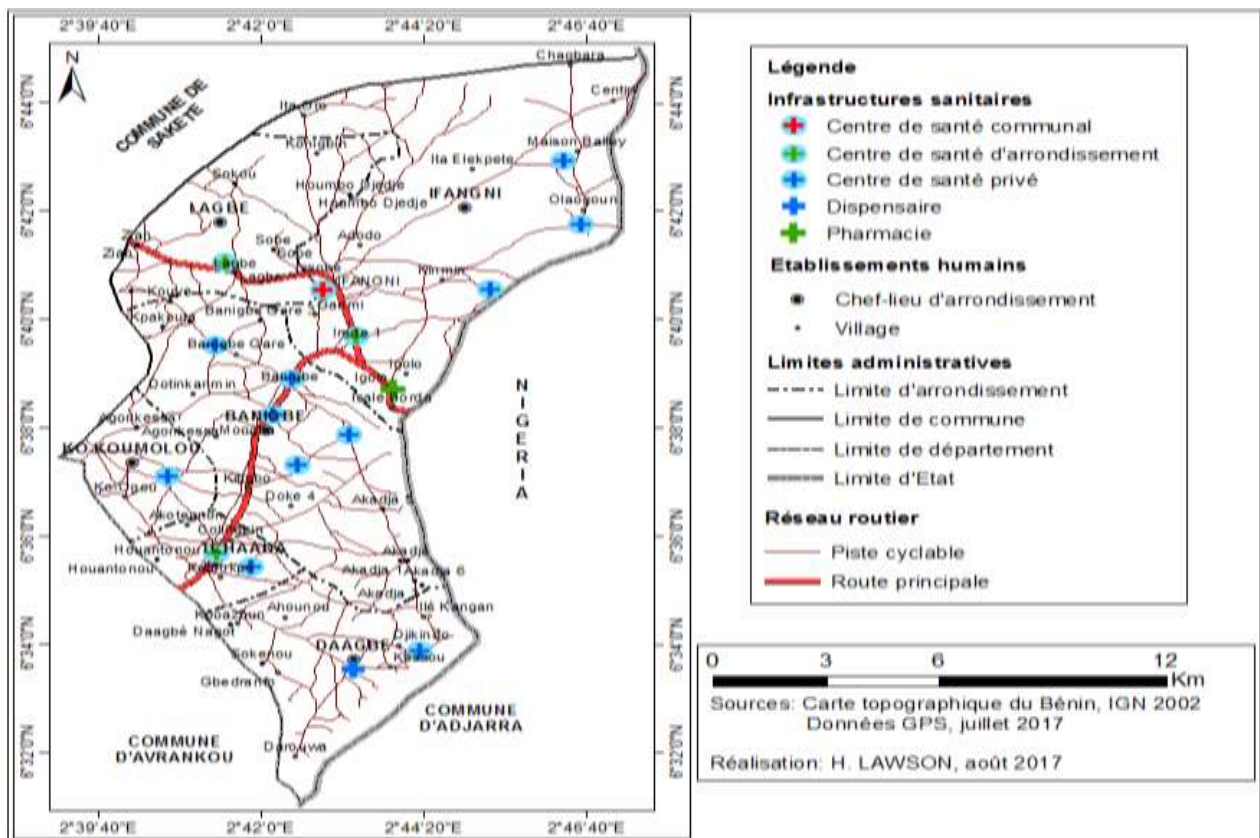
Figure 9: Accessibility of health centers to major roads.

✓ **Factors determining accessibility to health centers.**
Analysis of the determinants of access to health centers is extremely important for the formulation of policies and strategies in the health sector.
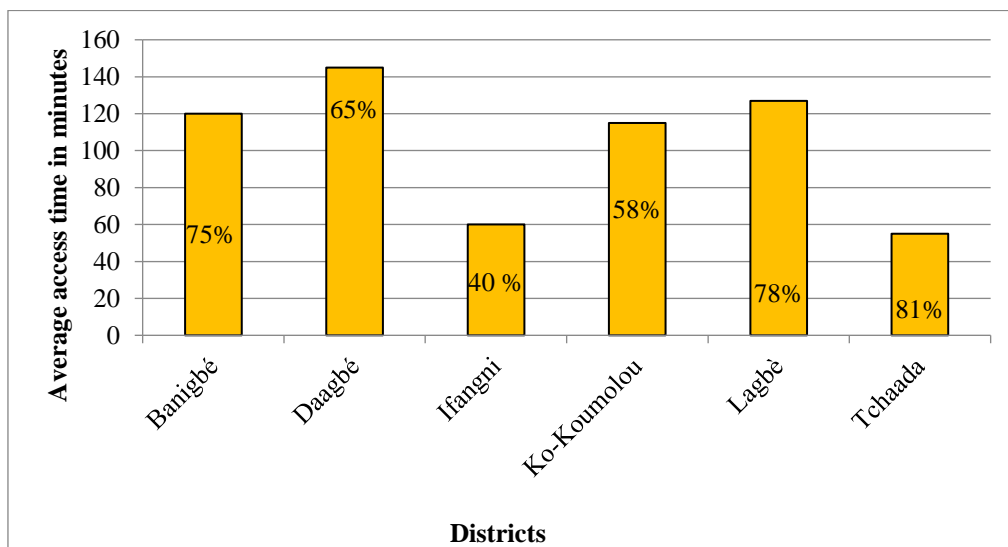

Figure 10: Distribution of access times to the nearest health center by district.

✓ **Difficulties of access related to relief.**

The digital terrain model provides an assessment of the gross form of the land without construction or vegetation (Figure 11). These data made it possible to produce the map in relation to the risk of flooding. It made it possible to know the highest areas and to delimit those with the greatest risk in terms of flooding.
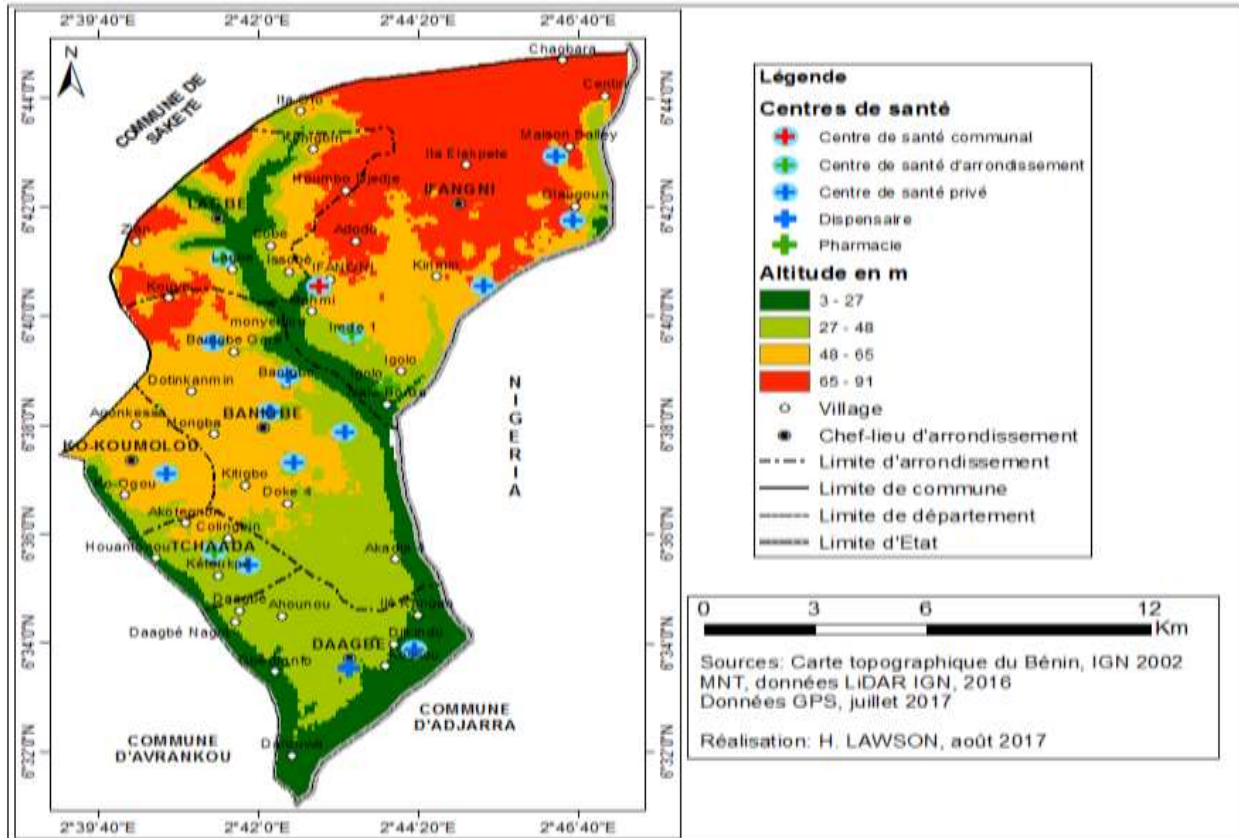

Figure 11: Distribution of the altitude of the Commune of Ifangni.

5.2 Discussions

The inventory of health infrastructures of the Commune of Ifangni has made it possible to identify 3 types of infrastructure. These infrastructures are: the municipal health center, the district health centers, the dispensary and the private care practices that are in the majority. Indeed, most of these infrastructures are located in the center of the Commune with a quasi absence in the north-east and west. It is obviously certain in the Commune of Ifangni that the health infrastructures are not equitably distributed. In reality, this distribution should take into account demography, geographical accessibility and other economic, sociological and cultural facts. It is not uncommon to note the presence of several health infrastructures in the same place. Prior work should be done to involve the population in the installation of infrastructure. The results obtained in this study regarding the utility and role played by GIS in the health field are similar to those of Sidibe (2010) and Tchikou (2004). This work made it possible to have an idea about the typology of these infrastructures and their distribution throughout the territory. Indeed, using a GIS approach for spatial analysis of health care, these authors used proximity analysis based on buffer zones in order to assess the spatial distribution and to determine the service area of health facilities. In conclusion, they showed an unequal distribution of infrastructures on the territory of the Commune. The method used for this work is different from that based on the Thiessen polygon.

5 CONCLUSION

The spatial facts, in particular the location and the distance have a major impact on the research behaviors in the care of the populations of the Commune of Ifangni. The starting point of this research is the finding of a

difficulty of access to the health centers of the Commune of Ifangni . Social and cultural barriers are of paramount importance in the demand for care of the poor. On their own, they can render totally ineffective any policy designed to increase the demand for care of the poor. The benefits of using GIS are enormous in the distribution of health centers: saving time, easy access to information, support for development.

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