DEMOCRATIC AND POPULAR REPUBLIC OF ALGERIA

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TOPIC

CITY OBSERVATORY AND ATTRACTIVENESS: CASE OF LAGHOUAT MUNICIPALITY

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Abstract

The local observatory is one of the observation networks' levels created by the United Nations in order to monitor the progress of the Global urban observatory (GUO). Such studies are not well known in Algeria, especially for their role of observing the evolution of cities and their urban conditions and trends. In this study we created the city observatory of Laghouat using a Geographic information system (GIS) oriented software while focusing particularly on public facilities, mainly the five sectors of: education, religious affairs, health, culture and sports that we had to find their location in the city and create their location maps. The major obstacle we faced was the unavailability and quality of data that narrowed our analysis later to one field and that is the primary schools field, which also served as a sample application of our analysis using two similar but different methods: the districts division analysis method and the grid analysis method in order to detect the facilities quality of distribution in the city and their impact on their neighborhoods and therefore also the needs of setting up some new facilities. These resulted information helped us in assessing the attractiveness of neighborhoods of the city of Laghouat as well as its attractiveness to immigrants due to its potentials and to the fact of being the capital city of the state of Laghouat.

Keywords: Laghouat, City observatory, City attractiveness, Geographic Information System, GIS, Grid analysis method, Public facilities.

ملخص

المرصد المحلي هو أحد مستويات شبكات الرصد التي أنشأتها هيئة الأمم المتحدة من أجل متابعة تطور المرصد الحضري العالمي. مثل هاته الدراسات ليست معروفة جيدا في الجزائر، خصوصا بالنسبة لدورها في مراقبة نمو المدن و حتى إتجاهاتها و حالتها الحضرية. في هذه الدراسة أنشأنا المرصد المدني للأغواط باستعمال برنامج موجه لنظم المعلومات الجغرافية حيث ركزنا على التجهيزات العمومية للمدينة، و بالخصوص على خمس قطاعات أساسية من المنشآت: التعليم، الشؤون الدينية، الصحة، الثقافة و الرياضة، والتي كان علينا أن نحدد فيها مواقع هاته التجهيزات في المدينة و ننشئ لها خرائط للموقع. العائق الأكبر الذي واجهنا كان إما عدم توفر أو سوء نوعية المعطيات، و الذي سبب تضييق مجال تحاليلنا إلى حقل واحد و هو حقل المدارس الإبتدائية، و بدوره كان هذا الحقل هو المثال التطبيقي لتحاليلنا مستخدمين نوعين متشابهين من الأساليب لكن مختلفين: أسلوب التحليل بالتقسيم المقاطعاتي و أسلوب التحليل بالشبكة، و هذا من أجل تحديد نوعية توزيع التجهيزات على مستوى المدينة و تأثيرها على الأحياء المجاورة و من ثم أيضا مدى الحاجة الى انشاء تجهيزات جديدة مماثلة. إستعنا بالمعلومات المستخلصة هنا من أجل تقييم جاذبية أحياء مدينة الأغواط إضافة إلى جاذبية المدينة ككل للأجانب عنها نظرا لإمكانيات المدينة المتنوعة و لكونها أيضا عاصمة ولاية الأغواط.

كلمات مفتاحية: الأغواط، المرصد الحضري، جاذبية المدينة، نظم المعلومات الجغرافية، أسلوب التحليل بالشبكة، التجهيزات العمومية

Résumé

L'observatoire local est un des niveaux des réseaux d'observation créés par les Nations Unies pour poursuivre le progrès de l'observatoire urbain mondial. Des études pareilles ne sont pas connues en Algérie, surtout pour leurs rôles d'observer l'évolution des villes et leurs conditions et tendances urbaines. Dans cette étude on a créé l'observatoire de la ville de Laghouat en utilisant un logiciel SIG (système d'information géographique), en se concentrant particulièrement sur les équipements publics, principalement les cinq secteurs de: l'éducation, les affaires religieuses, la santé, la culture et le sport qu'on a dû les localiser dans la ville et créer leurs cartes de localisation. L'obstacle majeur qu'on a trouvé était l'indisponibilité et la qualité des données, ce qui a limité notre analyse plus tard dans un seul domaine qui est les écoles primaires et qui a aussi servi comme exemple d'application de notre analyse en utilisant deux méthodes semblables mais différentes: la méthode d'analyse de découpage par districts et la méthode d'analyse de grille pour détecter la qualité de distribution des équipements dans la ville et leurs impacts sur les quartiers et par conséquent les besoins de mise en place de nouveaux équipements. Ces informations recueillies nous ont aidé à évaluer l'attractivité des quartiers de la ville de Laghouat autant que l'attractivité de la ville aux étrangers, compte tenu de ses potentialités et le fait que c'est le chef-lieu de la wilaya de Laghouat.

Mots clés: Laghouat, observatoire de ville, l'attractivité de la ville, système d'information géographique, SIG, la méthode d'analyse de grille, les équipements publics.

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List of abbreviations

GIS	Geographic Information System
RGPH	Recensement General de Population et d'Habitat
UN	United Nations
GUO	Global Urban Observatory
USGS	United States Geological Survey
UMD	Universal Map Downloader
GPS	Global Positioning System
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 1984
DPSB	Direction de la Programmation et du Suivi Budgétaires
DPAT	Direction de la Planification et de l'Aménagement du Territoire

General introduction

Knowing the surroundings has always been a priority for humans, and the fact that it facilitates understanding the world to organize life, define potentials, find out exactly where the shortages are, analyse what exists or what to expect in the future, is the reason people are always keen to learn more about their environment and it is always useful no matter who those people are, decision makers, simple citizens or even children who merely want to know where the stadiums of their city are or what the distance between their home and the school is. This is what we mean by territory observation, starting from the smallest village to the whole country.

The United Nations (UN) went further than that. In 1997, the UN HABITAT, which is the United Nations agency for human settlements, established the Global Urban Observatory (GUO) after 'Habitat 2' in response to the decision of the commission of the ONU-HABITAT to monitor global progress in implementing the habitat agenda and to monitor the global urban conditions and trends. Their activities fall under two main areas: global monitoring and development impact assessment, [i].

For that purpose, they have defined different levels of observation networks: global, regional, national and local, which is essentially the city level, [ii].

In Algeria, the lack of such studies, especially in the academic context, and therefore there is an increasing necessity of the information that responds to the needs of geo-location of areas, structures, and all types of geographic objects, and of defining the empty and dead areas. Therefore comes the need to the information that gives us ideas about installing new structures, facilities or buildings. That fact, leads us to reflect of a dynamic model to represent the existent data or even the data that can be acquired on a territory map, and all that can be realized with the help of a geographic information system (GIS).

The present work focuses on Laghouat city, the capital of Laghouat province, and particularly, we are interested in public facilities, which will be carried out with an updated data with a geographic information system under the concept of a city observatory.

Research question (Problematic)

Today, considering the rapidly expanding use of computer science and information technology, all organizations: administrations, companies, and firms, are more and more interested in acquiring, collecting and saving the data that concerns their works, production, costs… etc. to improve and develop their businesses. However, in many cases, especially for our administrations, these procedures led to an unused variety of data that can be described as a digital chaos badly organized and poorly managed and cannot be analysed correctly. Still, this information can be very prospective and quite analytically useful if it is well managed at the initial stages.

The visual effect of curves and graphs that can be drawn as a result of treating these data has really changed the concept of interpreting the results, and even better; this provided the possibility of representing the data on a geographic background which is known as the geospatial presentation of data.

In this context, geographic maps have an important role in understanding different phenomena, models, tendencies in almost all fields of study, but only if they are based on real, sufficient and updated data, and that is definitely the case for most of the existing data nowadays. This makes it necessary for us to search for the unfound data where it exists, then to organize it, to handle it, to visualize it and then interpret it in order for the information to become useful. All this described work, starting from acquiring the data up to its interpretation including production of the maps, may be done in a clean and efficient way by using a geographic information system that can also gather all kinds of information on the same graphic background for a better understanding using the layers feature where every phenomenon is presented in a layer. Finally, the result is an urban database which facilitates reading the city through its facilities and its buildings, all that by a know-how to use the data in order to evaluate and interpret it.

For that purpose, and regarding the illegibility of most of our cities, what model can we use to position the different geographic objects? How can we present these objects on a map? Is this model useful for other studies? And finally, how easy it will be to update the system in the future?

Chapter 1: Preliminaries and Generalities.

1.1 Introduction

The fact that the subject of our thesis is kind of ambiguous not even to most of the non-specialist people but also to the academic community including the interested in geomatics, city planning and management studies. That makes it important and essential to explain more and to clarify extensively a set of concepts and terms, and although a lot of those concepts are not yet agreed upon their definitions but hopefully that will be a reason to enrich the study with a variety of scientific point of views and to do some more reading to know exactly where people at now in this field and how are they doing the job properly. Eventually that will be our lead to better run the project and also to command properly the needed tools and to get the right « savoir-faire » of such work in the right context in order to get the best of it.

1.2 The city Observatory

We all know that the natural location of an observatory should be on the summit or the highest place of a city and that's of course because his role is to observe, but to observe what?

The first observatories were nothing but the astronomical observatories and their job essentially was to explore everything that is not on earth and that's what you would have in mind first when you hear the word "observatory" and that's why the dictionaries would define it as "a special building from which scientists watch the moon, stars, weather etc.", [1]. These observatories were meant to observe the outer space, the movement of other planets, and the appearance of different astronomy phenomena.

Later on, the meaning of the word "observatory" developed to include any place that is used to observe in many other disciplines such as climatology, oceanology, volcanology, etc. and the observatory became any building or structure providing an extensive view of its surroundings, [2], and that takes us to our subject. Regarding the rapid growth of population and the increased urbanization of lands the two thirds of the world population are already living in urban areas, [3], our surroundings are getting so full of information and so rich with details that it's getting harder and harder to know what's in it and to observe its evolution and growth (Figure 1) and that creates the need to an observation system that helps both citizens and policymakers in understanding the city and that's what the City Observatory is for.

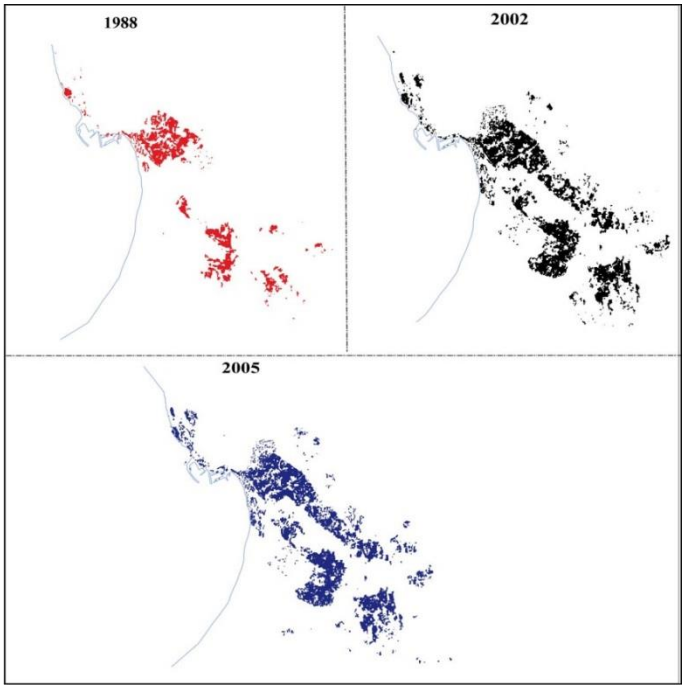


Figure 1: Evolution of the urban zone of Agadir (Morocco), [4].

Currently, it doesn't exist a unique definition or a specified one of the urban observatory, however, the few realised studies for that matter made the next definitions:

- An observatory is an observation system (of a territory for what interest us) implemented in order to follow the development of a phenomenon, a field or a part of territory in time and in space, [5].

  For the Gabonese Republic government, an observatory is a:

  - A tool of permanent observation and of visualisation of a precise urban space by means of data.
  - A tool of a decision-making advising and help that's intended for authorities and in favour of players of urban development thanks to the regular analysis of cities situations.
  - An interface and a support in the service of different ministerial departments in charge of city planning issues.
  - A vital tool in setting up a city policy, [iii].

- In another study, the local urban observatories are local platforms for policy information at the city level, coordinated by national urban observatories, [ii].

According to Jihad Farah, the city observatories are becoming a global phenomenon, and in the last decades, public actors, universities and civil society actors have established hundreds of

urban observatories all around the world. Some of these observatories contribute to the Analysis of urban dynamics and affect urban policy making. However, urban observatories are still understudied; the scientific literature on urban observatories is rare and culturally fragmented, [6].

For the purpose of our work, we can define a city observatory as the system of equipment (computers, printers, network, etc.) and the satisfying and sufficient data that serve to acquire all the information which concern the city in the subject of this observatory, to organize, to visualise and then to analyse them in order to make it easier to understand the city and to improve its management. This observatory can be considered as a private tool to be used only by the authorities as a decision making tool or even public that can be used by everybody else. The city observatory has as a product an interactive information system, thematic analysis and geographic maps, therefore, it has as functionalities, three main tasks:

- A decision making tool: the system is of a great help to decision-makers as it visualize spatially the data through the thematic analysis, it simplifies environment complexity and highlight the spatial patterns and relationships.
    - A communication tool: one of the most powerful functionalities, the observatory can be a communication tool between the different contributors to the city policy or management (decision makers) and it can also work between the observatory managers and the public (citizens, investors, academic researchers)
    - Monitoring tool: the observatory as a data manager can detect different phenomena evolutions and thus can help to warn or propose solutions in the right time and obviously the right place.

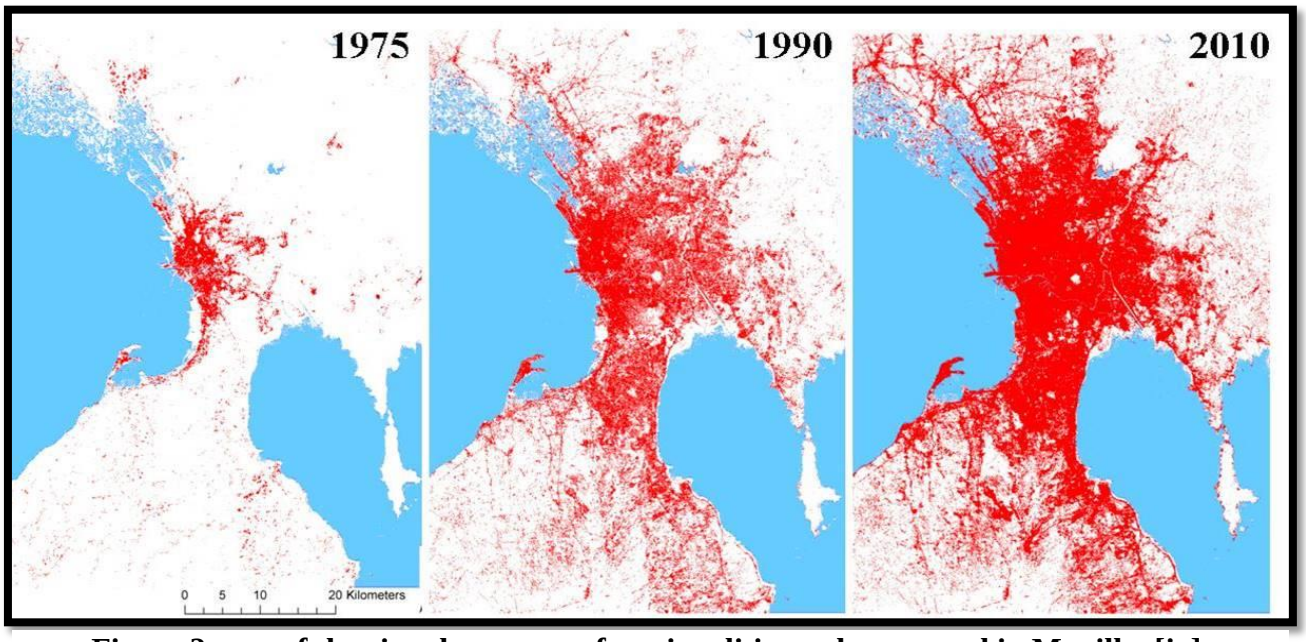


Figure 2: one of the city observatory functionalities, urban sprawl in Manilla, [iv].

1.3 Geographic Information System

A Geographic Information System (GIS) is a tool which allows representing and analysing all the things that exist on earth and also all the events , it's formed of many players: human, machine, approach and data allowing to integrate, to organise and to process data that is originally diverse, it also allows to perform analyses and to establish situations scenarios, and to produce as well some documents of decision-making support. The geographic information system allows to create requests and statistical analyses through a unique display and a very own geographic analysis of maps, these capabilities make of it a unique easy to reach tool to a very big public and addressing to a very large variety of applications, [7].

For the city of Shreveport, Louisiana, [v], a GIS is composed of five essential components: hardware, software, data, methods and most important component: people.

1 Hardware:

The needed computers and their peripherals on which the system will operate whether it's a simple computer or a centralized computer server running on an operating system and a desktop computer and it may operate on a network or not, it includes: computers, networks, printers, digitizers, etc.

2 Software:

A GIS software takes care of the functionalities that a user needs to store, analyse and display the geographical data, its main components are: the operating system software, the network software, the GIS software and the DBMS software.

3 Data:

We cannot say we have a GIS if we don't have a data that is accurate and sufficient and the different data types are: Raster data, vector data and attribute data.

4 Methods:

Methods are the plans and rules describing how the work should be done and that includes: Guidelines, specifications, standards and procedures.

5 People:

The GIS is not of a big use without the people who manage the system and develop it and they range from highly qualified GIS specialists to market analysts, whether they are administrators of the system, managers, technicians or consumers who use it to help them with their everyday work.

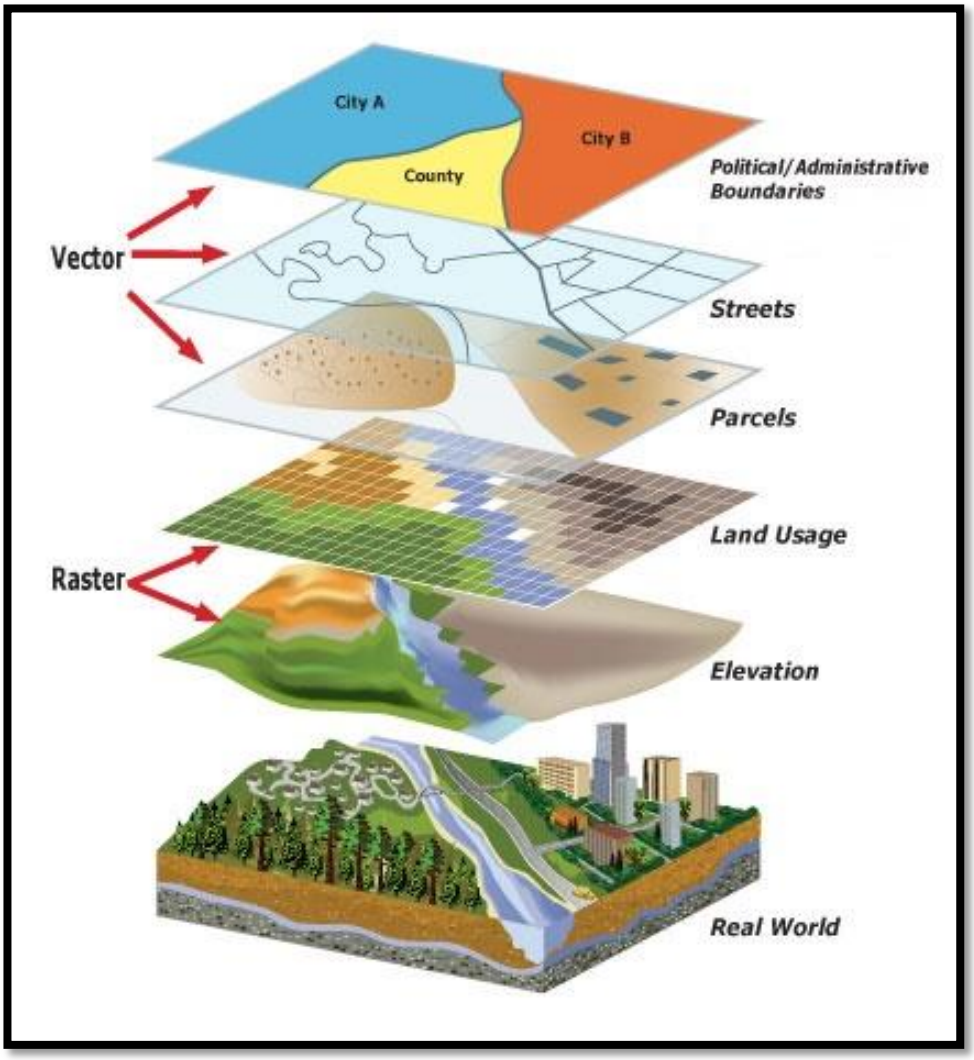


Figure 3:Representative photo of GIS working principle (Layers and different types of data), [vi]

1.4 Maps and Cartography

The man has always been fascinated by what exists on this earth whether it's a natural, or a human phenomenon. That's what gave him the geographical sense to represent these phenomena on his primitive tools at that time like drawing on cave walls his special monuments, roads and directions to help him in his travels and journeys and that was the birth of maps and earlier cartography. The earliest map discovered goes to almost 14,000 years ago in the Navarra region of northern Spain, [vii].

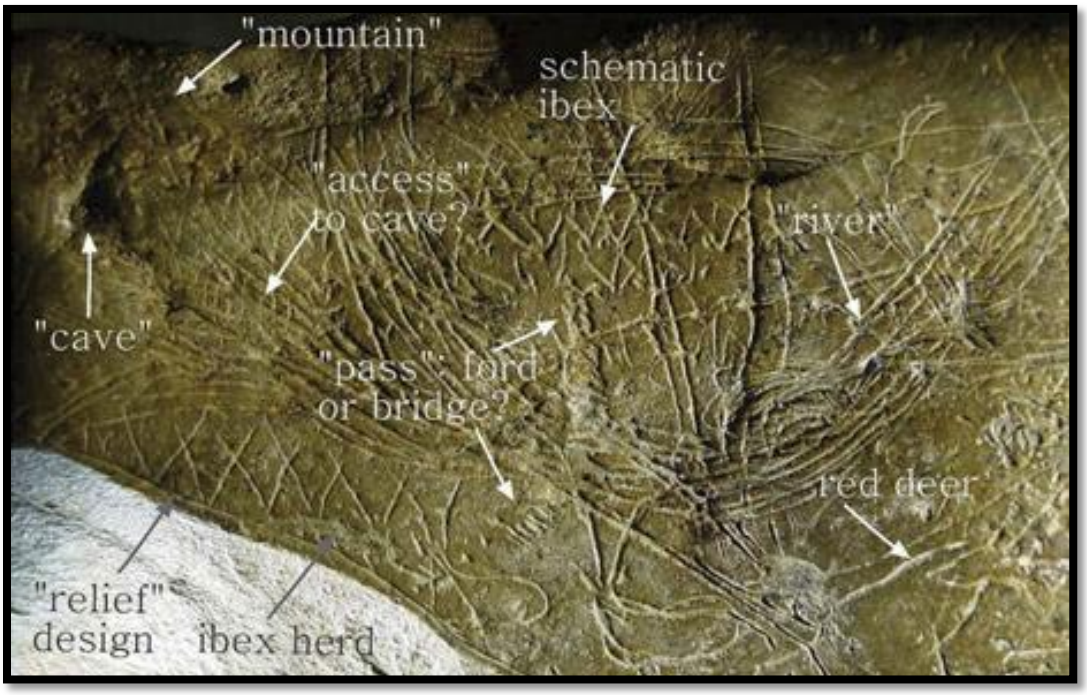


Figure 4: World's oldest map, [vii].

Maps as we know them today are "a symbolized image of geographic reality representing selected features or characteristics resulting from the creative efforts of cartographers and designed for use when spatial relationships are of special relevance", [8] .Maps are also defined as "a graphic depiction of all or part of a geographic realm in which the real world features have been replaced by symbols in their correct spatial location at a reduced scale", [9].

Some of the most important roles of a map include 'storage medium for information, and provides a picture of the world to help understand i.e. spatial patterns, spatial relationships and environmental complexity', [10]. In general, the mapping function include geography information storage, mobility and navigation services, measurement and computing needs, forecasting and spotting geographic trends, assisting in visualizing the invisible and to stimulate spatial thinking, [11].

The following map represents the evolution of the urban fabric of the city of Boussaada between the years 1972 and 2006, and it contains the basic elements of a map: a title, north arrow, a legend, an author and a scale bar.

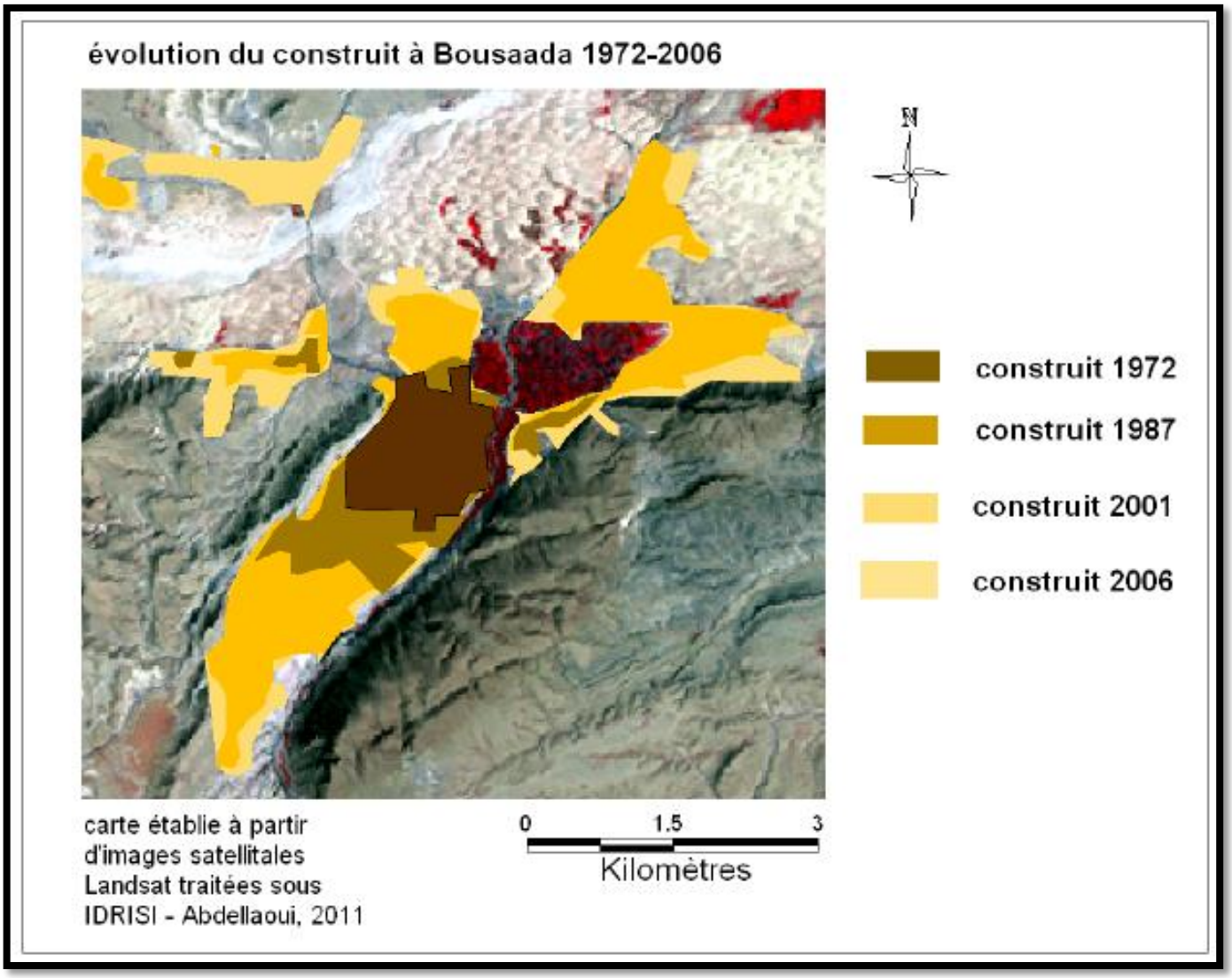


Figure 5: A map containing the essential elements of a map, representing the evolution of built space in Boussaada (Algeria) from 1972 to 2006, [12].

But generally, a good map should tell you what it is about (title), which direction north is (orientation), when the map was made or updated (date), who made the map (author), what the symbols mean (legend or key), how distances on the map relate to distances on the ground (scale), where to find selected places on the map (index), how to find places on the map (grid), and where the map's information comes from (sources or credits). However not every map will identify all of this information, [13].

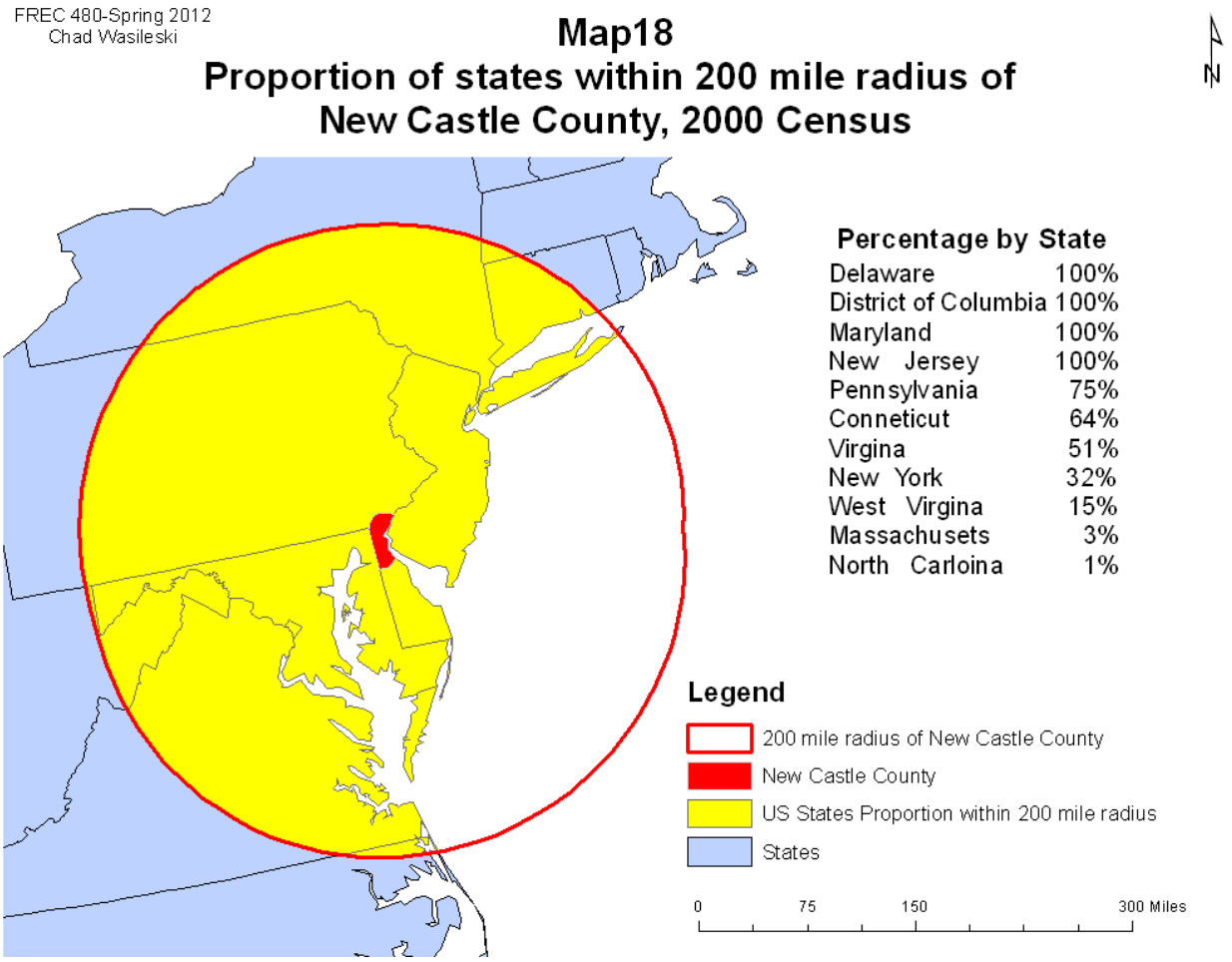


Figure 6: a map includes a title, a legend, a date, a scale bar, an author and a north arrow, [viii].

Cartography in the other hand is the discipline dealing with the conception, production dissemination and study of maps, [8]. Cartography then is also about representing the map which is the whole process of mapping. Cartography is not only the art of map making but also an academic discipline in its own right; it has its regional, national and international associations, its journals, conferences educational programs and its own identity as a discipline.

1.5 Computer assisted cartography

Due to the enormous developments of computers and therefore graphic designing and maps software, mapping is no longer like before. Today, most of produced maps and cartography works are done by computers and not by hands, their cost efficiency, fast production, easy to be modified or updated are among their advantages. Even though some cartographers are complaining about the low-quality maps made today due to the relative loss of "cartography traditions", still, the flexibility of the tool and the high quality of graphic visualization as applied to thematic analysis and cartography production is definitely a huge revolution to this art.

1.6 Cartography and GIS

A lot of people are confusing between the terms of GIS and cartography thinking they are the same thing, but the truth is they are not. GIS is mostly concerned with the analysis of spatial representation of data and their relationships, also the GIS is a product of the developed computer assisted cartography that generates geo-referenced spatial databases. Those databases become the platform for the creation of data structures that could be linked, processed analysed and results displayed in the form of maps, tables and reports, whereas cartography is only concerned with representation, [14]. That's why Aronoff, [15], believes that: 'while the main functions of the cartographic system is to generate computer stored maps, the function of a GIS is to create information by integrating data layers to show the original data layers to show the original data in different ways from different perspectives'.

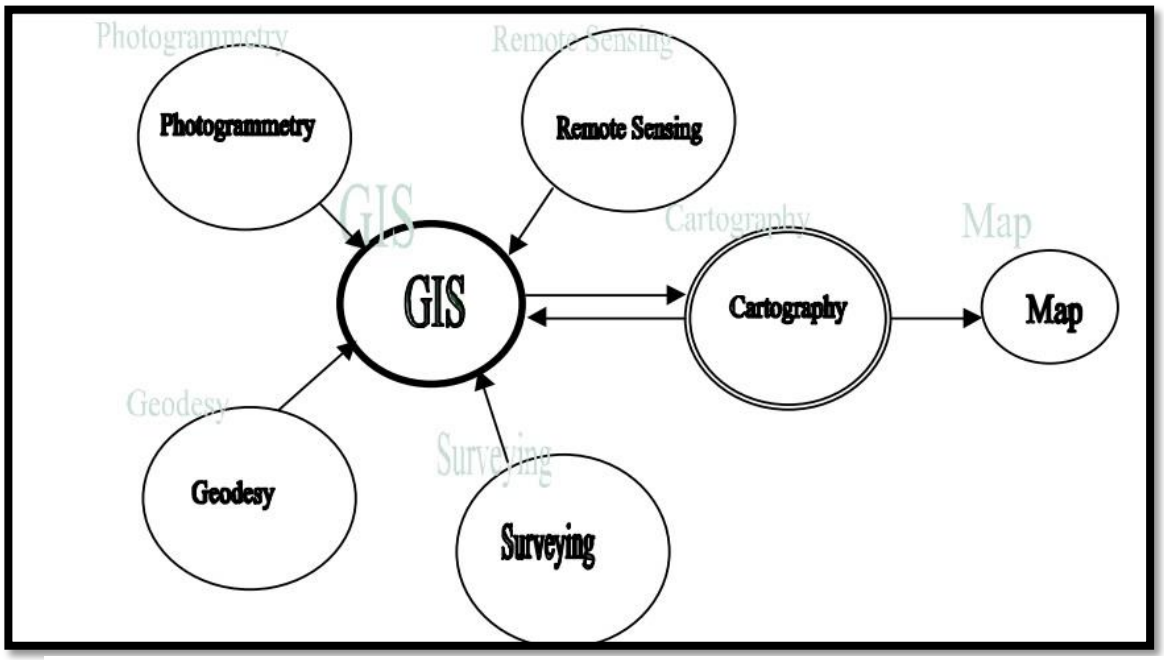


Figure 7:Cartography as a GIS module and map as a product, [14].

1.7 Public Facilities

According to Longman dictionary of contemporary English, [1], a facility is a place or building used for a particular activity or industry, or for providing a particular type of service, they are also defined, [16], as the basic services provided by the government institutions and are generally their responsibility whether regional or local, these services are not delivered directly to the individual and therefore they are utilised away from the individual residential dwelling unit. They can also be provided publicly or privately when the services are perceived to be inadequate and all depending on nature of facility. Facilities are classed as higher, middle, lower order and mobile as follows:

. Higher order: serve generally an entire region and their location should be in the most suitable location for the greatest number of people (e.g. hospitals, universities, etc.).

. Middle order: they are supported by a number of settlements and are essential to individual residential settlements (e.g. clinics, high schools).

. Lower order: they serve only one or a limited number of residential settlements (e.g. primary schools, crèches)

. Mobile: they can move from one location to another in order to serve the greatest number of people (e.g. libraries, clinics).

The following tables explain extensively the classification of public facilities.

FUNCTIONAL CATEGORY OF PUBLIC FACILITIES	NATURE OF FACILITY	PROVISION: PUBLIC OR PROVATE
Educational facilities		
Créche/nursery school	Local/middle order	Generally privately provided
Primary school	Local/middle order	Generally privately provided, but may be private
Secondary school	Middle order	Generally privately provided, but may be private
Tertiary facilities (colleges, technikons and universities)	Higher order	Generally privately provided
Adult training centres	Middle order	Generally privately provided, but may be communal
Health facilities		
Mobile clinics	Mobile	Publicly provided
Clinics	Middle order	Publicly and privately provided
Hospitals	Higher order	Publicly and privately provided
Recreational facilities		
Playgrounds	Lower/middle order	Publicly provided
Sports fields	Middle order	Publicly provided
Sports clubs	Middle order	Usually privately provided
Sports stadiums	Higher order	Publicly provided
Cultural facilities		
Libraries	Middle order	Publicly provided
Community centres	Lower/middle order	Publicly provided
Religious centres (mosques, churches, synagogues, etc,)	Lower/middle order	Privately provided
Administrative facilities		
Cemetries	Middle order	Publicly provided
Magistrate's court	Higher order	Publicly provided

Figure 8: functional categories of public facilities, [16].

1.8 Grid Analysis

The Grid analysis comes as a solution to the chaos in the city planning is an analysis method that is inspired from the concept used essentially in the advertisement digital boards that works on a plane space full of led lights arranged in a way to represent the board with identical meshing. The method was adapted to the urban space analysis of Dubos-Paillard et al.,[17], who consider the urban growth and many other geographic procedures can be explained by simple spatial laws, and in this adaptation filling in the meshes is happening semi-manually and thus we should be able to: i) find a way to define our space starting from a digitized cartographic document or a satellite image.

ii) Divide the obtained plane with an identical meshing

iii) Convert the resulted division to a set of homogeneous polygons next to each other readable by GIS oriented software.

iv) Associate to this group of vector objects, a group of fields

v) Finally, find a way to connect to this base grid the present themes in our plane affected by the adequate values that explains the strength or the presence of the theme, [18].

In (Figure 9) there was a mixed analysis of grid and regions in order to evaluate the evolution of built space between 1990 and 2007 of the region of Breaza-Campina in Romania.

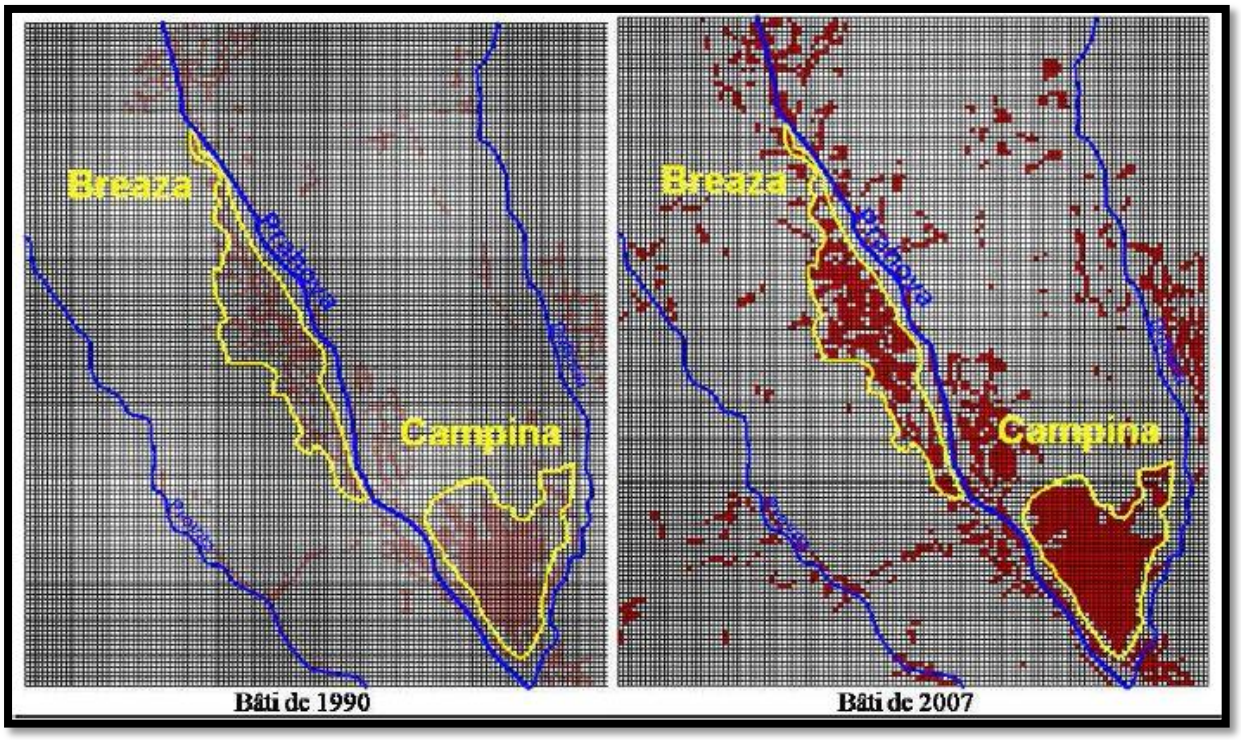
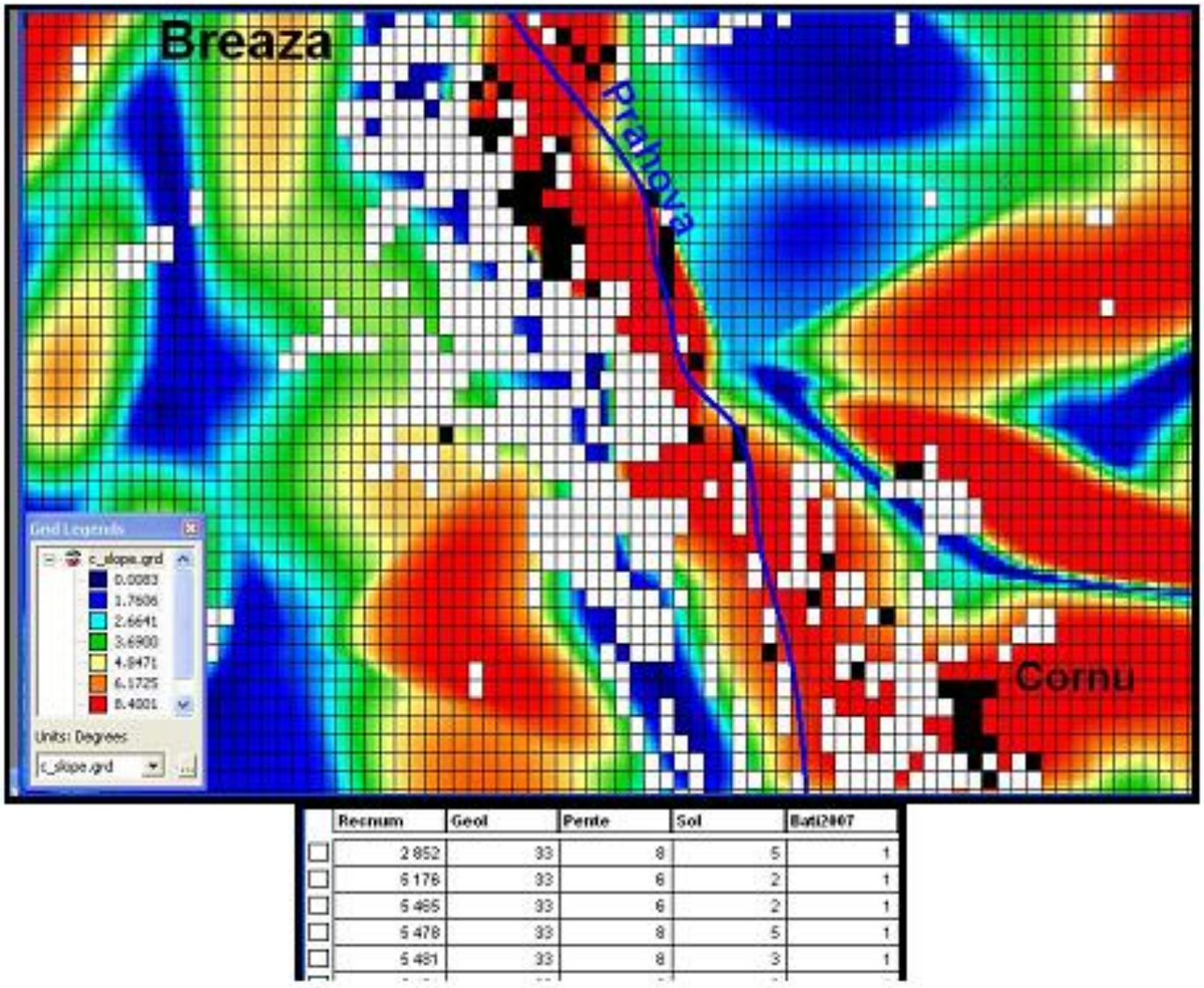


Figure 9: Evolution of built space between 1990 and 2007 of the region Breaza-Campina (Romania), [18].

The next figure shows the resulted map of an analysis using the grid analysis method.



Recnum	Geol	Pente	Sol	Bati2007
2 852	33	8	5	1
5 176	33	6	2	1
5 465	33	6	2	1
5 478	33	8	5	1
5 481	33	8	3	1

Figure 10: Example of the grid analysis resulted map, [18].

1.9 Territorial and city's attractiveness:

Attractiveness of territories is considered to be 'path dependent' and that means the future development is similar to the past, and according to that, population develops following certain factors, for example the regional patterns of mortality and fertility, and in the same way, interregional migration and tourism develop according to path dependent travelling flows. The latter factors are determined by the relationship between territorial attractiveness and tourism flows. City attractiveness can be evaluated by analyzing the ability to attract users and investments all depending on quality of living, business and environment generally and all that is based on government's actions and other private actors and therefore they introduce the concept of assets mobilization and the way assets are used to make a city attractive, [19].

In this context, the attractiveness of the city is influenced directly by policy creators and planners who make decisions that influence space objects distribution and therefore other decisions in other sectors are influenced by them as well, and that's why across the European countries, urban policy planners' are increasingly caring about the city and regional attractiveness. Attractiveness of a city is defined as a key issue to strengthen its competitiveness in a world of competition and economic-based knowledge and each territory has its own combination of attractiveness factors focusing on the strengths (social, economic, cultural, etc.) and that give the city an opportunity to compete with other cities. Depending on these factors it's essential to adopt the most convenient and appropriate plans and strategies, [20].

The choice of the adequate attractiveness factors is limited by the availability of data as it's always the case, for example the absence of certain data that affects largely the attractiveness of the city lead us to ignore their effect, for instance the availability of green spaces, open spaces, and recreational spaces is an important thing to discuss in this part of study but it doesn't exist an attribute data that we can represent and analyze, and that's not only in the city of Laghouat, in fact it's a widely known problem, [21]. Those problems and limitations is what give us or doesn't give us the ability of judging the reliability on factors as these factors should be representative and have timely availability, and as the study is only about the city, the data should be more detailed, as (how much case per neighborhood, division or district).

In order to clarify more about those factors and based on the experiment of establishing and running the Grand Medina's observatory, the choice of factors is based on ten criteria: Importance, generalization, priority, comprehensibility, economic, measurability, sensitivity, clarity and independence. And according to them, each factor should respond to those standards to be produced and used:

. Importance: where the factor should have a direct relationship with the civil policies or, current or suggested population policies, and it should calculate the results directly.

. Generalization: the factor should be able to represent a general image about the current situation of the city in economic, social, environment policies, etc. using the available data sources and it should be comprehensible by people.

. Priority: the priority is given to the principal factors that can be calculated using the available data, afterwards come the factor less important with relationship to policies and harder to identification, calculation and data collection.

. Comprehensibility: choice of the easy factor to understand to the majority of people that his comprehensibility doesn't require an expert or pre-knowledge.

. Economic: factors should be easy to collect effectively and cost-efficiently in a regular basis responding to predictions of factors rates variations.

. Measurability: of factor's qualification to show both quality and quantity of problems, not in a descriptive or a hypothetical way.

. Sensitivity: a factor should be sensitive to variables, so it can change with different situations, but not too sensitive as it gets hard to collect and to explain.

. Clarity: that means every factor should have a clear definition, clear objectives and specific sources.

. Independence: that it doesn't depend on other factors to measure the same case, [22].

Based on the aforementioned criteria, we will choose our main attractiveness factors to better understand our city's strengths and weaknesses and therefore establish the appropriate strategies to increase the city attractiveness.

1.10 Conclusion:

In this Chapter we focused on clarifying the ambiguity surrounding the difficult notions and terms that we use in this study and also that we need to know for a better understanding of the context of this work, and we tended sometimes to adopt a specific definition that suits best the context of our work.

Chapter 2: Methodology of establishing the observatory.

2.1 Introduction

The nature of project studies defines their specialty and particularity all depending on the area of study's characteristics, on the precise academic context and on available data. That will lead us to reflect of how are we going to initiate our study of the subject in order to achieve our research objectives and what methods should we use, with regard to the work means whether they are soft (programs, software, etc.) or hard (computers, devices, etc.). According to all that, the work will be limited by the necessary hypotheses, and finally, the realized work needs to be validated and proved to be working right and is giving the desired results.

2.2 Research objectives

Generally, when we're talking about establishing an organization, starting a company or launching a project, the location is one of the most important criteria that will define how much successful that will be. We cant say that we're making the right decision if we are not thinking geographically, and eventually that will cost us more money, and waste a lot of time.

As a case in point, health care services can face a lot of issues in geolocating a new hospital, they will solve many problems by setting up the hospital and may create other by their location choice for instance. Why would they choose this neighbourhood or why would they avoid that one, shouldn't they before even thinking of a new one know (geographically) their existing facilities, and act accordingly, and then, do they need any further information for a better solution. Appearently it's not that easy . The same thing happens with pretty much every other field of decision-making from governments trying to allocate funds for building sea defenses to farmers making better decisions about the amount of fertilizer and pesticide to apply to different parts of their fields, as well as delivery companies, transportaion authorities, geodemographics consultants, forestry companies, national park authorities and travelers and tourists, [23]. The following elements are some of the city observatory functionalities and they are our main objectives of this study.

2.2.1 Creation of a platform for future urban and facilities related GIS projects:

One of the problems that faced this work is the absence of previous similar studies and the lack of a similar oriented research about the city of Laghouat. Therefore, this study is going to help as a platform of data source and of a flexible management system to include different thematic analysis, as a prototype of an observation tool of the city urban growth, as a public facilities geo-location system and also as a projects monitoring tool.

The observatory as a platform makes a lot of space for improvements in the future to include expert's knowledge and searchers works in this field, it can also be developed to be used via the web as a tool of information and communication between different contributors and also

as a dynamic decision-making tool. Most importantly, this platform will not only be useful to urban design or facilities planning but also to any GIS based project.

2.2.2 Geo-location of city public facilities:

The location of public facilities is very important whether it's for a traveler patient who is heading to a hospital or to a decision maker trying to find a good place for setting up a new facility, and currently the access to that information where it should be, the concerned department or administration for instance, the geolocation data is not always there and sometimes it's not usable.

Nowadays, a lot of people are using web-mapping solutions like 'Bing maps' , 'yahoo maps', 'Google maps', etc., to get the information or end up lost in the streets asking people about their destination. The web-mapping solutions and even though are improving their services in a good pace are not always the right place to consult whether you're asking about a place or trying to add or to update a place on there, the data is not so accurate (figure 11) because it's only made by random citizens and not necessarily by specialists and then it needs time to be reviewed and in a lot of times, the information is not correct.

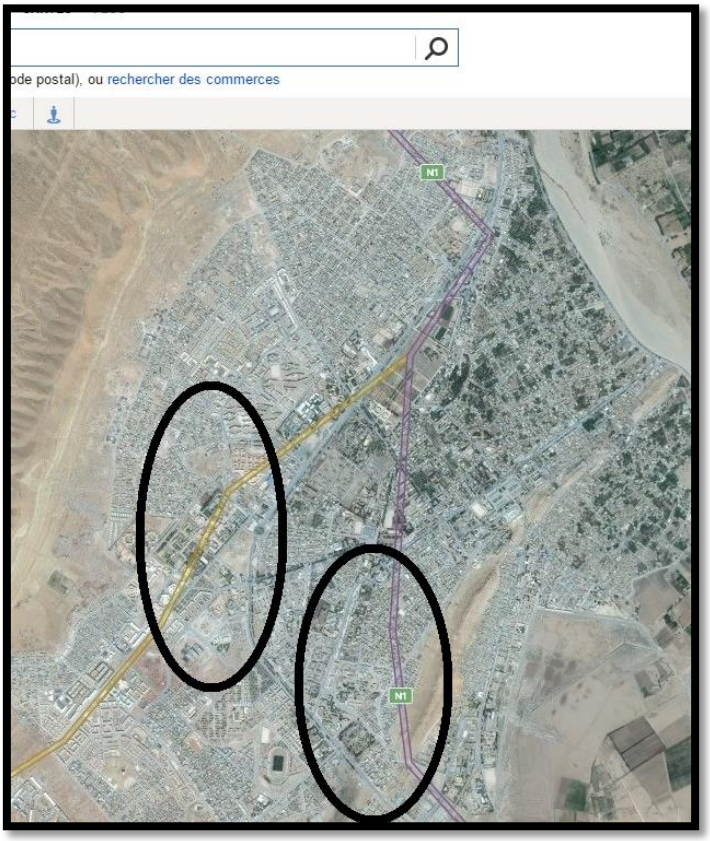


Figure 11: The huge problem of inaccuracy in many web mapping services: a picture of roads presentation not in their correct track.

Other times some services are deactivated restricting people from modifying, creating or updating and that limit the use of such tools (figure 12).

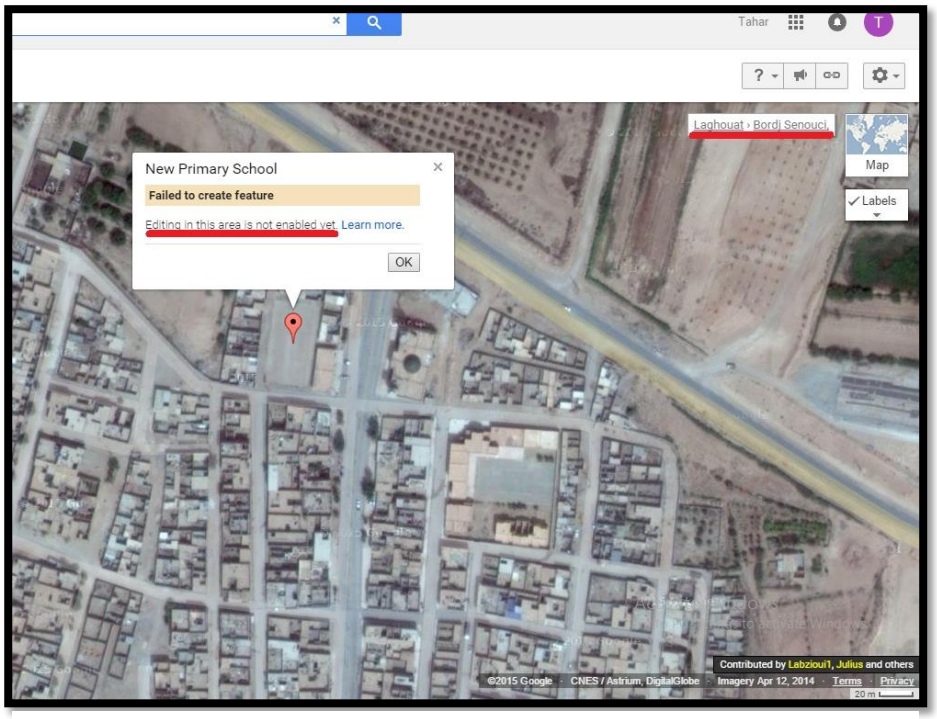


Figure 12: Restrictions of user's use of web-mapping services.

Hence, comes the need of an exhaustive geo-location of the city public facilities with their correct coordinates in a GIS based system that allows a further modification in case of mistakes as well as an update, for any purpose: planning, travelling, or even simple curiosity and of course with a proper visual presentation that allows a good use of the wanted information. This will be done with the concerned administration and then the work will be validated with necessary tools in order to maximize the accuracy of the resulting pubic facility maps and eventually the whole observatory.

2.2.3 Better data management:

In order to perform any GIS based work, our software will always need: a geographic image, and the associated necessary information to be presented on it, and that's what we call data. Sometimes when the data is of a big volume and a very complicated model we may need to connect to an external DBMS (Data Base Management System) to be able to manage and treat our data and usually this feature is available on the software. However, if our work is less complicated that will not be necessary and for that matter this software is equipped with the necessary features to manage a large amount of data that will become "Tables".

Now, our observatory system will allow us to change the tables structure, we can as well add data or delete it, we can update a certain column without a problem, we can as well import

and export a lot of different types of data, and the job that usually takes hours can be now treated with a simple query selection.

In the context of this study, the public facilities of the city of Laghouat are so rich of data at first glance but that is not necessarily a usable data for the assessment, manipulation and planning purposes unless it's well organized and associated to its geographical location, and the city observatory as a GIS based system will be a very good manager of the different necessary data.

2.2.4 Enhanced presentation of Co-location facility planning:

In order to increase efficiency and synergy of services, to enhance sense of community and resource savings, co-location, which is the intentional siting together of public facilities, such as schools and libraries on the same parcel of land, is becoming an increasingly common practice in the US, the UK, [24], and Sweden, [25]. To prove this theory right, a study about benefits of co-location of facilities in Loudoun county, Virginia, and the goal was to undertake a retrospective cost-benefit analysis for col-located elementary school and a library with the help of a GIS-based tool (Community viz) to evaluate and visualize the costs and benefits of different co-location scenarios (1^{st} scenario of not co-located school and library which is the as-is situation and the 2^{nd} scenario is the hypothetical co-location situation. In order to estimate the benefits, the study developed ten impacts of co-location and they are: cost of: construction, land, utilities installation, operating costs, planning resources, space savings, accessibility, resident coverage/service, time/distance savings, and synergy of services and the results were amazing: 5% of savings for construction estimated with more than a 1,000,000$, the same thing with space savings, and utilities installation, also the synergy of services was estimated to be moderately higher, and even though there was no savings on time/distance cost and even the accessibility to the co-location site is not ideal, there was no negative impacts from traffic congestion, [26].

We intend in the observatory, to help those in charge to better visualize the available spaces on the city map with regard of the existing public facilities in order to be able to co-locate new facilities in case of convenience. This work will be feasible with the proper data that should be collected, organized and then distributed to the relevant table and as every table will be represented as a layer on the GIS software, the decision-maker will use this feature to decide what facility will be located with what other facility and most importantly, where ?.

2.2.5 Ability of a visual facility location-allocation:

One of the most powerful tools of an urban observatory is the ability of location-allocation of a facility, and even though it's not that much interesting within the academic geography, it still has a commercial value particularly if combined with some more advanced computer programming skills, [27].

Location-allocation concept is finding the best locations for one or more facilities that will service a given set of points and then assigning those points to the facilities, taking into account

factors such as the number of facilities available, their cost, and the maximum impedance from a facility to a point, [28]. The principles of location-allocation model developed in the 1960's as an effort to develop technical solution of the optimal location of some central facilities like schools, fire stations and retail stores, [29].

The usual planning facilities involves the application of planning standards, such as how many square meters of open space are required for a certain number of people in a district and they seldom specify where this facility should be located. That can be very crucial especially in the case of a fire station where the intervention time to the furthest point is mainly influenced by the accessibility to different destinations and by the location itself. For that matter the location-allocation model is a useful tool in the planning process, and now with the availability of land information systems, the combined spatial analysis and display functions of the GIS associated with any location allocation model is a powerful tool for a better decision-making support system for public facilities planning, [30] . It is there where the city observatory intervenes as the application tool of this principle using the visual presentations results of the grid analysis method, and reinforced of course with the necessary statistical and geographic data in order to answer the two types of decisions that location-allocation involves: where to locate our facilities and how to allocate the demand for service, [23].

2.2.6 Maps and cartography products:

Usually, and in many GIS based projects, maps are a fundamental product of the system and in this work maps are going to make an essential tool in understanding the city and the location of its facilities and therefore the solutions we may deduce to a better management of them or to create new ones. A map before the advent of GIS was the database but a map now is considered as a single product generated from a digital database and as we know a map is a great way of summarizing and communicating the results of the GIS operations to a larger audience and their importance is more apparent when many of geographic information users deal with GIS only through the use of mapping outputs (e.g. maps)(figure 3). We should distinguish here between two types of GIS products: formal maps, created according to a certain cartographic rules, that are used as a reference product (e.g. a military mapping agency 1:250.000 scale topographic map), and a transitory map that is used simply to display, analyze, edit, and query geographic information (results of a data base query to retrieve certain facilities viewed on a desktop computer). Both of the maps types can be displayed on a hard copy on paper or other media or in digital display devices, [23].

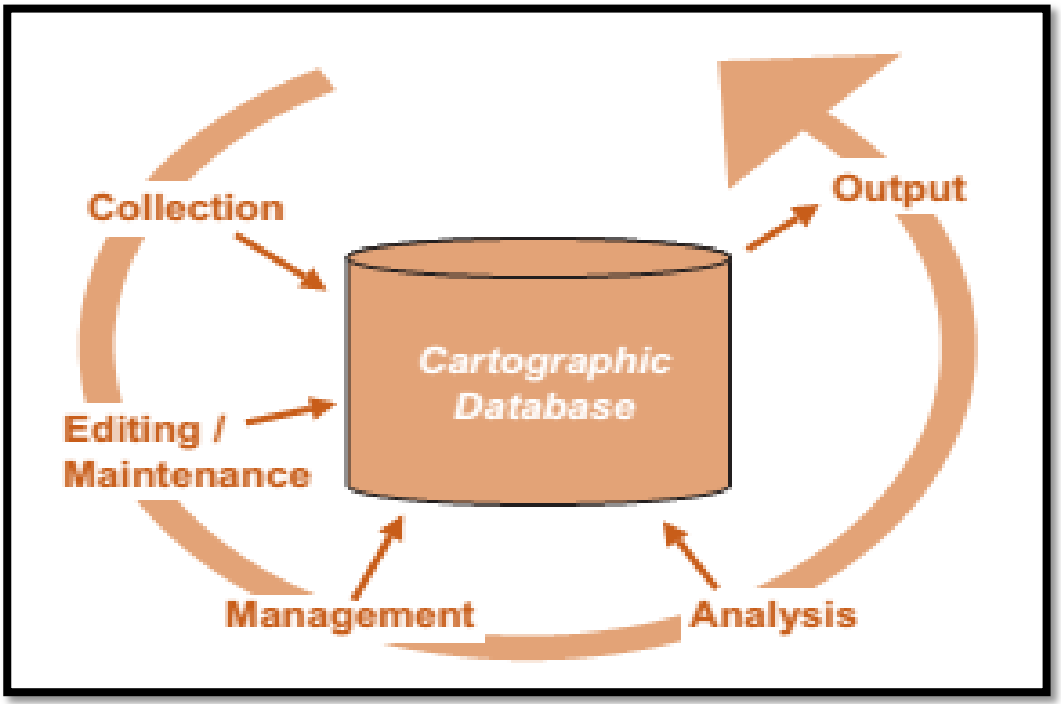


Figure 13: The necessary process to create a map, [23].

As an output, the city observatory will have cartographic products displayed in both hard and soft formats and ready to communicate the public facilities locations in the city as well as the thematic analysis that facilitate the understanding of the city to the larger public: decision makers, researchers and every interested citizen.

2.2.7 Attractiveness assessment and factors choice

The talk about attractiveness is related directly to available data and factors we can produce from them that respond to the precise ten criteria: importance, generalization, priority, comprehensibility, economic, measurability, sensitivity, clarity and independence, [22]. The problem is that those criteria don't apply to most of factors we could collect data about, especially in the context of the study as it's neither a comparative study that allows us to compare between several cases of study and detect differences and therefore strengths and weaknesses and that's limited again by the data as this kind of study requires a lot of information about a lot of cities, nor the available data is detailed enough about the city alone and allow us to represent it geographically and attribute to it the representing information.

All the mentioned issues led us to think of an efficient and valid model that allows us to assess and evaluate the city attractiveness as well as its different neighbourhoods. The remarked thing is the attractiveness of the city is not only affected by the existing facilities within the city, it's also affected by the outside elements (projects, places and potentials) and for that reason, we propose that the study of the city attractiveness will be divided into two parts, internal attractiveness factors, and external, and we mean by internal: the facilities potentials that ensure a

decent level of health, education, spiritual life, etc., and by external we mean the other elements from out of the city but they eventually benefit the city in terms of attractiveness, and once again the study will be done according to the available data and the factors we can produce about the different aspects of city's attractiveness: social, economic, demographic, health, etc. Those analyzes are the result of the grid analysis method of the city facilities and the collected documents about the city's current state as well as the past few years state (to calculate possible rates and ratios).

2.3 Area of study presentation

2.3.1. Geographic location of the province of Laghouat

The province of Laghouat is situated in the centre of Algeria, about 400 km to the south of the capital Algiers; it became a Wilaya (province) after the administrative regional division in 1974. The province is spread over a surface of 25052 km² with an estimated population of 539955 citizens at the end of 2011, [31]. It is crossed by the Saharan Atlas with peaks that are over 2000 meters high, [ix]. It shares borders to the North and the East with the province of Djelfa, to the West with the provinces of Tiaret and El-Bayadh and to the South with the province of Ghardaia, [32].

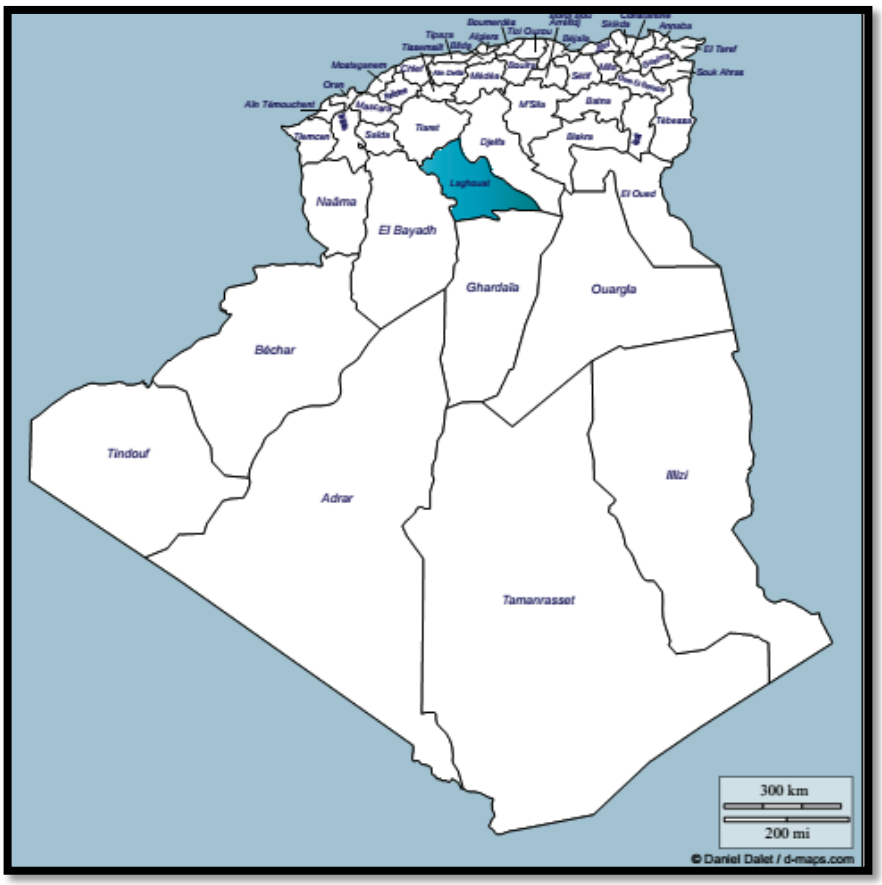


Figure 14: The location of the province of Laghouat on the map of Algeria, [x].

2.3.2 Geographic location of Laghouat municipality:

The municipality of Laghouat is the capital (or administrative centre) of the province of Laghouat; its area is about 400 km² with a population of 168184 citizens, which makes a population density of 420.46 citizen/km²; this represents 31.15% of the population of the province. It has a border to the North with the municipality of Sidi Makhlouf, to the East with the municipality of Al-Assafia, to the West with the municipality of Tadjemout and to the South with both the municipality of Mekhareg and that of Kheneg.

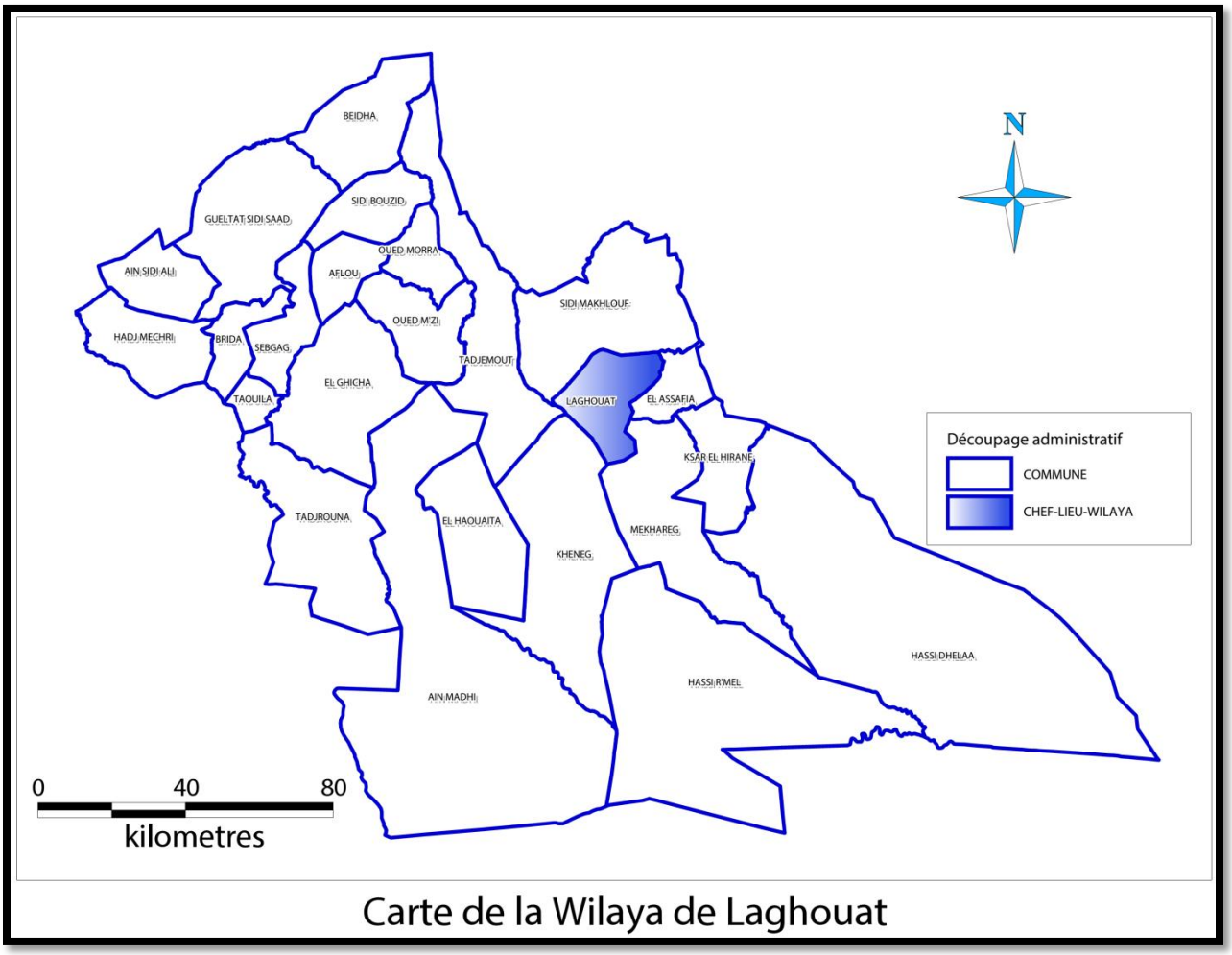


Figure 15: Location of Laghouat municipality on the map of the province of Laghouat.

2.3.3 History of the province of Laghouat:

Precolonial Laghouat (Before 1830):

The modern birth of Laghouat city goes back to the early eighteenth century, but Ibn Khaldun mentioned the existence, in about the fourteenth century, of a palace in a site that seems to be that of the current city, being a shelter for a faction of Laghouat tribe, a branch of the berber tribe "Maghraouas".

In 1548, Laghouat was included in the "Beylik of Titteri" organised by Hassan, son of Khair Eddine, [xi].

In 1725, the creation of the urban unit of Laghouat took place probably under the rule of Marabout El Hadj Aissa, [xii].

In 1727, Laghouat went under the Turkish domination.

In 1785, Laghouat was included in the Beylik of the West in the era of Bey Mohamed El-Kebir.

In 1789, it joined the Beylik of the East with Saleh-Bey.

Colonial Laghouat:

Up until 1852, the French army did not seem to be interested in the southern regions of Algeria, Laghouat among others. On the 4th of December, 1852, Laghouat was assaulted by French troops after a siege of 9 months.

Postcolonial Laghouat (After1962):

The Independence City Centre, which is the old Laghouat, still keeps its stone walls that existed even before 1852, made of seven portals.

In 1974, after the administrative division of that year, Laghouat became a province.

In 1979, the opening of Bouygues hospital (Ahmida Ben Adjila) and the construction of the university took place, [xiii].

2.4 Data of study

The geographic information is the data that is: Georeferenced, digital and viewable.

. Georeferenced: means the data has an explicit spatial coordinates (i.e. x, y, z,) or implicit spatial reference (i.e. an address).

. Digital: means it's ready to be used (viewed, modified, moved etc.) digitally.

. Viewable: able to be displayed or printed as a map on request, [7].

And the data that should be collected can be divided to two types: cartographic data: maps, satellite images, aerial images, etc. and statistical data: attribute information that describe objects that will be represented on the city observatory.

2.4.1 Cartographic data:

We can get here two cases, first, we can use a cartographic data from a digital cartographic background, and then we can integrate this background to our map or, in case of absence of this background, second, we can through a digitization process create one using a scanned map, an aerial photo or a satellite image, [33].

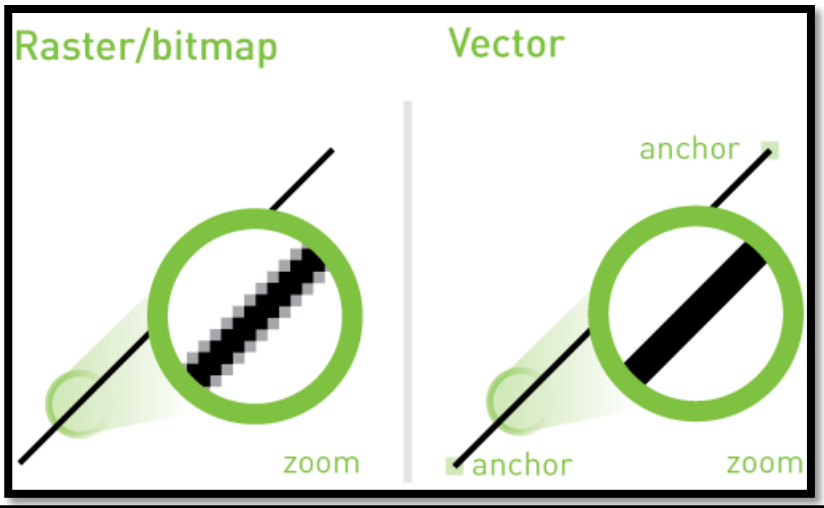


Figure 16: the difference between raster and vector presentation is clearer when you zoom, [xiv].

These cartographic data is then represented in a computer as raster image or a vector image, and the difference between them is that the raster image represents the space divided into square cells and the geographic attributes are assigned to them, sometimes the cells are called pixels and one of the commonest raster data is the remote-sensing satellites images. The raster image however, represent all lines as points connected by straight lines , and an area is represented as a series of point connected by straight lines, so to capture an area in a vector form we only need to specify the location of the points that form the vertices of a polygon and that's more simpler than listing all of the cells that form the area like it happens in the raster representation, and that's what the comment 'Raster is vaster, and vector is corrector' means, [23].

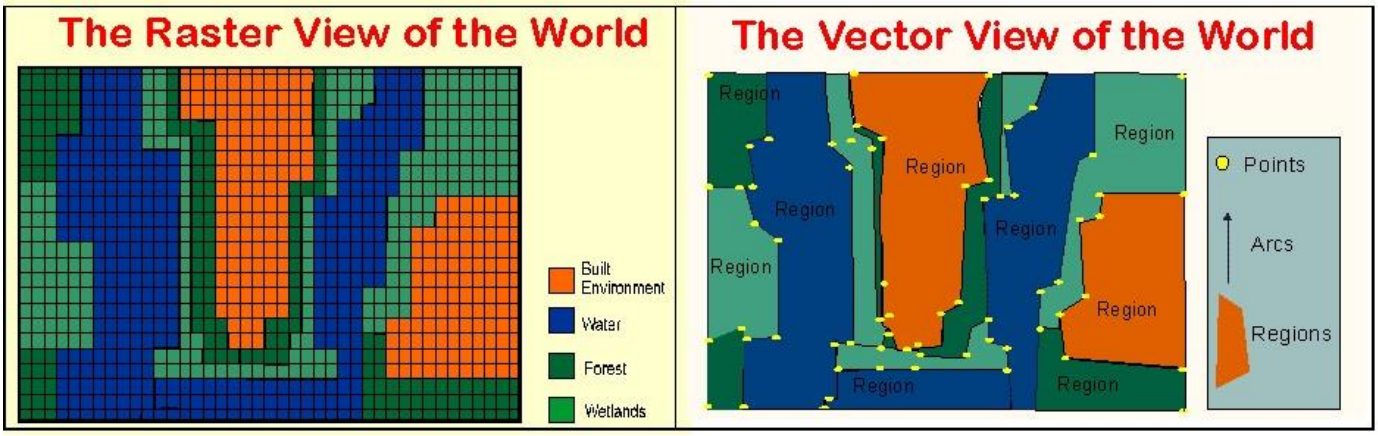


Figure 17: the difference between a raster presentation and a vector presentation from a GIS point of view, [xv].

2.4.2 Attribute data:

The objects that we're going to create in our observatory whether they are points, lines or areas are going to need to an identifying data that characterize every and each object, and that's the attribute data known also as statistical data or assigned data, the attribute data is considered in the academic community as more cost-effective and simpler task that can be undertaken by clerical-staff (Geographic information systems and science, 2005). However, this is not totally the case in our country, as this data is unavailable or lost in many times and considered confidential some other times and especially with this study, the data should be collected carefully with attention to the details.

This data can be entered simply by using a keyboard directly to the database or by assigning a soft copy of the data to their objects using a "joint" feature of any GIS based software and that's especially when the data is collected from its concerned administration or organism.

The metadata is a special type of the non-geometric data that is being increasingly used; some of it can be derived automatically by the GIS software (like length, areas, objects coordinates and count of features) and some other metadata should be collected explicitly and entered the same way we collect other attribute data.

2.5 Data acquirement

The collection of data is a very delicate procedure as in most of cases it's not only about asking for the data, it's more like do I have the right to get the needed data?, does this data exist or is it available?, sometimes is it useful? Not only because the data is corrupted but also due to the unneeded large volume of data. So that's how we're going to start the acquirement.

2.5.1 Imagery data:

The background image can be a satellite raw image that has to be treated before using or a high definition satellite image ready to be used or even a map that we can buy. For the first one we can download it directly from the USGS website, [xvi] (United States geological survey) or through the global land cover facility website, [xvii], after we choose the map place we want to download, we can choose what kind of image we want to download, the Dataset, the producer, the date, the type, etc. and we can treat that image to be used later as our background. If this image is not usable for any reason, we can still get a free high resolution image from one of the free providers of the personal usage or academic usage software and use it directly. For example, the software 'UMD: universal map downloader' is not free itself but it provides some good quality satellite images that can be used in this study. And for the last choice, and currently, it doesn't exist a map that we can purchase or buy for the purpose of this study with the convenient scale and desired details as it's considered confidential and for our knowledge it doesn't exist.

After having the image, we should get the geographical position of every and each object that is going to be in the observatory, whether by visiting the concerned local authorities and ask about a facilities map or by the help of an expert to show us the facilities on the map, and in the case where this doesn't work we'll have to do some investigation on the field in order to create our vector objects or to do the unfinished job with the authorities.

2.5.2 Attribute data:

The same thing that happened with the imagery data, will happen with the attribute data as the main source of our statistical and assigned data, and as we know the attribute data is the information that we will assign to our objects and will be characterizing them, some of it can be easily created using the GIS Software features (i.e. lengths, areas, coordinates, count etc.) and some others should be collected from their sources, for example we have to pay the direction of education a visit in order to get the full details of their existing facilities: primary schools, middle schools and high schools of the city: number of classes in every facility, number of students, year of establishment, available services, etc., and the same thing should be done with the direction of health and population, direction of religious affairs and so on and that would be a good source not only of data but also of the decision makers point of views and also needs.

For the unavailable data, there should be some field visits to the facilities in order to get all the necessary data and that would be an opportunity to get familiar with the different existing facilities in a hand, and have a close view and a clearer idea about the public facilities intern problems related to their geographic position.

2.6 Data processing

The collected data is what we may call raw and so far this data is not yet ready to use, in this part we are not only going to talk about how to treat this data to be used in our

observatory but also to question it, and see if the gathered data is correct or not and that's an important part of the processing.

2.6.1 Cartographic data processing:

Usually the satellite images are purchased in their raw format and not like we see them on 'Google earth' for example with the clean almost real view, and in order to get the desired photo we have to get our satellite image through a process of treatment or what we call 'the image processing' using a REMOTE SENSING software. One of the best choices is 'TerrSet' formerly known as 'IDRISI' which is a software developed by Clark University, [xviii], to analyse and display digital geospatial information, the powerful tools of this software allow us to do a variety of image processing and analysis including the classification, combinations of two images, comparison between them, apply some analysis filters, isolate or separate a certain object using the available indexes and give eventually the image the appropriate colours for a better presentation and then the ability to cut or to crop the part of the image that we need. However, in the case of our study the available images are not clear enough to be used and that takes us to our second choice of using a higher resolution image that suits best our objectives.

Using a high resolution image is a critic choice to our work, and the easy available satellite images servers don't offer great images. Universal Map Downloader 'UMD' and as described on its own help is a tool that helps download small tile of images from different mapping sources that can be viewed using the software viewer or combined to create a big BMP image of a city for example using as well the UMD combiner, and that's what we're going to use. We should start by selecting a path for downloading the image pieces and a task name and then we choose the source of image we want to get, after that, there's a scale to choose the appropriate zoom of the view and finally we have to choose the four coordinates parameters of the area (left longitude and right longitude, top latitude and bottom latitude) to define our image area. After downloading the images, we can use the software combiner to combine all the tiles and get the larger image that covers the entire city's area.

Now, to finalize the graphic part of our observatory data, we should add the vector objects that represent best our observatory aims and for that matter we're going to represent our public facilities as points on the map and do it with the assistance of the concerned authorities' experts or by field visits in case of inexistence of the information.

2.6.2 Attribute data:

When the acquirement of data phase is finished, the gathered data needs to be treated and organized in order to be ready for use, and every object that is going to be called FEATURE needs to be in a table with its assigned properties where every row will represent a vector feature whether it's a point, a line or a polygon and every one of those objects will have its properties on columns and therefore the information that will be represented on a layer is already organized in a table. The entry of data can be done generally using the tradition way with a keyboard and do

the entry manually, or using optical character recognition (OCR) or even a voice recognition tool, and most probably; and regarding the available tools and also for a better quality of data and a high accuracy of work, we will be using the traditional way of keyboard, in addition to the data that can be generated automatically by the GIS based software, that can apply the pre-determined functions to create a new data (coordinates, areas, lines length, etc.) out of the geo-referenced images for example and the objects locations and presentation on it.

Creating our database model is not necessary in this study and we're not going to need to an external database management system as the observatory is not going to need to connect the data tables to each other and the queries happens separately with every table.

2.7 Working hypotheses:

After collecting the necessary data, both cartographic data and attribute data, our work will be done according to the available data, software, and devices with regard to our target users and necessary analysis methods, and of course without forgetting the obstacles that will lead us to do our study under certain hypotheses that we can summarize them with the following points:

. The observatory as a GIS is only a tool that helps those in charge to make better decisions; the observatory per se doesn't generate solutions or make a decision by itself.

. In addition to the first hypothesis, this work is considered as a prototype usable only by specialized people in order to extract some solutions on the subject of this study.

. The data will be collected about five main sectors: Health and population direction, education direction, religious affairs education, culture direction and youth and sports direction.

. The vector data will be presented according to the administration that it belongs to, as every sector has its own type of data organization, and thus every object type will be represented with a particular table.

. The population of the city will be considered homogeneously distributed on the city in the case of grid analysis.

. The city limits are not necessarily the administrative limits, instead we will consider the urban fabric or the urbanized area of the city as the city's limits.

. The analysis will be done using both: the districts division analysis method and the grid analysis method, as it provides a homogeneous division of the city, an alternative solution to the administrative division of the city and a reliable conversion of the points object attribute data to an area object attribute data.

. The choice of grid cells dimensions will be taken later based upon the dispersion and density of different facilities on the city as well as the usability of each dimension.

. The city observatory's data should be continuously updated in both cartographic and attribute data in order to get a better analysis results.

. In this study there will be no research about the reasons behind the current localizations of public facilities.

. The analysis part and due to the available data will be done only about primary schools of the city.

And in order to do the part of the city of Laghouat attractiveness, the study will be conducted with the following hypotheses:

. In case of a need to a multi-criteria analysis, the software used in this study doesn't allow it to happen simultaneously between many layers; instead, we will do a partial type of it crossing two layers, and then once again, do the same with the results of the previous analysis with another layer till we get the desired results.

. As the attribute data and tables structures' change from a layer of objects to another, and as the collected data don't have much common properties that allow us to measure their affect equally, the weight and influence of different facilities will be considered equal and their effect is considered to be the same for different age groups and genders.

. The city attractiveness assessment will be done following the type of influence as mentioned earlier in the work objectives section: local or general.

. Due to the missing data concerning the districts division of Bordj Essenoussi, the whole area of Bordj Essenoussi will be considered as a whole one district.

2.8 Devices and work means

A large part of realization of the city observatory depends on the availability and quality of the work means, whether we are talking about devices or about software, there's no doubt that the used tools will define the accuracy and quality of the work, and in this part we will talk about two used tools: a software (MapInfo) and a positioning computing device (GPS device).

2.8.1 GPS device presentation

In order to complete the missing data especially the facilities geo-localization data (latitude and longitude coordinates), and also to validate the entered data, an investigation is necessary as we've seen before, and that part can only be done using a GPS tool. GPS stands for Global Positioning System which is a computing device that knows its location almost anywhere on earth through a system of 24 satellites. Each satellite is orbiting the earth on distinct orbits every 12 hours at a height of 20200 km, and to determine position a receiver must at least make precise calculations with four satellites above the horizon in order to get position in three

dimensions (latitude, longitude and elevation) and at least three satellites if elevation is not required, [23].

The GPS device we will be using is a Garmin Etrex which is a professional GPS device with a high accuracy that we can rely on, and we can later extract the created data and export it to our system to be treated and assigned to its geographic objects.

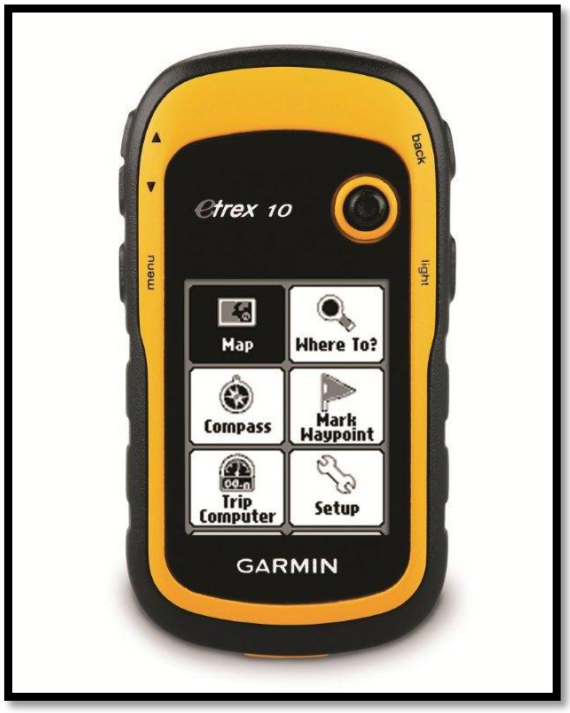


Figure 18: an image of the used GPS: Garmin etrex 10, source: Garmin website, www.garminonline.co.za.

2.8.2 MapInfo software presentation:

As it's always the case, any GIS projects needs to operate on a GIS based software to achieve its objectives starting from the inputs (different data) and finishing with inputs (resulted analysis, cartography products, etc.) and currently we can find a large variety of those software and our choice depends on our project particularity and requirements in a hand and our budget in another hand. And for our study, MapInfo is the GIS based software that we will be using to create our city observatory and it will be the tool to store our data, organize, query, analyze and represent it, through the large collection of functions that allows us to do the necessary work.

MapInfo software was initially released in: 1986 by MapInfo Corporation, currently known now as Pitney Bowes software, and used for mapping solutions and spatial analytics in order to reveal relationships and trends about different objects and phenomena through its several functionalities that include: creation of layers from different types of data and ability to combine them, data queries, thematic mapping, maps production, etc. all that can be learned and practiced easily comparing to other GIS software solutions.

2.9 Conclusion

In the case of our work, the city observatory is one type of the many observatories used nowadays and the fact we are studying the public facilities of the city in particular, and the insufficient data or their inexistence sometimes made us work in a limited context. That fact pushed us to think a lot about the adequate analysis method. The grid analysis was perfect for the study, its manageability and efficiency solved many problems such as the unclear city divisions and boundaries and made it easy to visualize the available data through a thematic analysis. The city's attractiveness is going to be much clearer using the analysis results of different sector's data and that will be an enormous plus to the lack of information that is related directly to the subject of attractiveness.

Chapter 3: Observatory implementation and results

3.1 Introduction

The methodology of establishing an observatory presented in the previous chapter is applied on the city of Laghouat and this Chapter's objective is to explain and clarify how to create a city observatory following the necessary steps.

Starting with acquiring the imagery data and attributes data. this data will be the object of verification taking in consideration all the modification and changes, how to treat them, what to add from a further research with administrative directions and what to get from a site investigation in order to get an up to date and complete database. Then, what's the best way to represent this data and how to analyse it using the grid analysis method or other necessary methods. After that in this chapter, we will be representing not only the location maps that represent the different type of public facilities and their localization in the city of Laghouat but also the thematic maps using different representations types, ranges of representation, and accurate attributes and of course analysed with the grid analysis method. Finally, the attractiveness study will be done based on the attractiveness factors produced with the available information and according to the particularity of the city of Laghouat and its characteristics.

3.2 Realizing the observatory:

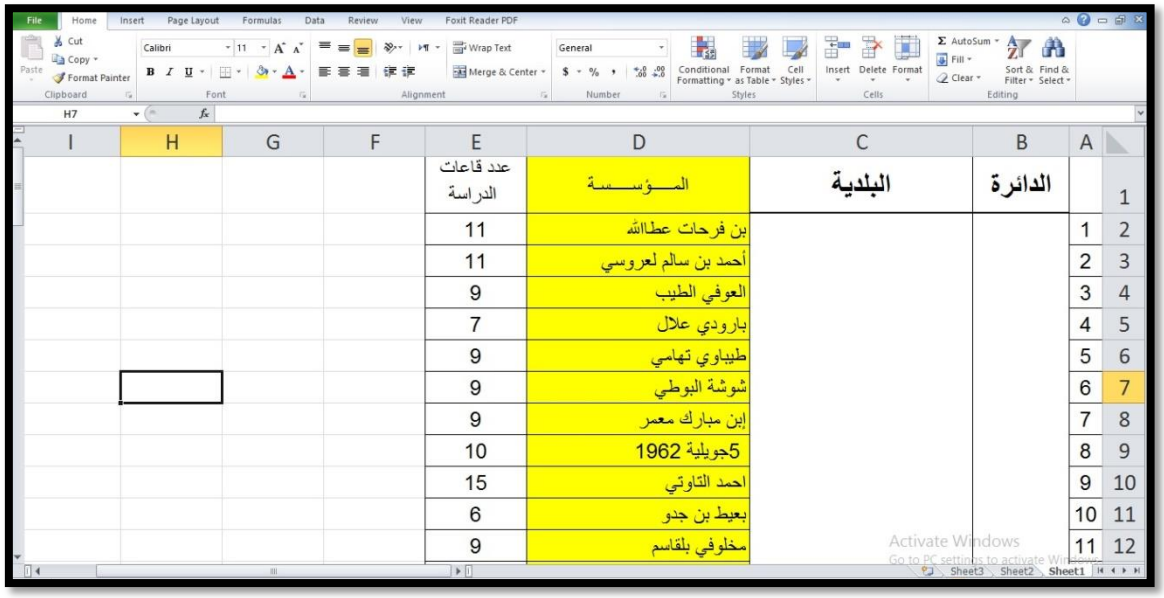
As we have seen in the previous chapter, the study is based on an essential part of every GIS project which is the data collection and processing, we've also seen that the data is divided to visual or graphical data, and attribute data. Our graphical data collection had to start with the raster image of the city of Laghouat, and our acquirement tool was the UMD software (Universal Map Downloader) and we could download a clear image of the city with a very good resolution, but there was the problem of the image volume, more than a one gigabytes, and that wasn't easy for our GIS based software 'MapInfo' to open, read and visualize it. We had then to change the image format to a lighter volume, and we had to use another software called 'Global Mapper'. Global Mapper is a GIS oriented tool as well, except it has the ability to read bigger volume images and export them to different formats, it has also the ability to understand the geocoding concept of images with all the coordinates and systems of projection concepts, so it's easy for it to open the raster image and compress it or save it as a JPEG (Joint Photographic Experts Group) format that allows the adjustment of compressing degree and therefore a selectable tradeoff between storage size and image quality and that's what we did. We compressed it to a reasonable range of size to be opened easily with MapInfo (51 Mb); and a good quality of image to help us visualize and digitize the necessary objects of the city.

Figure 19: Satellite image of the city of Laghouat, Universal map downloader, 2012 [xix].

The chosen image is ready now to be used, except it's not geo-referenced and that means when you select a point on it, you can't read its coordinates and now it needs to be geocoded; which is the action of determining the correct position of the photo in space by pre-determination of coordinates of well-known points of interests (at least four points in the case of MapInfo) that can be noticed on the photo under a certain projection system like: intersections, buildings, bridges, etc. The chosen points better be well dispersed on our image for a better geo-referencing results and we will be working with a UTM (Universal Transverse Mercator) projection system and a standard of WGS84 (World Geodetic System 1984). After that the software will do its job by interpolating between these points to let us know the exact coordinates of every point on our map. This geo-referenced image will be the cartographic background of our work and the next phases of work will base on it.

Collecting the data starts now from the concerned directions and the Direction of programming and budget monitoring (DPSB) and formerly known as Direction of planning and territory development (DPAT) is a good place to start this phase's work. The DPSB at the beginning of every year produce the state Monograph of the past year collecting information about every sector and administration of the state and that seemed to be a good source of data. Unfortunately, these reports are the response to the administration need of development assessment and not conducted in an academic context and all we could find are the final reports and not the used data. Therefore, the needed information wasn't available there as our work is only about the city of Laghouat and the monograph information were not detailed enough, and the facilities location didn't exist at all in there which was the most important thing at that point of work, besides, we needed a person who works closely with public facilities and who knows their location and may possess a pertinent data about them.

The next destination was the concerned direction itself of each sector, there we can meet people who know everything about their own direction facilities and if anyone can provide us with any existent data they will be in the direction. The problem is that there was always a missing data, in

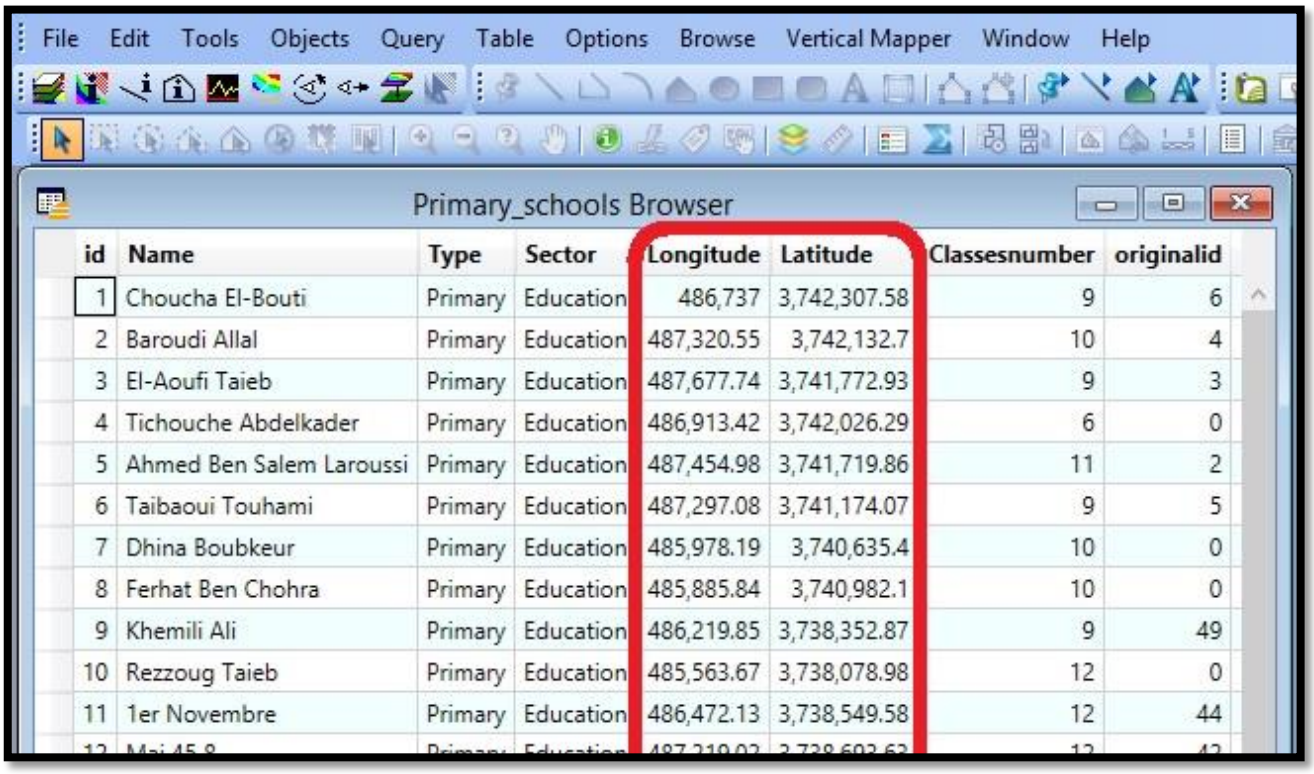


	A	B	C	D	E	F	G	H	I
1		الدائرة	البلدية	المـــؤســـســة	عدد قاعات الدراسة				
2	1			بن فرحات عطاالله	11				
3	2			أحمد بن سالم لعروسي	11				
4	3			العوفي الطيب	9				
5	4			بارودي علال	7				
6	5			طيباوي تهامي	9				
7	6			شوشة البوطي	9				
8	7			إبن مبارك معمر	9				
9	8			5جويلية 1962	10				
10	9			احمد التاوتي	15				
11	10			بعيط بن جدو	6				
12	11			مخلوفي بلقاسم	9				

Figure 20: The data collected from Direction of education, Source: Direction of Education of Laghouat

both of attribute and geographic data and we had to complete the data with field investigations to find about some facilities location.

In order to complete the data, MapInfo functionalities allow us to create some data out of the existing data, for instance new columns can be filled with precise data out of the existing data, for example the surface of a given area or region can be calculated automatically using the function 'area' in the column 'Update Column' section under 'Table' tab. The functionality of calculating coordinates can be easily done using the tool 'Coordinate Extractor' that can be found in the 'MapBasic program' section under the 'Tools' tab.



id	Name	Type	Sector	Longitude	Latitude	Classesnumber	originalid
1	Choucha El-Bouti	Primary	Education	486,737	3,742,307.58	9	6
2	Baroudi Allal	Primary	Education	487,320.55	3,742,132.7	10	4
3	El-Aoufi Taieb	Primary	Education	487,677.74	3,741,772.93	9	3
4	Tichouche Abdelkader	Primary	Education	486,913.42	3,742,026.29	6	0
5	Ahmed Ben Salem Laroussi	Primary	Education	487,454.98	3,741,719.86	11	2
6	Taibaoui Touhami	Primary	Education	487,297.08	3,741,174.07	9	5
7	Dhina Boubkeur	Primary	Education	485,978.19	3,740,635.4	10	0
8	Ferhat Ben Chohra	Primary	Education	485,885.84	3,740,982.1	10	0
9	Khemili Ali	Primary	Education	486,219.85	3,738,352.87	9	49
10	Rezzoug Taieb	Primary	Education	485,563.67	3,738,078.98	12	0
11	1er Novembre	Primary	Education	486,472.13	3,738,549.58	12	44

Figure 21: An example of generated data by MapInfo.

After finishing the data collection and processing, it's important now to mention that the database relations or any kind of Database management is not taking place here, as our database is too much simple due to the low amount of data we collected, and the software MapInfo itself is able to manage all the created tables, and it can get any information existing within the observatory with a simple query functionality, or an SQL selection query if it has to.

Now, it's the time to choose how to visualize every object on the city of Laghouat, what symbols should we pick and what colors describes best and are easiest to be distinguished. For that task we didn't add any symbols, in fact we only used the MapInfo default symbols and lines styles, the symbols varied from same symbol for the same sector or direction like the case of the Religious affairs sectors, to different colors and sizes of the same symbol for the same sector like the case of Education and Health sectors, and even different symbols for the same sector like the case of Culture and Sports sectors in order to get a better presentation of the facilities on the map. Our database is now ready to be visualized, and the choices of visualization are made, the only problem is that our map doesn't' look rich with information, instead, it just looks full with unrecognized symbols and overcrowded and the symbols in many places are superimposed, the following figure represent the created map of the public facilities of the city of Laghouat including the five sectors of the study: Education, religious affairs, health, sports and culture.

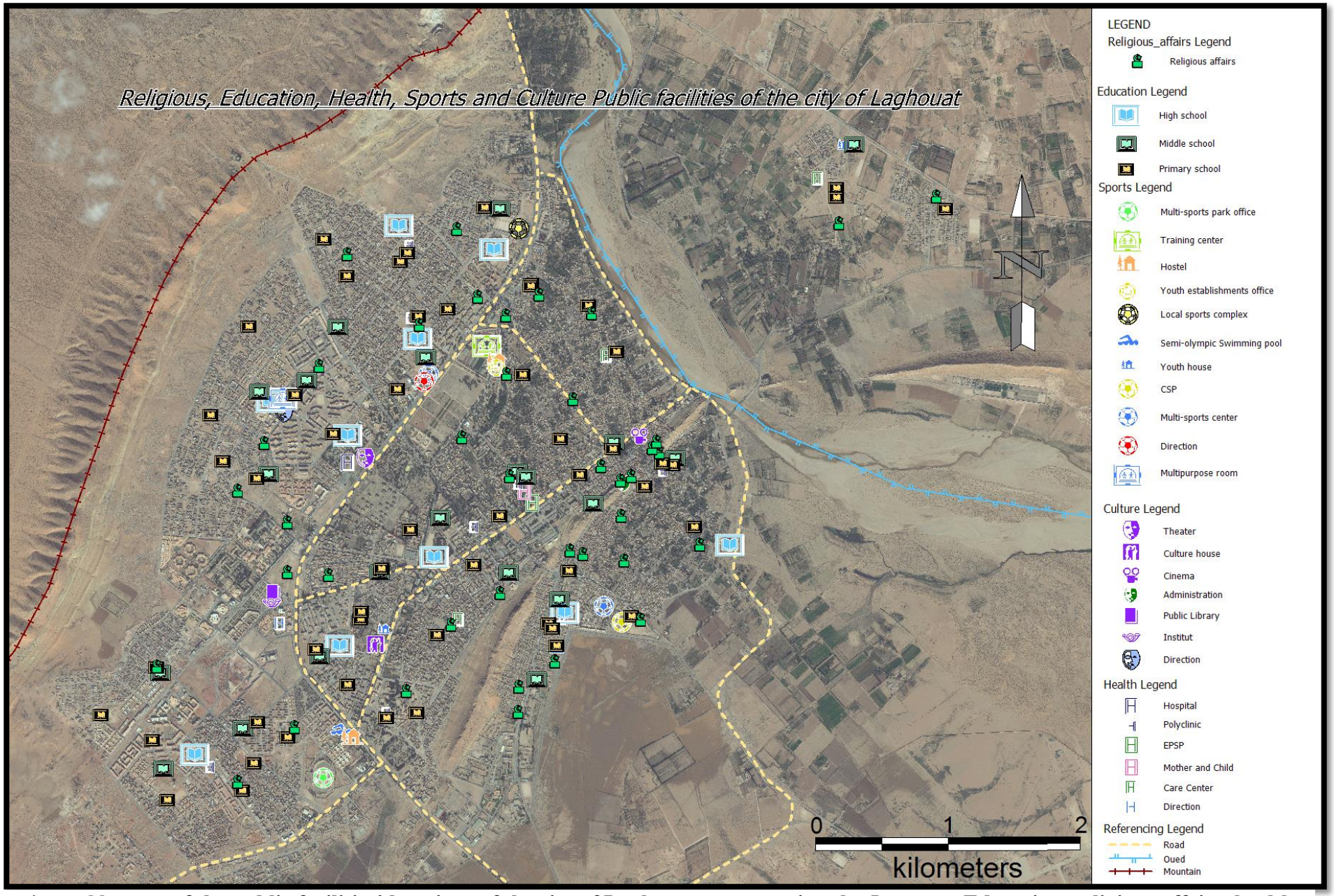
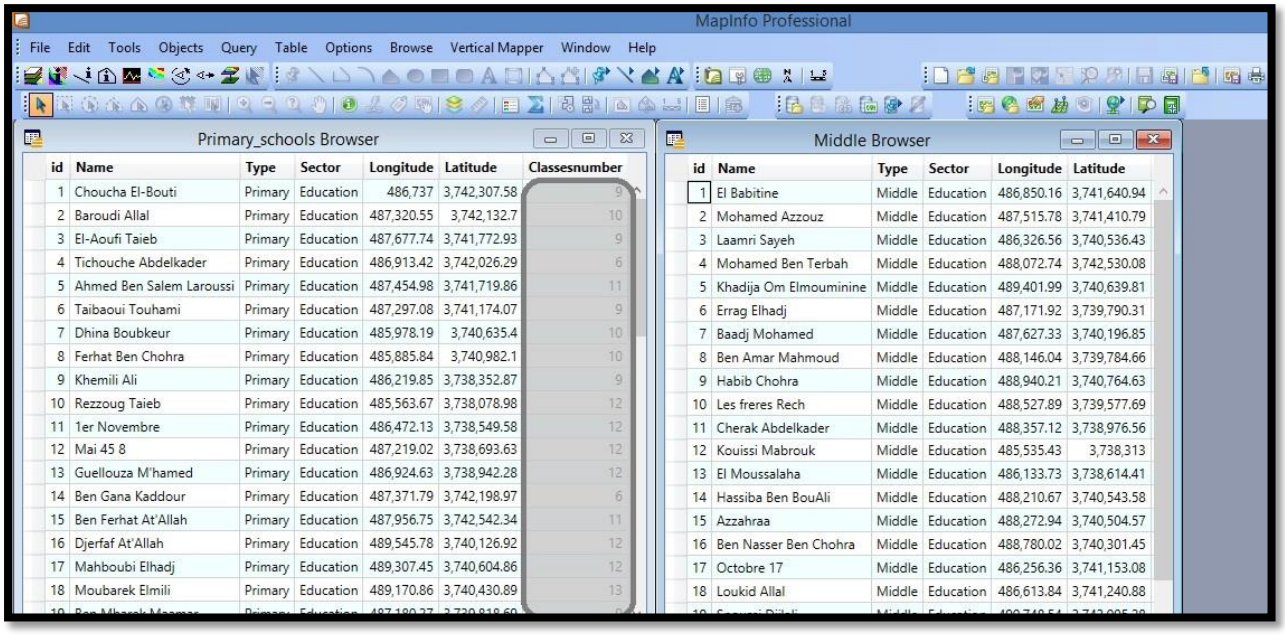


Figure 22: Map of the public facilities' locations of the city of Laghouat, representing the 5 sectors: Education, religious affairs, health, sports, and culture.

As shown on the previous figure, the overcrowded map is not legible and therefore the observatory has to be divided to multiple layers where each layer contains only one sector or subject. for example: the education layer and due to the large number of facilities can be also divided again to a primary schools layer, middle schools layer and high schools layer; not only that, the properties of each table or layer changes from a type of education facilities to another, for example: the number of classes in every primary school is available, where that number of middle and high schools is not, and therefore we will not have the same table structure for every type of facilities and consequently even the representativeness of primary schools is going to be much more higher than its counterpart of other education facilities.



id	Name	Type	Sector	Longitude	Latitude	Classesnumber
1	Choucha El-Bouti	Primary	Education	486,737	3,742,307.58	9
2	Baroudi Allal	Primary	Education	487,320.55	3,742,132.7	10
3	El-Aoufi Taieb	Primary	Education	487,677.74	3,741,772.93	9
4	Tichouche Abdelkader	Primary	Education	486,913.42	3,742,026.29	6
5	Ahmed Ben Salem Laroussi	Primary	Education	487,454.98	3,741,719.86	11
6	Taibaoui Touhami	Primary	Education	487,297.08	3,741,174.07	9
7	Dhina Boubkeur	Primary	Education	485,978.19	3,740,635.4	10
8	Ferhat Ben Chohra	Primary	Education	485,885.84	3,740,982.1	10
9	Khemili Ali	Primary	Education	486,219.85	3,738,352.87	9
10	Rezzoug Taieb	Primary	Education	485,563.67	3,738,078.98	12
11	1er Novembre	Primary	Education	486,472.13	3,738,549.58	12
12	Mai 45 8	Primary	Education	487,219.02	3,738,693.63	12
13	Guellouza M'hamed	Primary	Education	486,924.63	3,738,942.28	12
14	Ben Gana Kaddour	Primary	Education	487,371.79	3,742,198.97	6
15	Ben Ferhat At'Allah	Primary	Education	487,956.75	3,742,542.34	11
16	Djerfaf At'Allah	Primary	Education	489,545.78	3,740,126.92	12
17	Mahboubi Elhadj	Primary	Education	489,307.45	3,740,604.86	12
18	Moubarek Elmili	Primary	Education	489,170.86	3,740,430.89	13

id	Name	Type	Sector	Longitude	Latitude
1	El Babitine	Middle	Education	486,850.16	3,741,640.94
2	Mohamed Azzouz	Middle	Education	487,515.78	3,741,410.79
3	Laamri Sayeh	Middle	Education	486,326.56	3,740,536.43
4	Mohamed Ben Terbah	Middle	Education	488,072.74	3,742,530.08
5	Khadija Om Elmouminine	Middle	Education	489,401.99	3,740,639.81
6	Errag Elhadj	Middle	Education	487,171.92	3,739,790.31
7	Baadj Mohamed	Middle	Education	487,627.33	3,740,196.85
8	Ben Amar Mahmoud	Middle	Education	488,146.04	3,739,784.66
9	Habib Chohra	Middle	Education	488,940.21	3,740,764.63
10	Les freres Rech	Middle	Education	488,527.89	3,739,577.69
11	Cherak Abdelkader	Middle	Education	488,357.12	3,738,976.56
12	Kouissi Mabrouk	Middle	Education	485,535.43	3,738,313
13	El Moussalaha	Middle	Education	486,133.73	3,738,614.41
14	Hassiba Ben BouAli	Middle	Education	488,210.67	3,740,543.58
15	Azzahraa	Middle	Education	488,272.94	3,740,504.57
16	Ben Nasser Ben Chohra	Middle	Education	488,780.02	3,740,301.45
17	Octobre 17	Middle	Education	486,256.36	3,741,153.08
18	Loukid Allal	Middle	Education	486,613.84	3,741,240.88

Figure 23: Difference between tables' structures and data in properties requires multiple layers.

In order to create our thematic maps and analysis maps, certain maps important elements can be automatically done by MapInfo like: the north arrow and the scale bar, we can find them in the MapBasic program tools and we can find there a variety of styles and we can also choose size and colors; however, the choice of ranges' calculation methods in analysis presentation and their relations with legend properties is extremely crucial as the same data may give some very different results all depending to the choice of ranges' calculation method, and the method chosen by default doesn't help us with this study. For that matter we found it important to apply the two following criteria:

1. Let the lowest range of thematic analysis with ranges type be under the lowest value of our analyzed data in order to detect all the empty cells and not to mix them with cells that contain some low representing objects. For example, the lowest value of primary schools class rooms is: 6 rooms and in order to analyze the number of classes in the city; our first range should represent cells that contain less than 6 class rooms.

2. Ranges should be customized to be calculated after respecting the first criterion and divided to equal ranges rather than equal count of objects, as it's the best way of presentation in the case of our study.

The following figure represents the difference between the two types of presentation.

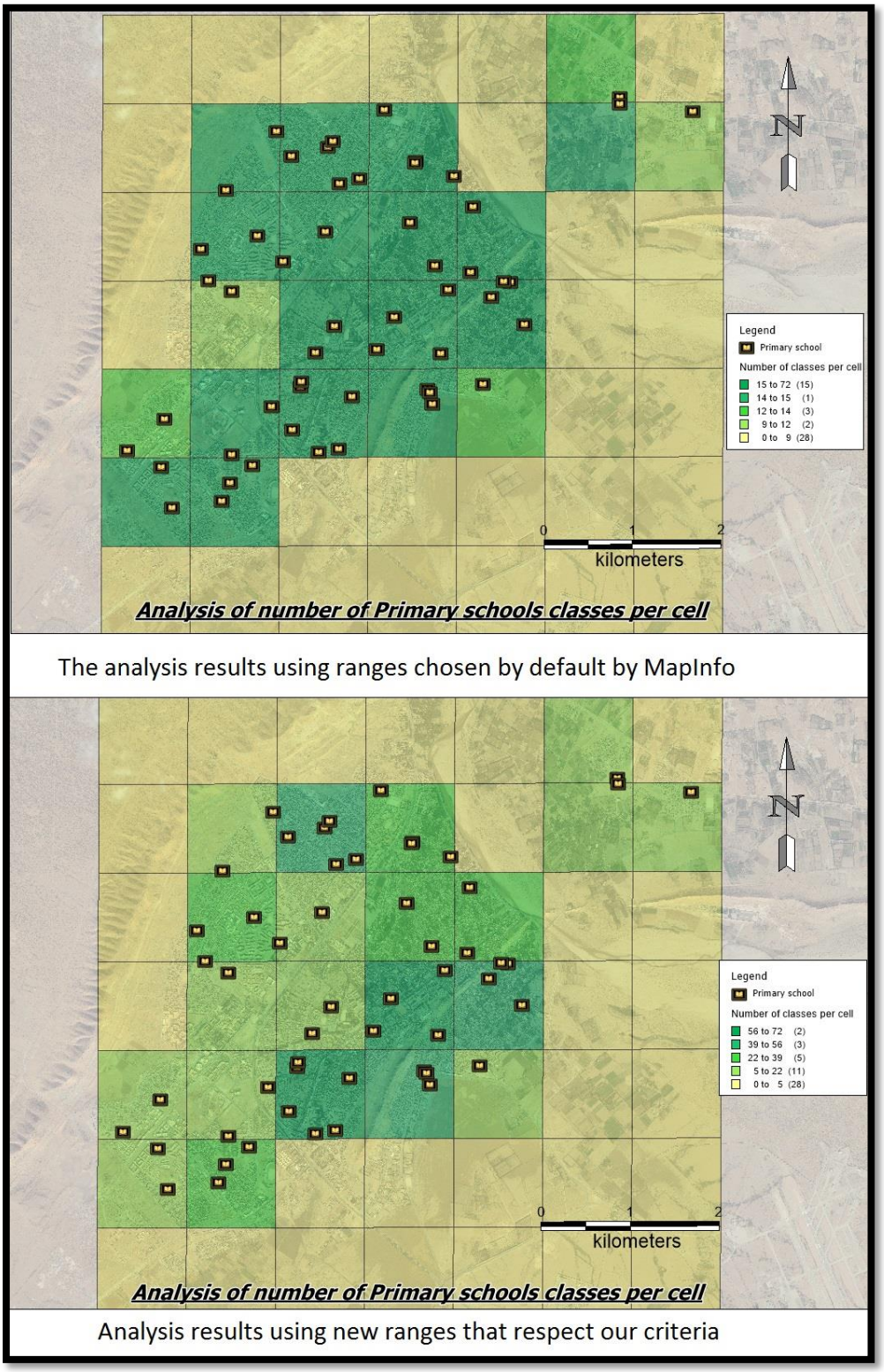


Figure 24: Difference in presentation results between two choices of legend ranges

The difference between the last two shown maps is too obvious as the first map shows the default chosen ranges and they mislead the map reader as the highest range varies from 15 to 72 classes per cell, which is enormously larger than its previous range that varies from 14 to 15 and that way gives the illusion of an equally distributed classes. In contrary, the second map shows reasonable divided ranges that vary from 56 to 72 and from 39 to 56, etc. in equal ranges.

Finally, in this section, and to achieve the aim of an easy visual referencing, the image of the city of Laghouat is characterized by many elements that respond to some of the elements mentioned in Kevin Lynch's famous work 'The image of the city', [34], and he classified them into five types: Paths, edges, districts, nodes, and landmarks. He defined them as follows:

. Paths: The channels, along which the observer moves and other elements are arranged or related, they maybe: streets, walkways, railroads, etc.

. Edges: the linear objects that r not considered as paths, they are boundaries between two phases and linear breaks in continuity.

. Districts: the medium to large section of the city which are recognizable as having some common, identifying character from the inside and also used for exterior reference if visible from the outside.

. Nodes: strategic point and spots in a city into which an observer can enter, they are primarily junctions, places of break in transportation , a crossing or convergence of paths or they may be simply concentrations as a street corner hangout or an enclosed square.

. Landmarks: unlike the nodes, the observer doesn't enter within landmarks, they symbolize a constant direction and they seem to be increasingly relied upon as a journey gets more familiar.

And in our case, we'll rely on the largest streets of the city as our paths, on the Oued and Mountain as our edges and our facilities will be the landmarks except you can get within them, as they don't respond to the nodes definition in a hand, and the nodes themselves are not possible to be identified in a conventional and official way in another hand. And about the districts, currently the only division of that kind doesn't respond to the needs of the city planning as in term of neighborhoods division but more like a temporary solution that has a lot of missing parts and there will be a further explanation about their issue in the next dissertation, under the title 'reliability of current location of public facilities'. Our elements of the image of our city will be used as a referencing layer in our observatory for a better geo-referencing of the city public facilities and visual analysis.

3.3 GIS and produced maps Analysis

The following work is the resultant products of our geographic information system in terms of both: maps and analysis, and it aims to achieve some of this study's objectives, starting by the geo-location of the city's main public facilities and then how the analysis is going to be conducted and performed with the relevant analysis methods.

3.3.1 Location maps of different public facilities

The city observatory of Laghouat is now created following the previously mentioned steps and is now ready to give its first results responding to the work objectives that we talked about in the second chapter of this study, and one of those objectives is the location determination of the city public facilities. As our work is limited by the hypotheses mentioned in the preceding chapter we've only collected data about five sectors or directions that we've created a location map for each sector of them as illustrated in the following maps, and that came also as a solution to the problem of overcrowded map that gathers them all in one figure.

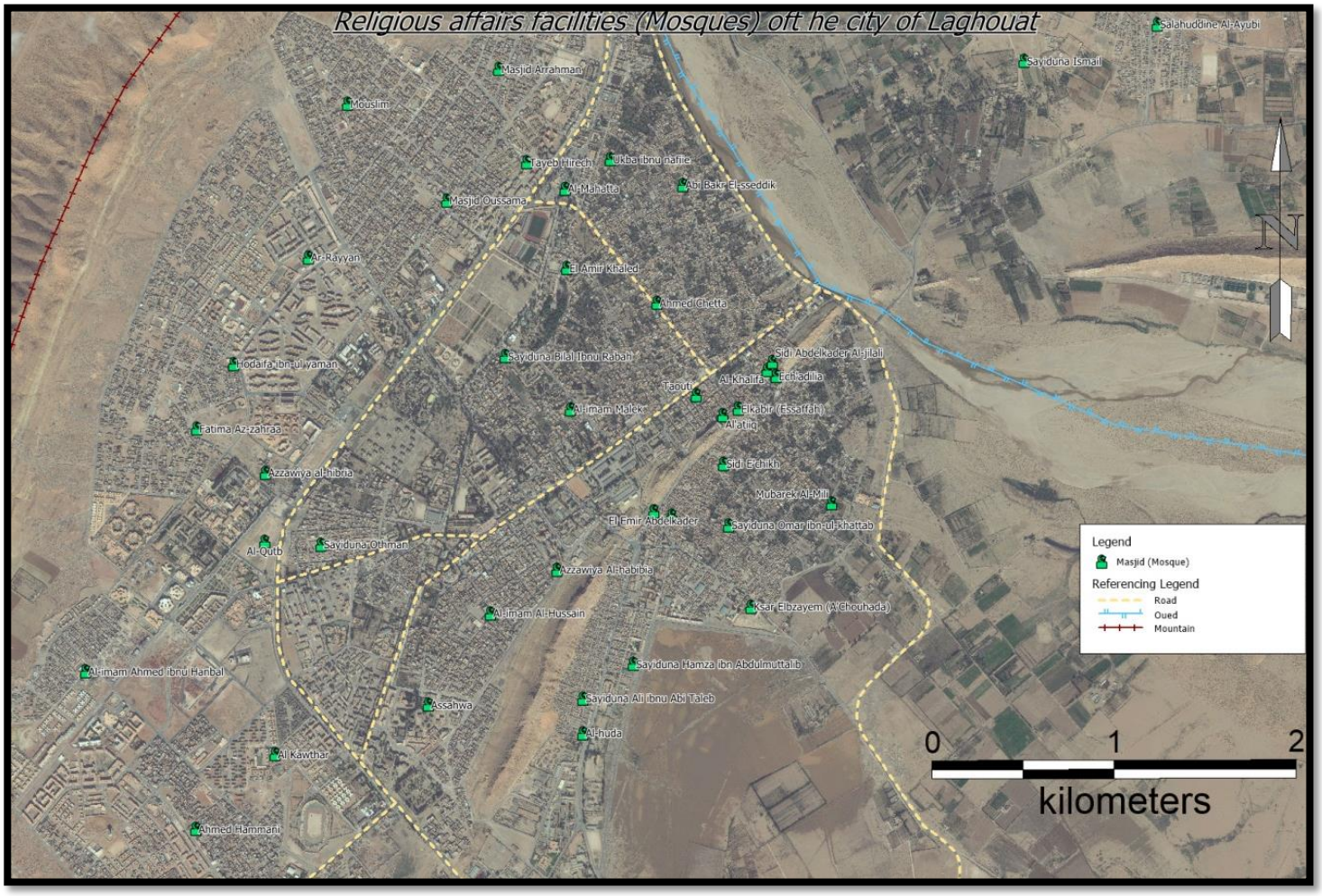


Figure 25: Religious affair facilities (masjids) location's map of the city of Laghouat

This map represents the public facilities of the religious affairs directions which are the city mosques known as 'Masjids', we counted there a sum of forty mosques where 38 masjids of them are spread over the urban zone of Laghouat plus two others are situated in its periphery Bordj Essenoussi.

The next map is the Health Direction facilities locations of the city of Laghouat including the Hospital, polyclinics, EPSP facility, mother and child center, care centers and the direction

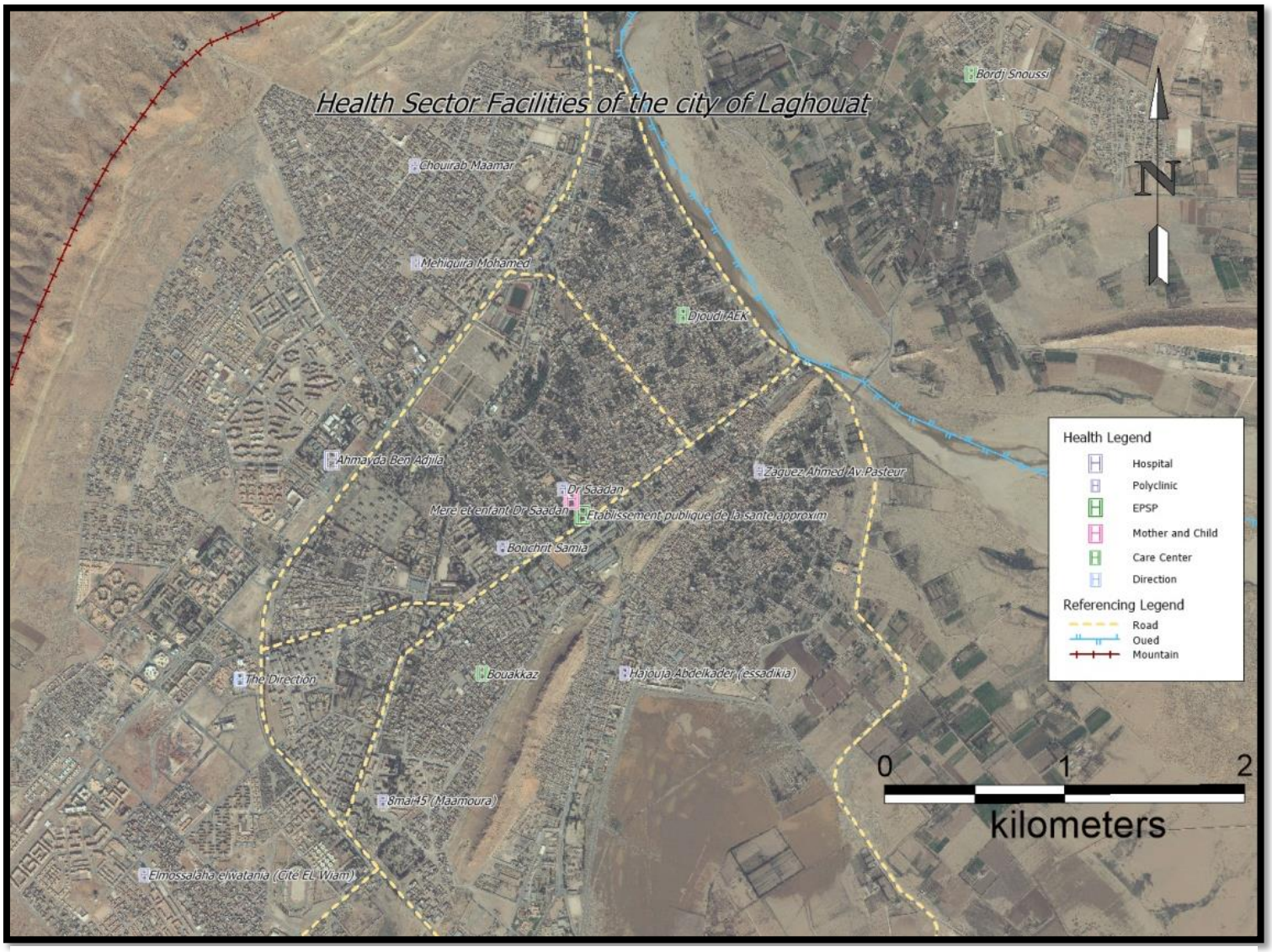


Figure 26: Health facilities locations map of the city of Laghouat

Following, is the sports facilities locations map of the city including types: Multi-sports park office, training center, hostel, youth establishment office, local sports complex, semi-Olympic swimming pool, youth house, CSP facility, multi-sports center, multipurpose room, and the direction of sports of the state of Laghouat.

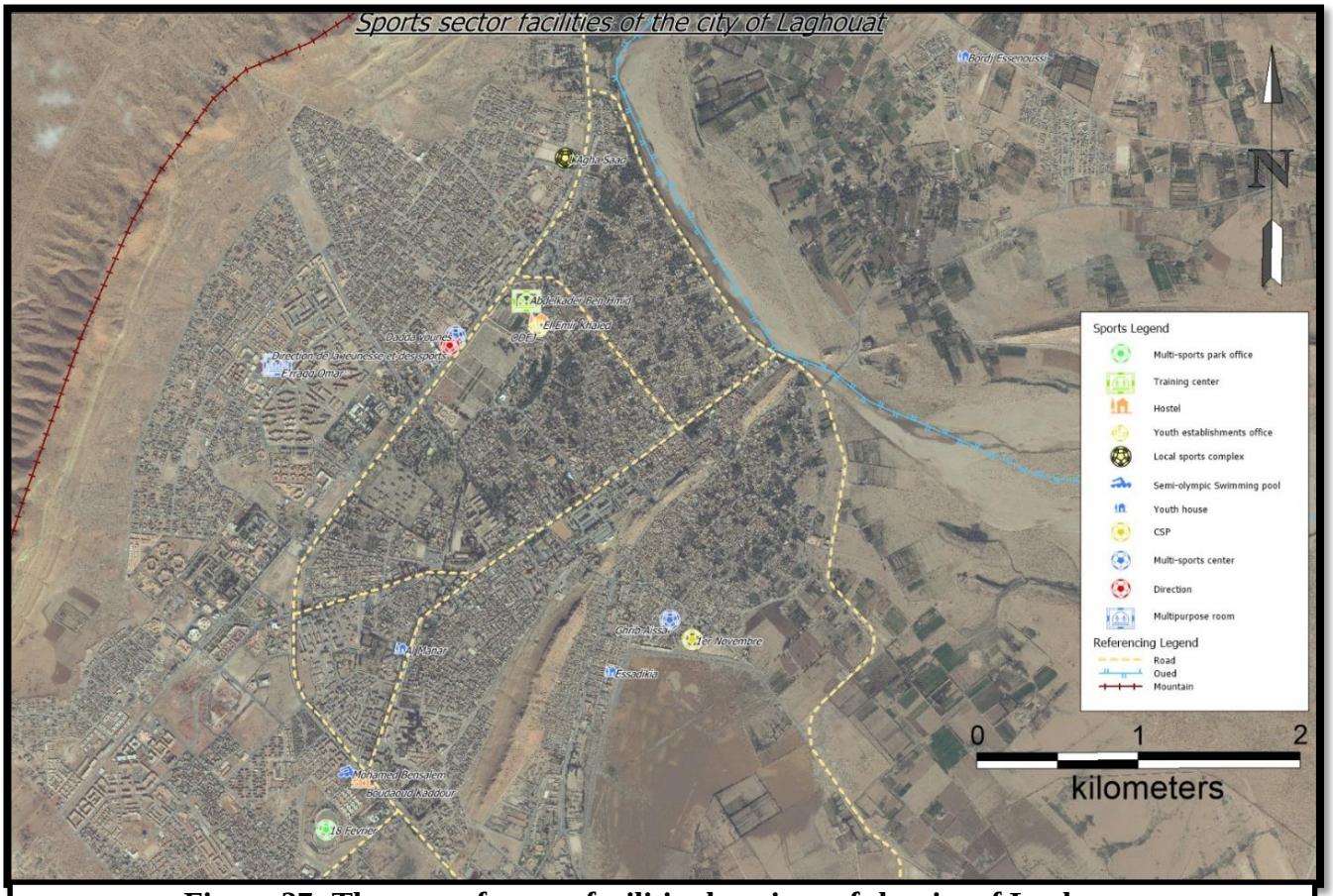


Figure 27: The map of sports facilities locations of the city of Laghouat

Figure 28: Culture facilities location of the city of Laghouat Map

The Last map represented the public facilities locations of the culture direction of the city of Laghouat including: theater, culture house, cinema, public library, music institute and administration offices.

The next map represent the education direction's public facilities' locations which are the primary schools, middle schools and high schools, and the direction of the city of Laghouat:

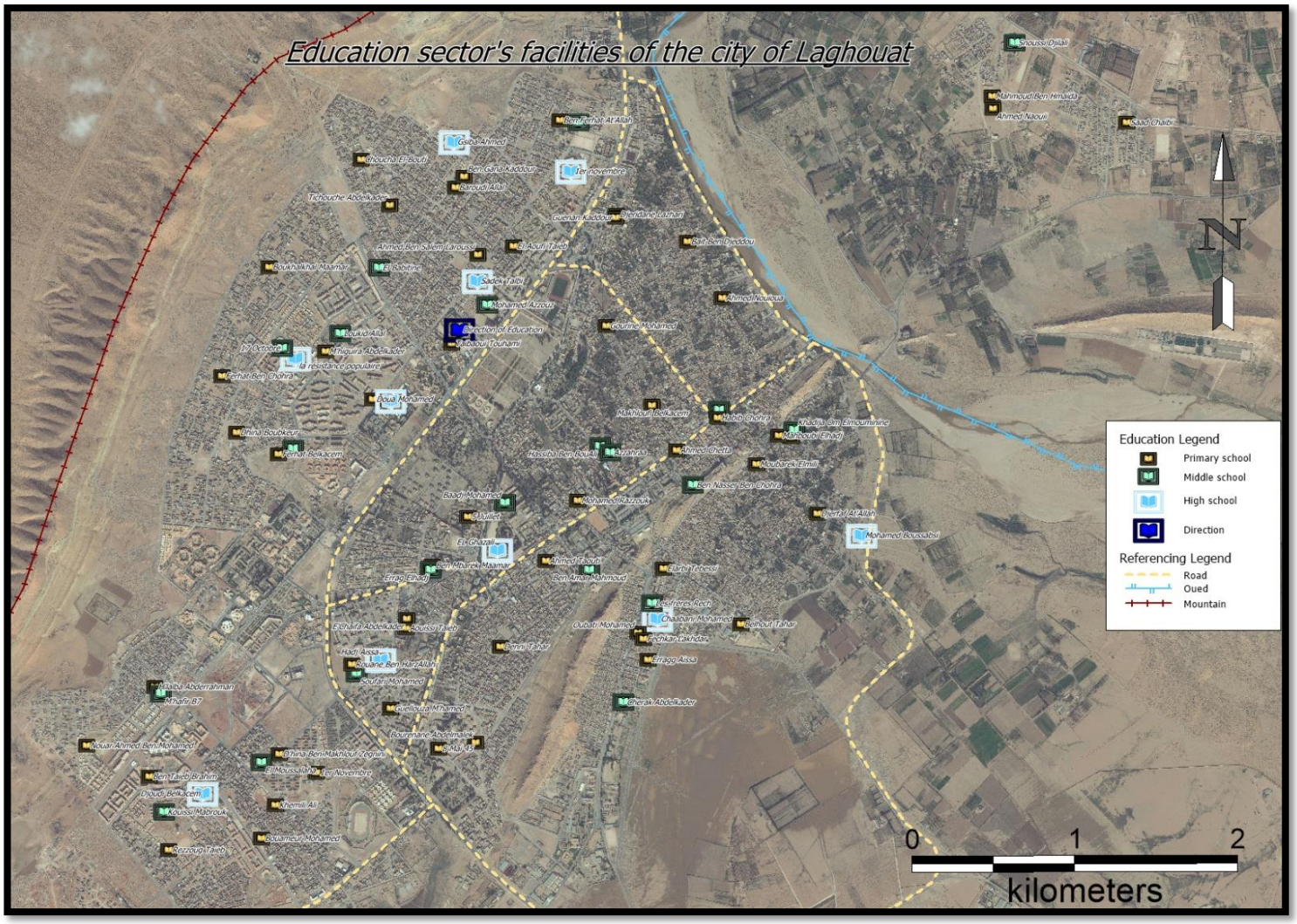


Figure 29: Public facilities' locations of education direction of the city of Laghouat.

What we should mention here, is that even though the education map is only about one sector, the large number of its facilities that exceeds 80 public facilities, cause a relative eligiblity of the map and therefore this map may need –in case of a further analysis- to another division of its facilities according to the facility types: Primary schools, middle schools and high schools in order to be more comprehensible, which mean three different maps, every type with its own location map, however, for the purpose of facilities' location, this map is adequate for us.

3.3.2 Reliability of current location of public facilities (case of Primary schools)

The previously realized mapping works representing the five facility sectors gave us an idea about their services concentration in the city's different places and therefore we may estimate their impact on their neighborhoods, but the reality is that the same type of facilities doesn't necessarily represent the same thing. For example a school of 20 class rooms is twice as big as a 10 class rooms' school and so on, besides the type of division has a very important role in our assessment. For example: a 20 class rooms' school in a 2 km² district is not equal to its counterpart in a 4 km² district. It is also essential for us and for the purpose of the coming analysis of the grid analysis method, to know another type of division of the city which is the district division. The district division is realized in the first place for the purpose of the general census of population and housing of the year 2008 by the authorities (mainly the municipality of Laghouat) in order to continue the census previous works that runs every ten years. A simple comparison between this division method and the grid division method in term of analysis will take place in the next dissertation and we will try to get a general idea about the use, pros and cons of both of them.

Finally, and in term of work hypotheses and due to the following reasons, we are going to choose the primary schools of the city as our analysis subject of application:

. The large number of primary schools of the city comparing to other public facilities (higher than any other sector)

. Because of their relatively representative data: (number of class rooms in every school), where the same data is not available in case of middle and high schools.

. The dispersion or distribution of those facilities is much better than other sectors facilities.

. Also, as long as the analysis is going to follow the same steps with every sector and it will be only a matter of repetition of the same analysis with other direction facilities.

For the previous mentioned reasons, the application of analysis method is going to be limited only on the primary schools of the city.

3.3.2.1 Districts analysis method

The districts division of the city is proposed by the municipality in order to ease the census work and divide the tasks and missions between their site and office workers in a hand, and to have representative relatively equal areas in the other hand. During the search and collection of data, we could find a printed copy of the city division and it was the only existing copy there, unfortunately it couldn't be scanned and Georeferenced. Also, it was unclear due to the long time it was hanged on the wall and therefore it was unreliable source to create a digital copy out of it; we had the chance later to get a clearer copy of the city districts from the studies bureau 'URBATIA Laghouat' except it had some differences with the Municipality copy, we had

to compare between them and based on the URBATIA image we created our district division's map and we validated the results with the municipality officers who worked in the 2008's census with the help of their printed map.

Figure 30: the city of Laghouat districts division's map, Source: URBATIA Laghouat.

The result of our digitizing work is processed with geo-referencing tools of MapInfo and represented after validation with the real view of the city of Laghouat, and then mapped with the appropriate scale and divided to populated and unpopulated sectors as described by the municipality officers.

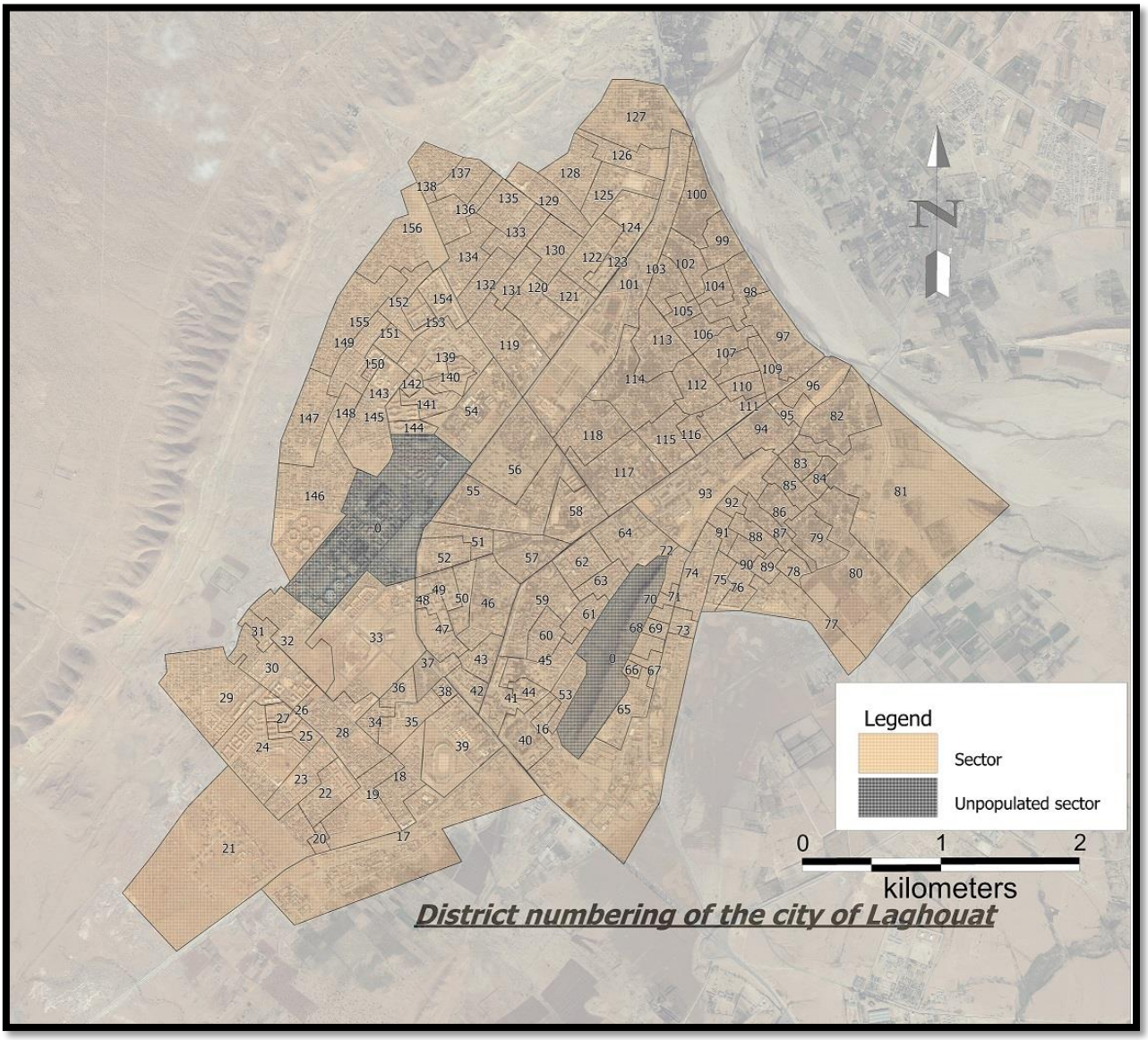


Figure 31: The resulting map of Laghouat city's districts division after validation

The numbering of districts or sectors starts from 16 and ends at 156. The first fifteen districts were dedicated to the peripheral regions of the city of Laghouat, including for example the region of Bordj Essenoussi which is actually a natural expansion of the city of Laghouat, but unfortunately these fifteen districts went missing.

Districts' division analysis of primary schools

In order to create a simple comparison between district division and grid division analyses, we created a map of the primary schools' class rooms' distribution over the city represented by the previous districts, and therefore a better presentation of primary schools concentration in the city of Laghouat, results are illustrated in the following map.

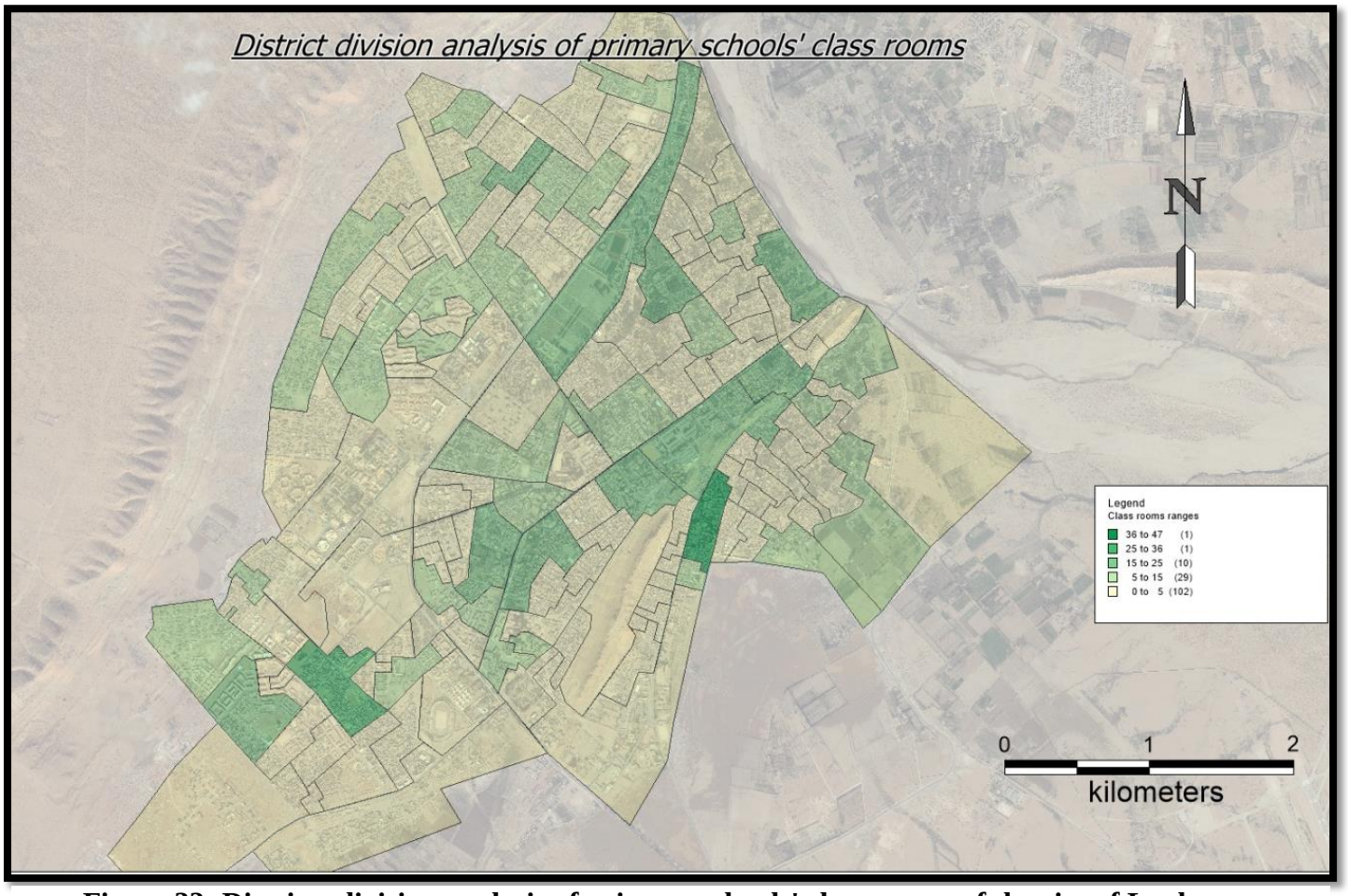


Figure 32: Districts division analysis of primary schools' class rooms of the city of Laghouat.

This map ranges are calculated according to the criteria mentioned earlier in this chapter, and class rooms number's ranges look reasonably divided, and we can notice easily that there's only two districts with a relatively high concentration of class rooms district 74 (36 to 47 classes) and district 28 (25 to 36 classes), where there are 10 districts that vary from 15 to 25 class rooms (districts number: 24, 46,59, 64, 93, 94, 97, 101, 113 and 133) and 29 districts with 5 to 15 classes. All that of a total of 141 populated districts; but still the map is ambiguous and needs more clarification because the shown results doesn't tell whether these information are satisfying or not to the number of habitants of these sectors. Now, it's important to think of a model of analysis that gathers all those data and help us get the useful data for a better understanding of the primary schools situation in the city of Laghouat.

Districts' division analysis of primary schools per population

The previous map gave us an idea about primary schools distribution in the city, even though their location alone doesn't draw the whole picture for us, as it doesn't compare the resulted map with the actual need of the city, for example comparing that to the population

distribution on every district, and then there's the problem of missing data that concern the districts of Bordj Essenoussi, and that's why we considered the whole area as one district that gathers the population of Bordj Essenoussi, therefore the districts' division map of the city will look like follows:

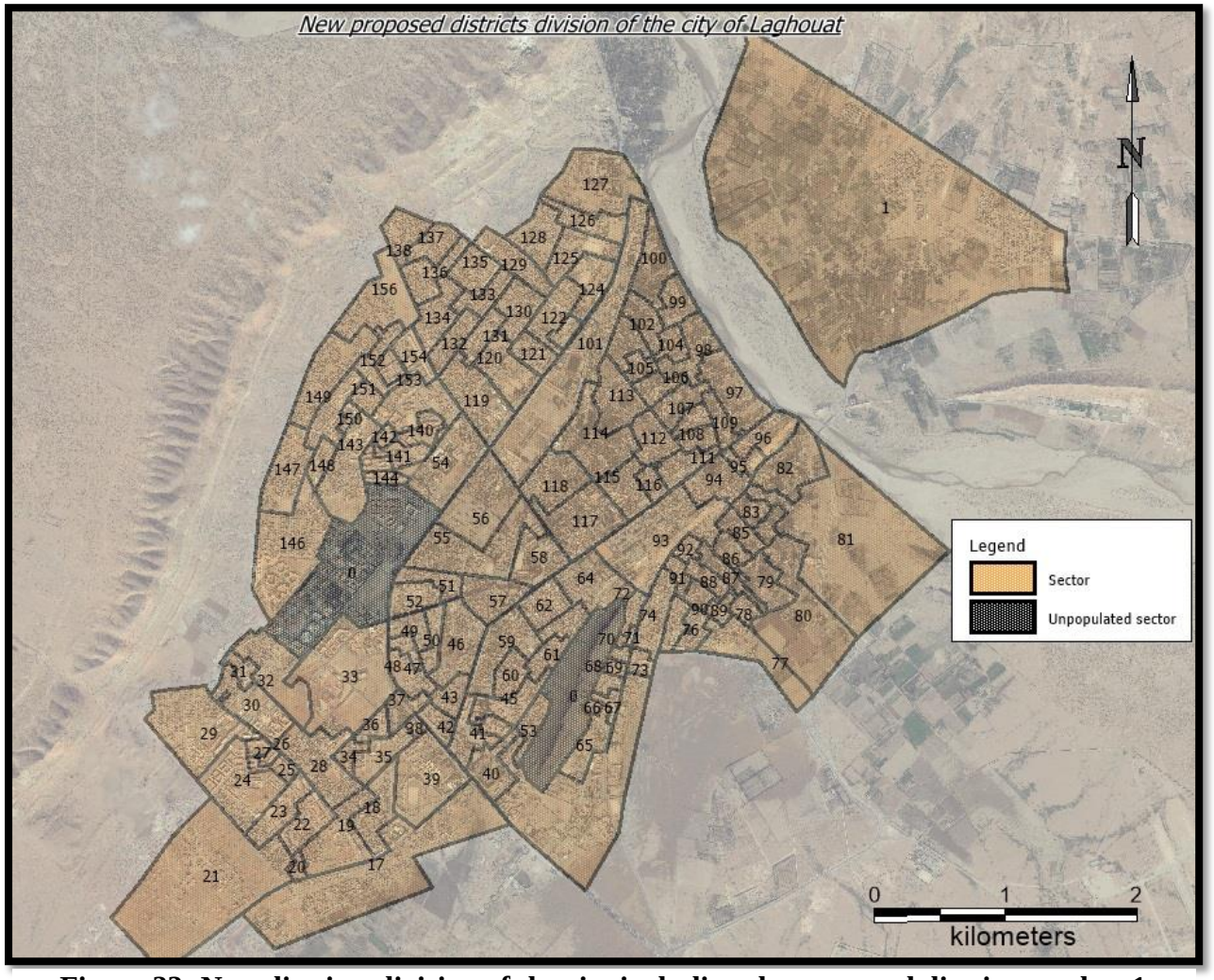


Figure 33: New districts division of the city including the proposed district number 1

Now, and according to the new division of the city, we will create the map of population distributed on their districts and we will accumulate the different districts populations of Bordj Essenoussi to estimate the whole population of what we called district number 1.

The following map represents the number of habitants of every district of the city's urban fabric without any analysis added.

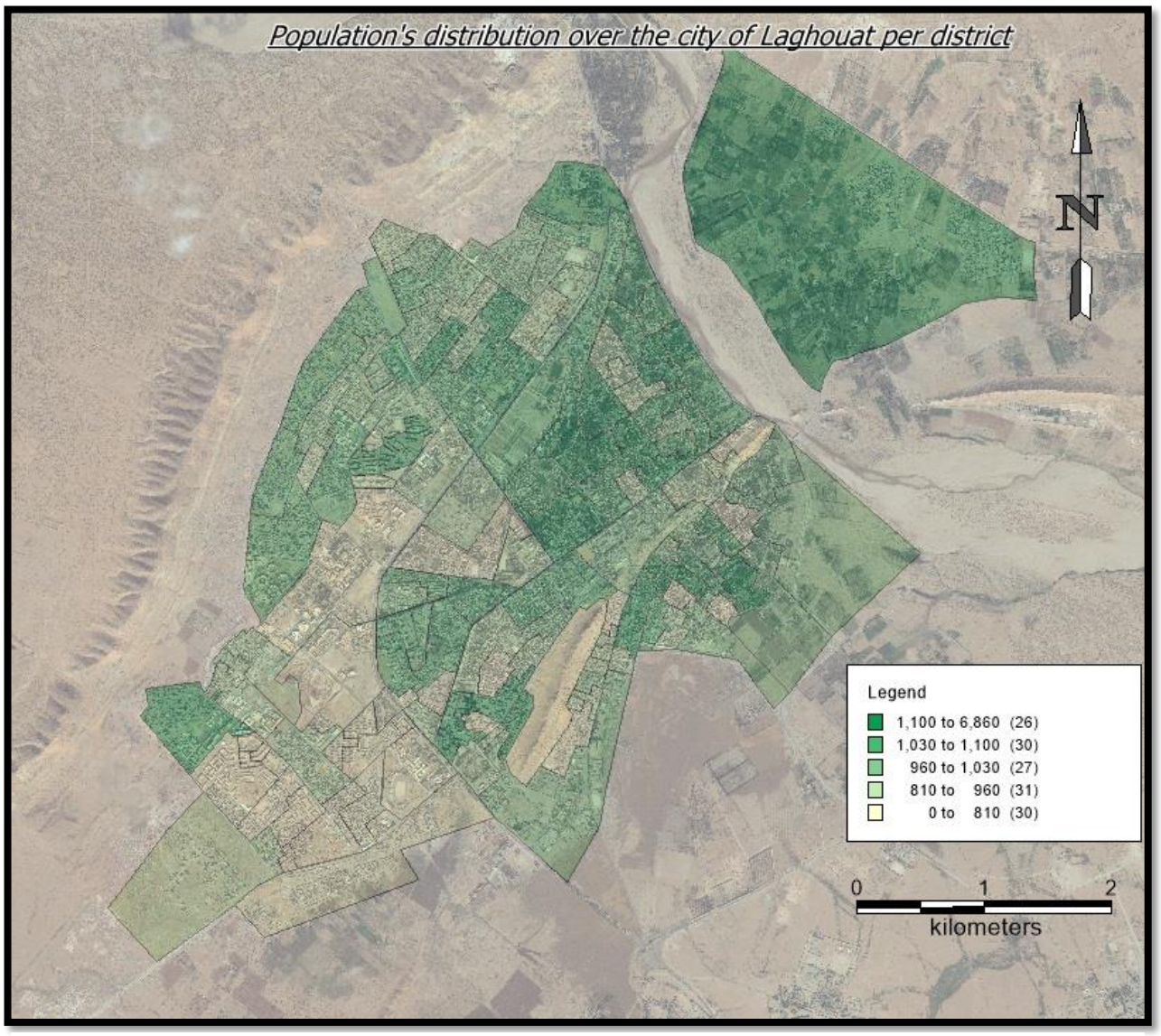


Figure 34: Number of habitants per district and their distribution in the city of Laghouat

What we mention here is that the legend's ranges are almost divided to equal count of districts but we can see that the majority of districts (88 districts) are of short ranges: 810 to 960, 960 to 1030 and 1030 to 1100 habitants, where the other districts are divided to long ranges: 0 to 810 and 1100 to 6860 habitants; and that's due to two things: 1. The district number 1 counts 6851 habitants as it gathers in reality seven districts and 2. The census method was meant to create districts of around 1000 habitants. We can also see that the concentration of population is mainly in the older part of the city or what is considered to be the center of the city. And finally the map as it is now can't tell us much unless we talk about its relationship with number of primary schools or more precisely the class rooms.

In the next map we will compare the class rooms' number to the population of every district and see if the available facilities are enough to the targeted population or not, we will also add the primary schools location on the map in order to understand their impact.

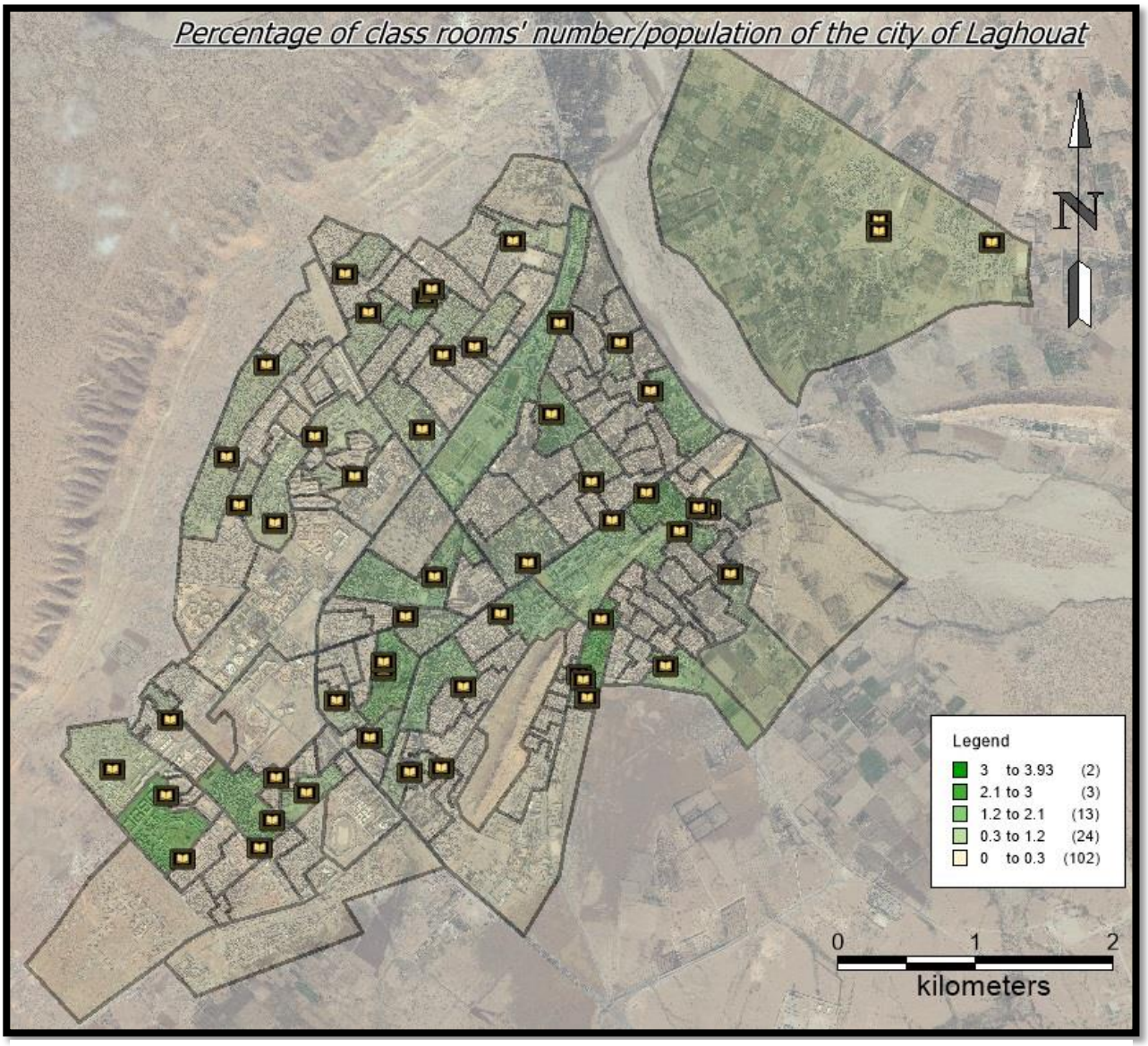


Figure 35: Primary schools' class rooms per population percentage (%) in every district

The above map shows the concentration of primary schools' class rooms divided by the population number in every district, and we can observe the ratio of class rooms/population doesn't appear proportionally with population concentration as shown in the previous map as it appears only where there is at least one primary school in the district and that kind of eliminate the primary school's location impact on the adjacent neighborhood. We can also see that the concentrated districts are not much: 5 districts of high concentration that varies from 2.1 to 3.93%, and 37 districts of moderate concentration that varies from 0.3 to 2.1%; and that's a low value comparing to the total of 144 districts of the city of Laghouat.

These results created the urge of thinking about another model of phenomenon presentation and a different method of analysis; the following dissertation is about the grid analysis method and its results.

3.3.2.2 Grid analysis method

In this section we're going to study the primary schools distribution over the city of Laghouat as well as the reliability of each school, expressed by its number of class rooms and eventually their concentration in each cell of the grid. The grid analysis method is based on the attribute data that can be represented by each cell not only by presence or absence of data in that cell but most importantly by the amount of the attribute data and its concentration in a cell that can vary itself in term of dimensions and visual appearance. The dimension's choice depends mainly to the study's goals and objectives, and for that matter, most of the GIS oriented software tools are flexible and doesn't require much effort in creating the grid, the real trick is in assigning the pertinent data to the correct cells, and in case of high number of cells it will take some effort and time if the attribute data has to be assigned manually, therefore it's preferable to use some automatic functionalities of the software like the 'Update column' functionality in the case of MapInfo, which is the function of adding information to a certain table from another one by joining between them with a common column. In another hand the cell dimension choice is also limited by the mapping visual presentation, as we can't use too small or too big dimensions for that matter.

. 300 meters cell choice

The following map represents the result of Grid analysis method's application on the city primary schools distribution and more specifically the schools' number of class rooms as it's more representative, we've chosen as a first attempt to analyze it using a 300 meters large cells.

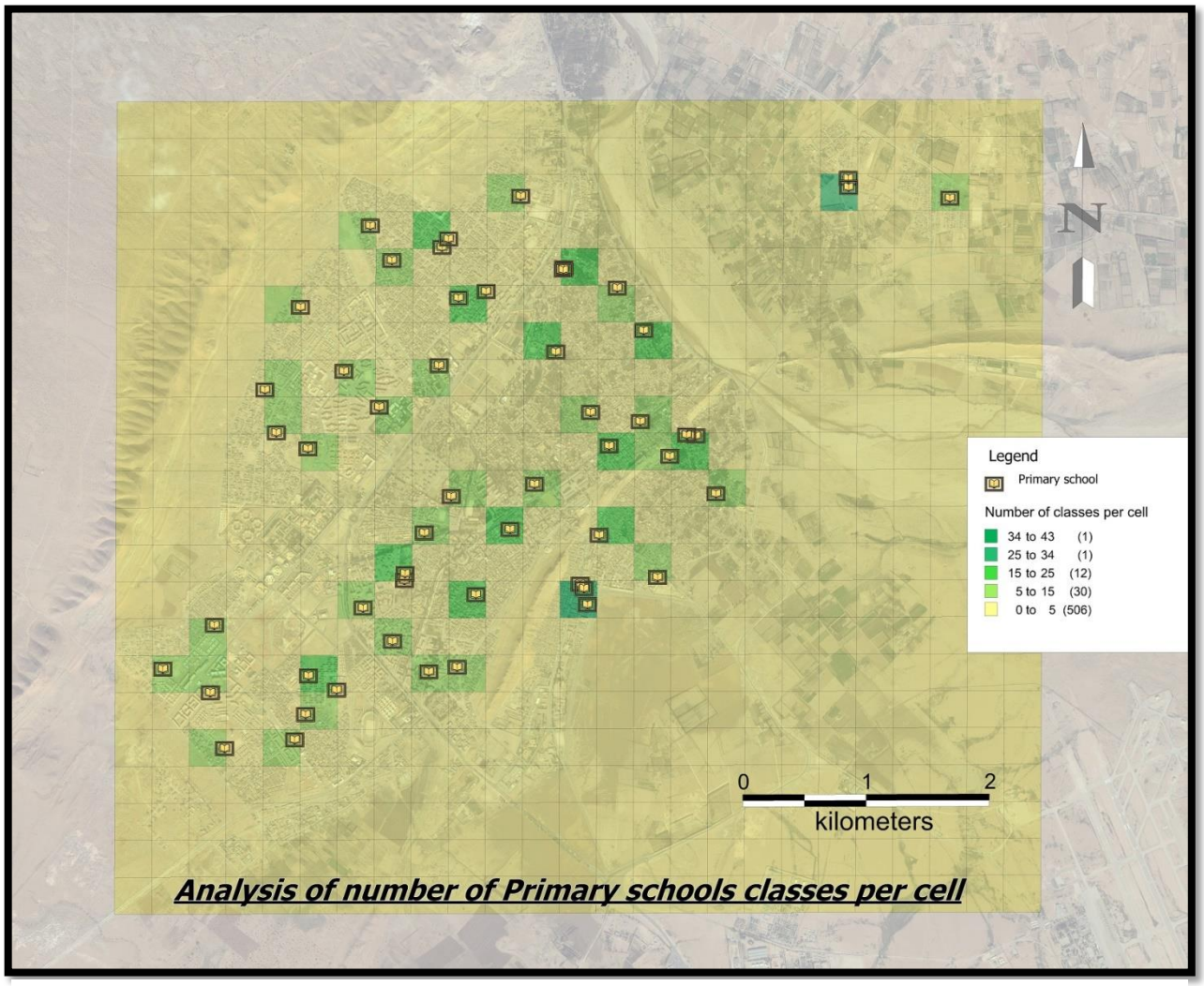


Figure 36: Primary schools of Laghouat analysis using grid cells of 300 m of dimension.

The map represent the analysis of primary schools distribution over the city of Laghouat as well as their concentration and their service's impact expressed by the number of their class rooms using a 300 m grid cells, where we can see a number of 30 cells containing 5 to 15 class rooms. We notice also another twelve cells that contain from 15 to 25 class rooms, where only two cells represent a high number of classes, one with 25 to 34 class rooms and the other with 34 to 43. Using this size of cells and at first glance the city doesn't appear to be well covered, but the location of the primary schools even without them being apparent is well exposed using only the grid thematic analysis.

. 500 meters cell choice

The same analysis we conducted previously will happen again about the same subject: class rooms' number of primary schools, the only difference this time is with a different cell dimension of 500 meters.

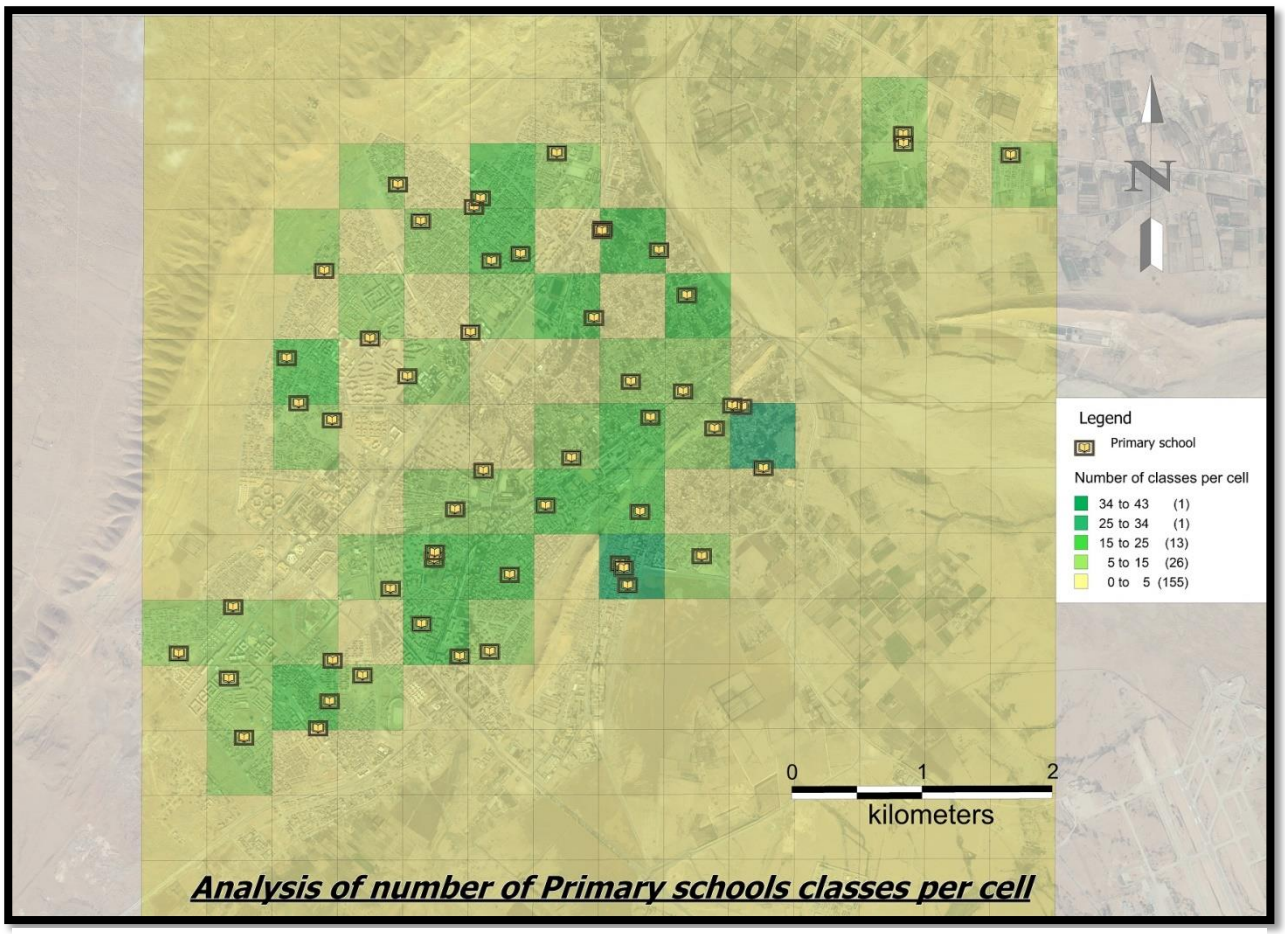


Figure 37: Primary schools of Laghouat analysis using grid cells of 500 m of dimension.

In this map, the same analysis method conducted previously, with even the same class numbers ranges presentation, but with larger cells. The results are: most concentrated cells are still two cells but the second concentrated cell (with 25 to 34 classes) changed location and moved closer to the most concentrated cell (34 to 43 classes). The city now appears more covered with primary schools with a few empty cells over the urban fabric. The number of representative cells didn't decrease highly even though we used a relevant higher dimension.

. 1000 meters cell choice

In a third time, we repeat the same analysis method of grid analysis, using the same subject: class rooms' number of primary schools and once again we use a higher size cells and we use a grid of 1000 meters cells, the following figure shows our work results.

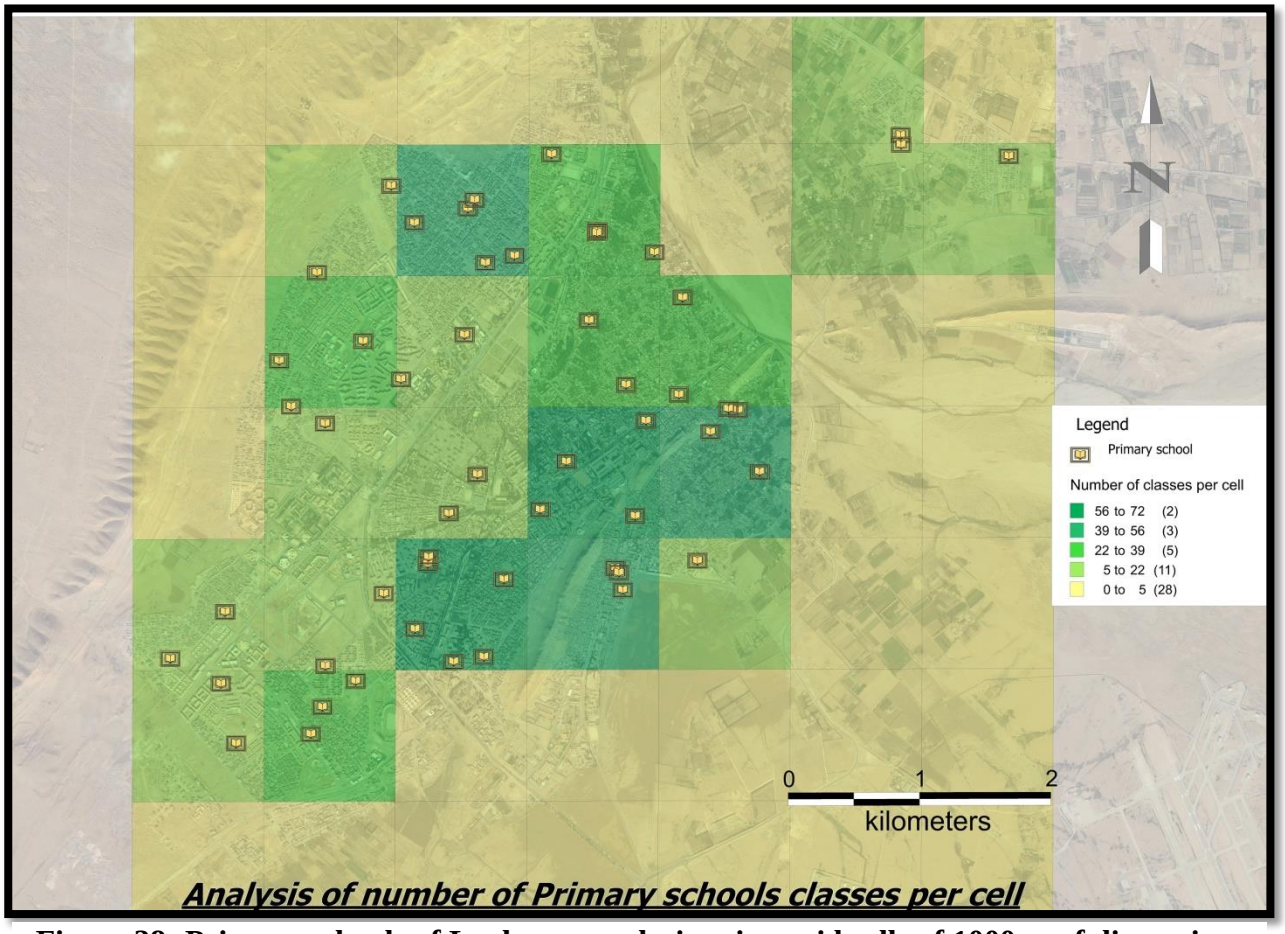


Figure 38: Primary schools of Laghouat analysis using grid cells of 1000 m of dimension.

As it was expected the difference between this map and the previous two maps is much clearer. The class rooms number ranges varied noticeably to higher numbers ranges, the number of concentrated cells increased to 2 cells of 56 to 72 class rooms, and to 3 cells of 39 to 56 class rooms, for the two other ranges, 22 to 39 class rooms and 5 to 22 class rooms, they cover 5 cells and 11 cells respectively. The concentrated cells looks more reasonable in their distribution and the city general image looks much more covered that it almost covered the entirety of the city.

3.4. Attractiveness assessment

The city attractiveness assessment is a delicate subject to treat, as it doesn't only depend on the city potentialities but more importantly, it's related to the population behavior with its both types: the city population and immigrant population, and that lead us to propose for discussion two aspects of attractiveness, local attractiveness and general attractiveness. Local attractiveness, as in the neighborhoods attractiveness of residents due to the quality of everyday services, to available close facilities and to the comfort of a certain area inhabitancy. Due to this study's subject and the available data we will be concentrating on the impact of 3 types of facilities existence: schools and specifically the primary schools as the need is more persistent; mosques as a spiritual source of comfort and peace and an important aspect of Laghouat residents cult and conservative life; and finally health facilities as a vital element of attractiveness and important part of public facilities. And general attractiveness that is expressed by investments' attractiveness, industrial potential, manpower or unemployment rates, tourism factors, etc.

3.4.1 Local attractiveness:

The assessment study of local attractiveness will be performed using the visual and attribute data of the previously mentioned directions and therefore the resulted analysis will be based upon their three attractiveness factors:

. Education services factor represented by primary schools existence and distribution.

. Health services factor represented by the existence of any type of health facilities' types and their distribution.

. Religious affairs factor that is represented by mosques' -known as Masjids- existence across the city.

The following map shows the result of our assessment using the grid analysis method with adoption of 500 meters dimension as it's not too big to cover the whole city, nor too small to narrow our research.

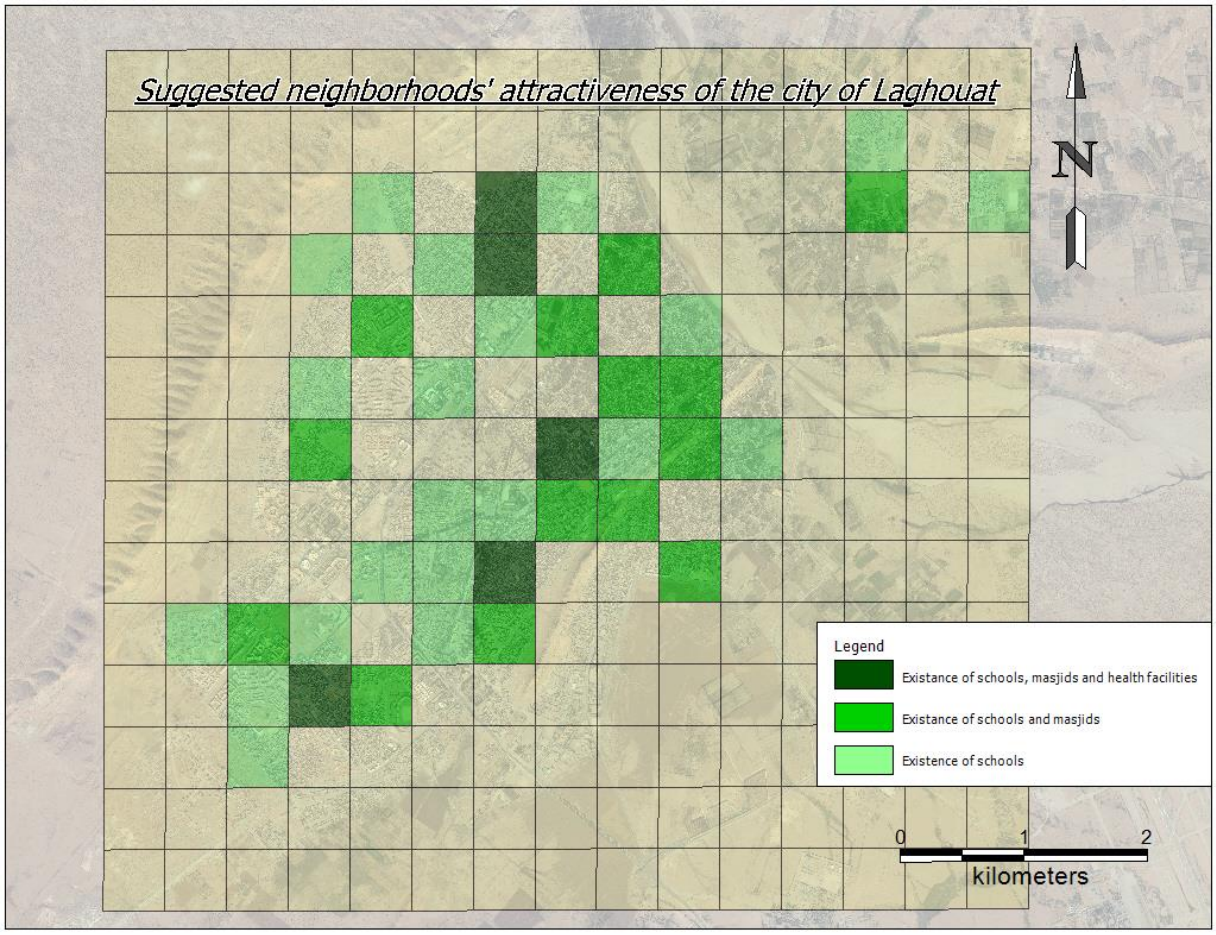


Figure 39: The Grid analysis of the city of Laghouat local attractiveness.

This map shows the attractiveness concentration of the city of Laghouat neighborhoods, illustrated according to the existence of public facilities object of study. Starting with primary schools as the most important type of facility due to the targeted population (kids under 11 years old generally), and that requires necessary implantation of at least one primary school in every neighborhood; besides the large number of primary schools in the city of Laghouat (in fact, the largest number of all public facilities) accord us to get a good analysis surface, and that's why we started our analysis about this sector. Secondly, and due to their good number, the mosques of the city will be our second element of the city local attractiveness, their importance in the daily life of Laghouat population appears for example in the properties' prices, they increase remarkably when they're close to a mosque; the comfort and the inner peace they grant people make them an essential type of facilities to the city and therefore a good cause of attractiveness. Finally, the health facilities come logically as an attractive type of facilities, their vital role imposes their existence, and even though not every neighborhood needs such type of facility, their analysis is essential in the context of our study. The map shows as expected a good number of 40 cells containing primary schools, some of them contain more than one school, almost the half of them, 19 cells contain both at least one primary school and one mosque, and then we find the highly attractive neighborhoods where there are all of three facility types: at least one facility of each in 5 cells as shown in the map above.

3.4.2 General attractiveness:

The discussion about attractiveness generally require a certain amount and quality of data that we can represent and expose to a good analysis but unfortunately the collected data didn't give us much about the city's general attractiveness that we can represent geographically and eventually analyze, therefore; our work will be limited to this year's 'DPSB' data of the state of Laghouat, [35].

. Employment factor: the state of Laghouat has witnessed an impressive decreasing rate of unemployment this last 15 years; from 36% in 1999 to 8.99% in 2014, and the general number of job requests during this year in the Municipality of Laghouat was 10950 requests, only 1846 of them affected to a job which 258 are permanent and 1588 are temporary. That implies the good availability of manpower, it's also important to mention the high number of microenterprises created in Laghouat municipality estimated of 211 and providing 394 job positions.

. Industry factor: the data related to this sector is poorly represented and the following results doesn't really describe the situation of Laghouat city, however, there are about 8 different companies activating in the limestone quarry of "Kef Dakhla" of Laghouat and another one in a clay quarry in "Mrigha" Laghouat. In the same sector, the connection with domestic gas is about 90% and to electricity is even more than that, about 98%. The activity zone of the city spreads over an area of 460600 m² that is fully assigned.

. Higher education factor: the city of Laghouat is equipped with a university since September 2001, and it governs seven faculties and an institute: faculty of technology, faculty of sciences, faculty of rights and political sciences, faculty of economics, business and management sciences, faculty of letter and language sciences, faculty of human and social sciences, faculty of medicine and the institute of sciences and technics of physical and sports activities, it gathers currently 21 446 students in graduation and 934 students in post-graduation. The university comprises the principal with an area of 13 Ha, and the ex-ITE with 05 Ha of surface, and another 13 Ha to the new pole.

. Tourism factor: the city of Laghouat is provided with many hotels that range in their capacity from 39 beds and 15 rooms to 90 beds and 36 rooms and their accommodation capacity is 296 beds; the investments in the hostelry field are currently up to 6 hotels and a tourist village. The tourist sites of the city has an important role in the city tourism attractiveness as the city of Laghouat is the capital city of the state and generally it must has its attractiveness share of the sites' visits. We can mention among those sites: the Ksours, the crater of Maadna, Tadjmout water dam, the oasis, Kourdna palace, Tidjania brotherhood, Saharan atlas, etc. and the cultural heritage presented in rock carvings in EL Ghicha, Sebgag and Tadjrouna, the hills (Fromentin rock), protohistoric ksours, celebrations, and the diesel power plant. About handworks and craft works, the city provide about 1841 job positions between production, traditional and services.

3.5 Conclusion:

The city observatory of Laghouat has been realized following the steps earlier mentioned in the second chapter and it was conducted according to the many constraints and obstacles of data acquirement, their rarity or lack and afterwards their treatment and completion. The finished observatory system allowed creating some location maps of the chosen directions' public facilities and their different types of thematic analyses; we tried to evaluate the reliability of some facilities and the city attractiveness with its local and general compartments. The resulted work will be the subject of a critic and discussion in the following dissertation.

Chapter 4: Critics and discussion of results

4.1 Introduction

This chapter has as a goal to exploit the results of previous chapters, to evaluate how far we went in this research in comparison with observatory realization steps mentioned in second chapter, from data collection to their processing and methods' choice. After that we will talk about the third chapter results, to comment about different kinds of produced maps, to compare between districts division analysis method and grid analysis method, to discuss the analyses results and deduce some problems if there's any and suggest their solutions as well, to assess the city attractiveness and criticize it with its both parts: Local and general as we proposed, all that according to the Algerian norms and standards of town planning and particularly the case of public facilities establishment.

4.2 Critic of followed procedure

The data collection in any GIS project is an essential and an important part of it if not THE most important part, and generally in our research we found that the quality of data is more important than its quantity and that appeared to us when we faced different problems of lack of data or sometimes its inexistence. We also found some data are irrelevant or corrupted, and in case we wanted to purchase we even couldn't afford the high priced data. In addition to that, our GIS software limited us to some point even though it was highly capable of performing some interesting analyses using its powerful functionalities, and all that led us to make certain choices.

4.2.1 Data

We can summarize the problems we faced during our data collecting and processing in the following notes

4.2.1.1 Imagery data:

The choice we took about our satellite image is influenced by the problems we encountered when we decided to process a raw satellite image that we can download for free, as this step requires a deep knowledge about remote sensing operations and a good knowledge of the software IDRISI, besides their quality wasn't good enough for our study, and that led us to think about buying a satellite image and that also was a rejected solution as their prices can get from at least 10$ for 1 Km² and up to 60 Km² and they require us to buy at least 25 Km² and up to 100 Km² depending on the quality of the image, on its resolution and its accuracy; our hands were tied and we had to download a good resolution image using 'Universal Map Downloader' but only for educational purposes. Later on and with concerned direction, their specialized officers were of a great help us, they helped a lot with what they knew and even more by telling where to go next for a further help about the vector visual data especially the symbol or point kind of data.

4.2.1.2 Attribute data:

The attribute data as we've seen can generally only be found in the concerned direction and that was the case with almost all of our data, however there was always

something missing, for example there was some interesting detailed data at the religious affairs' direction but only about some mosques and that wasn't representative and therefore not valid for a good analyses. In another case with education direction, we could get the class numbers of all primary schools, but not the middle schools and high schools. In the same context there was no connected data to health facilities like number of patients, kind of diseases and such important and essential statistics; and that really narrowed our research area. The data processing wasn't hard itself as in tables' structures choice and what to put and what to remove but injecting the data and thinking of automatic methods to update tables later and create the correct queries for that matter took us a while to understand it and master it. We could later create easily some automatic data that helped us with location validation phase or by further analyses that were essential to the study.

4.2.2 Produced location's maps

Our realized maps can be divided mainly to two types: Facilities' location maps and analyses' maps, the latter will be discussed in the following part; even though their general theme is the same with location's maps. Afterwards we will talk about the regulatory technical document of public facilities used by the public facilities direction, [36] and its effectiveness and usability as a regulatory document to the city needs of public facilities.

Map's elements

In this maps' part we will talk about maps' elements, and that is the format and art of drawing a map, as it's essential to add a title, north arrow, scale bar and a legend to any map as shown in the following figure; and those are not only elements of format but they're important to every map and without them our maps will be ambiguous and incomprehensible.

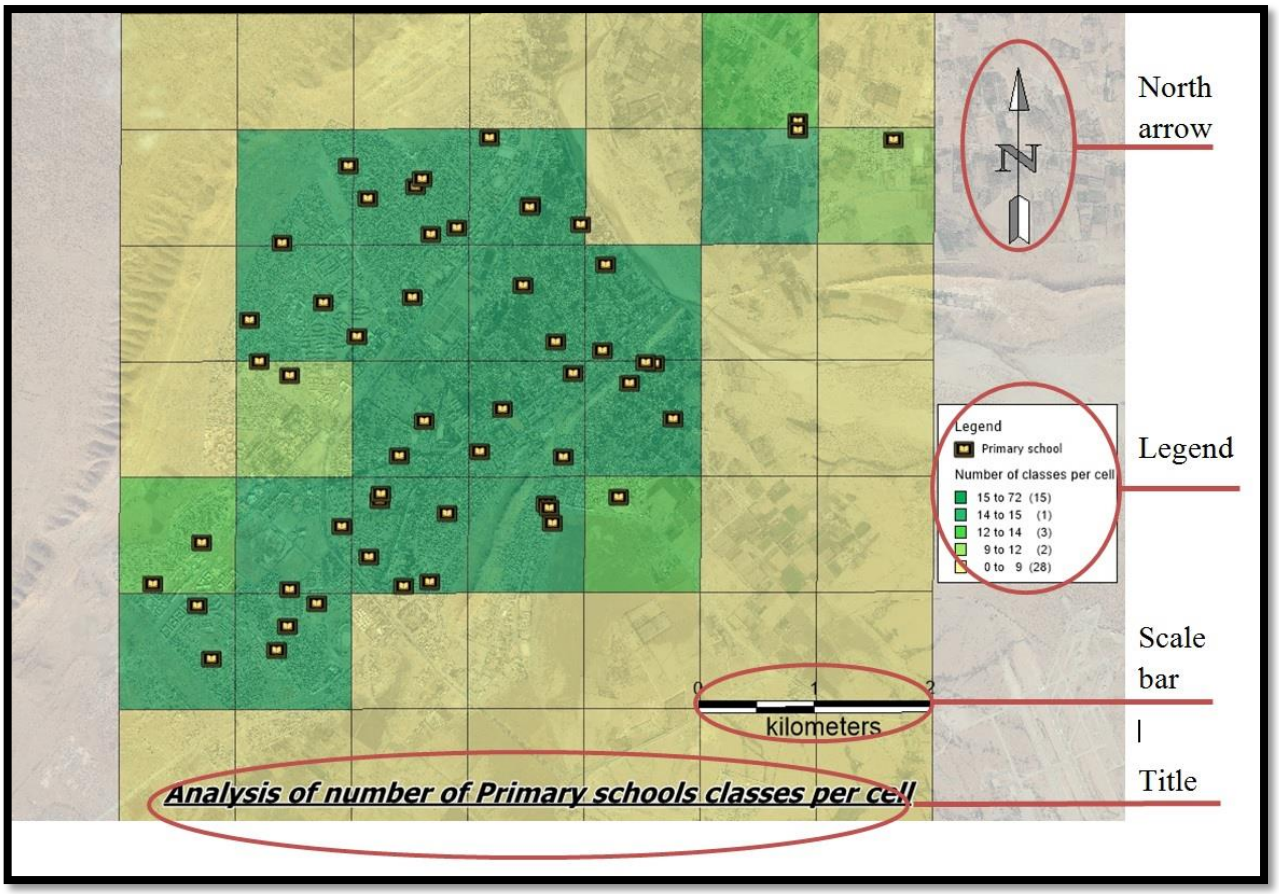


Figure 40: The elements of a map

In the case of our location's maps, we added a referencing layer to geo-locate our facilities on the city visually by inspiring from the book of "the image of the city", [34] where he mentioned the elements of the city which among them, paths like: roads, streets, etc.; edges like: rivers, mountains, etc. and nodes: like strategy points that an observer can enter within them and we proposed our facilities as nodes.

4.2.3 Regulatory documents and public facilities' location

Even though the public facilities regulatory document "Grille théorique des équipements" is an official document and is currently used by the concerned authorities, there are a lot of problems about it, for example and for the mosques facilities, it considers a planning of a mosque for 2 to 30000 habitants which is way beyond reality, as for the city of Laghouat there are 40 mosques and the number is increasing.

About the health sector and for the same purpose; in the case of a "neighborhood" as defined by the document, it gathers 33000 habitants, and it plans for it a 'Maternity center' or a mother and child health facility of 60 beds for each neighborhood, which is extremely over planned.

And for the geo-location distribution of public facilities in the city, the document identifies five types of zoning: a basic unit; a vicinity unit, a group of vicinity units, a

neighborhood, and a group of neighborhoods or a city, and then it distinguish them with the number of habitants, and the bigger the city is, the bigger that number gets. And then the document allocates certain facilities to each type of zoning. The problem is that zoning doesn't exist in reality and the only way of geo-allocation is by mentioning "in the center of" each zoning type.

4.2.4 Analyses' Methods

The use of the district analysis method came as a result of the fact that it's the official division method of the city, even though it was created just as an organizational tool to ease the population census of the year 2008, it helped us in estimating the population concentration over the city and the distribution quality of public facilities as well. The problem is there were some missing information that had to be issued from the analysis and that's why we had to think of an alternative method and use the grid analysis method and benefit from its flexibility; therefore, the use of each method came as a response to our needs depending on the qualities of every analysis method and for a better comparison, we will explain further in the next part of this chapter.

4.3 Comparison of used analyses' methods

In the beginning we should talk about the first thing we noticed about district's analysis which is the inability to change dimensions or size of districts when it's need for a better localization of phenomenon or the source of a certain effect, and that's something we could resolve using a smaller grid dimension (300 m) as shown in the following figure:

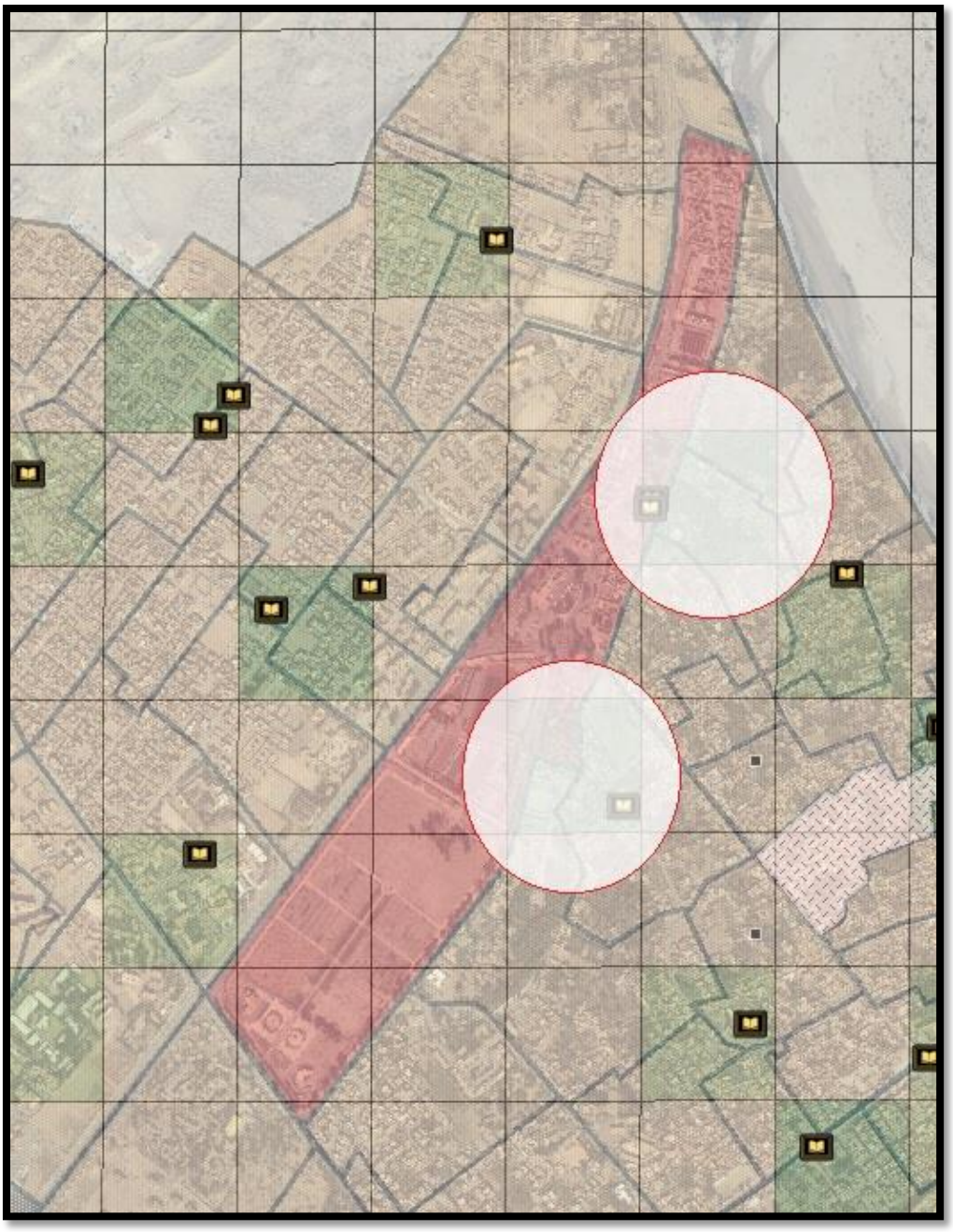


Figure 41: The effect of refining grid cells for a better accuracy of analysis

The district number 101 represented in red is actually affected directly by the upper cell in white circle, and partially by the lower cell in white circle, and both of cells cover only a part of the district that is about 600.000 m² of area and that's a large surface that can't be actually covered effectively with two primary schools. However, in reality the district is not fully inhabited, and therefore the smaller dimension of grid cells can do the limitation of primary schools location better than districts that are not homogenous in their size; and that's only one case that is repeatedly existing in the city.

The inability of resizing the districts in order to refine our analysis is solved by the flexibility of grid analysis method that allows us to create a different grid's dimension every time it's required. For example and even though the 300m dimension of cells allows a good refined analysis, it doesn't actually give us a better idea about primary schools impact as the 1000m dimension does; and thus we can create easily a 1000m grid cells and move the whole grid to whatever direction we want for any required analysis purposes, and that's a big plus to the grid analysis method.

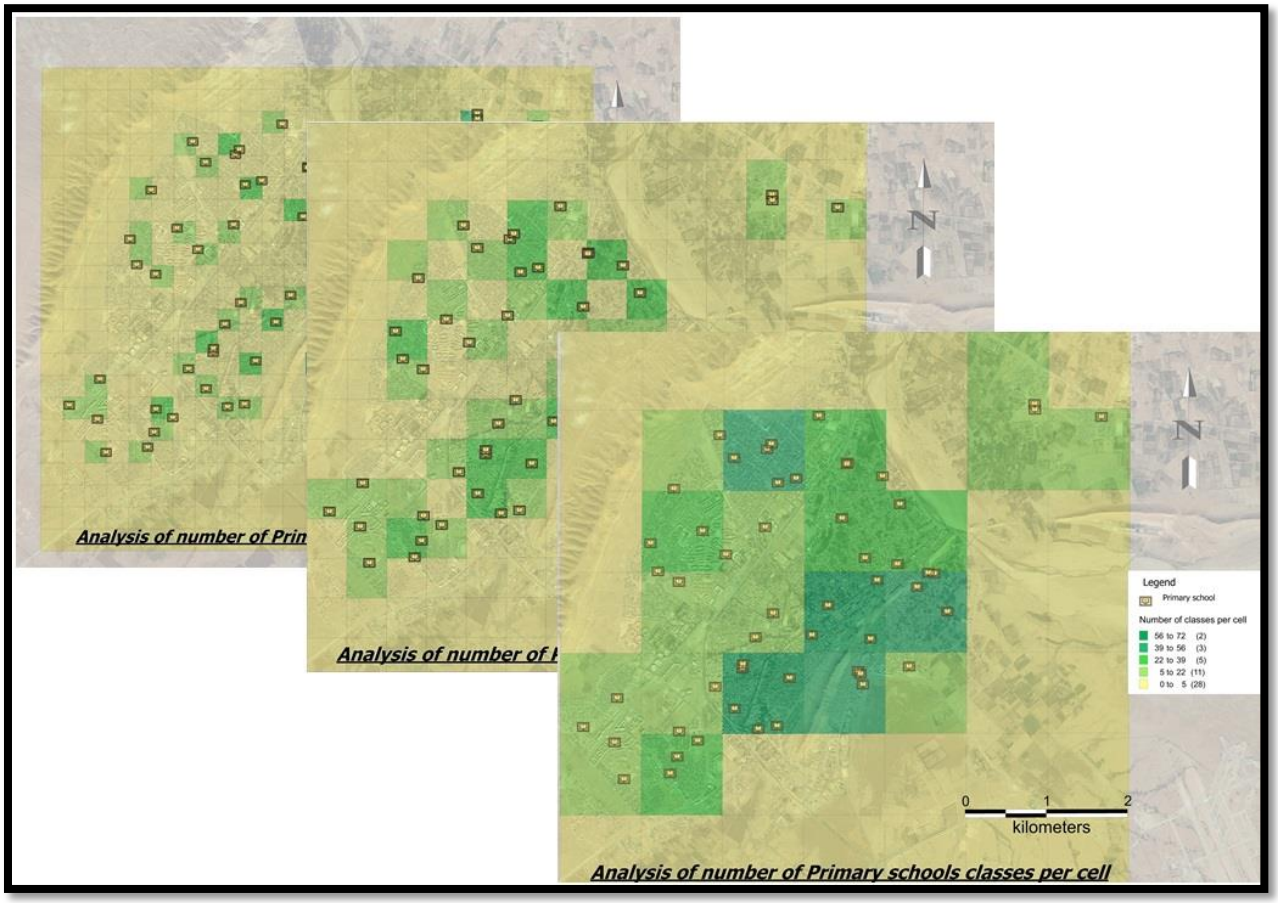


Figure 42: Different dimensions of grid cells signify the flexibility of grid analysis method.

For the purpose of estimating the primary schools existence's impact on the city, we created earlier in chapter 2 a map of districts' division analysis about class rooms per population; but the resulted map wasn't very expressive. We needed then to create a map of grid analysis method of 1000m cells to estimate the general impact of primary schools on the city and we mentioned there was a good distribution of primary schools in the old city of Laghouat or what we may call the center of Laghouat and the furthest we went to the southwest of the city and specifically around the state's road N 230; and still the districts that needs more attention regarding the implantation of new primary schools needed a further analysis. For that matter we have to do a double analysis of grid analysis method and districts division analysis method in order to detect the less beneficial districts of primary schools services. The following map reveals those districts.

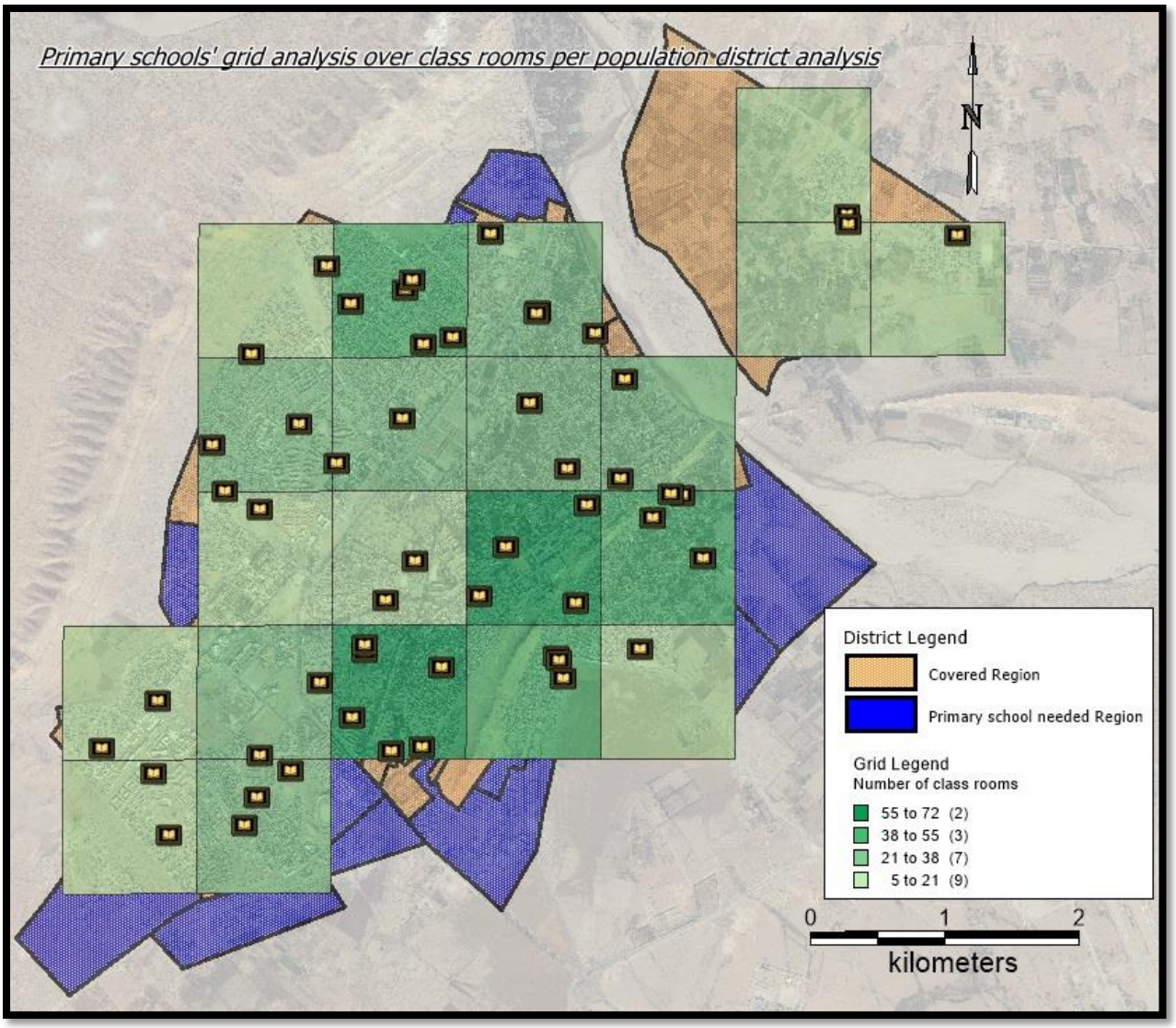


Figure 43: Map of double analysis to reveal less profitable districts of primary schools.

The districts represented in blue are where we should set up some new primary schools depending on the population of that district, however not all of the blue districts needs so. As for the districts in the east and the north are not very populated districts and thus they won't be needing to new schools in addition to being close to primary schools in the limits of adjacent cells. However, districts number (146 to the west) and (16, 17, 21, 39, 65 and 67 to the south and southeast) looks as more in need to primary schools especially with their opportunity to grow better and faster and that is most probably in the region known as Al Wiam.

4.4 Attractiveness of the city

The city attractiveness cannot be discussed without respecting the unicity and particularity of the city, and that's why we can see in many cases different cities or states has their own assessment factors. For example: the Medina Observatory in the Kingdom of Saudi Arabia, has the need to use the Hajj and Umrah factors: rate of visitors, rates of Hajj hotels workers around the year, hajj visitors increase rate, etc. [22], and that can only be seen in the KSA and nowhere else. In another study and in order to benchmark the attractiveness of 50 cities in Canada, they faced the problem of no available consistent source of data on the proportion of green space within cities for all 50 census subdivisions, they even found out the terms green space, open space, and recreational space are often used interchangeably from a city to another and that was a big problem, [21]. In 2012, a paper was published about neighborhoods attractiveness in New York City and its relationship with safety hazards and physical activity and therefore a healthy weight of people, [37].

In the case of the city of Laghouat, we preferred to talk about local attractiveness and its relation with primary schools, health facilities, and mosques; without regard to their quality of services, their availability or the impact of each facility and that was directly related to the absence of information. In that context, we would like to mention the lack of any data that concerns the museum of the city that is considered as an attractive facility. Another facility is the botanical garden, it doesn't possess any kind of data recording system and is considered as the only large green space within the city; and therefore u won't know what facilities are attracting more people and what should we promote more or less for that matter. Furthermore, there was no actual data that we could get from anywhere about green spaces in the city and that was really limiting in term of local attractiveness assessment.

As a second source of attractiveness to the city, we treated in the general attractiveness only four sectors: employment factor and the manpower availability of the city; and then the industry factor and the main fields of activity. We also talked about higher education factor as an important factor of attractiveness to both local and immigrant populations. Finally, the tourism factor and the way the city as the capital city of the state can benefit from the touristic potentials of the whole state of Laghouat; and once again the lack of useful data about many other sectors prohibited a better discussion of the city attractiveness.

4.5 First recommendations as the outcome of the realized observatory

The first recommendation we can extract from the use of our observatory concern the different aspects of this system, its implementation in a hand and its results in the other hand and that can be summarized as follows:

. The required data better be acquired from its concerned directions or administrations.

. The quality of data depends on its state whether it's updated or not, as well as its availability, and in case of official work it's preferable to purchase some paid data (imagery data for example).

. It is important to feed the observatory with data in a continuous way in order to enrich it with sources and therefore better results.

. The location maps are an important part of the observatory products as a geographic system and therefore they need to be produced respecting the mapping rules.

. The use of both analysis methods: districts' division analysis method and grid analysis method is essential due to the qualities of both of them as for the Districts division method is:

- The official and only available division method known by the authorities

- Richer with information (population for example);

And for the grid analysis method is known and widely used for:

- Its flexibility in terms of cell dimensions variations or what we call refinement, and its ability to be moved or resized every time that's needed.

- The homogeneous used cells that ensure a better and equal division of our space.

- The automatic data that can be created using the GIS based software.

. For a better evaluation of the city's benefit of the public facilities' subject of study it's better to use larger cells in analysis for a good assessment of their impact.

. the use of the regulatory official document of public facilities management 'grille theorique des équipement' is not necessarily correct, as it's not updated since a long time ago in a hand, and in the other hand the document doesn't give accurate instructions to the user for a better planning.

. The attractiveness' assessment of the city complains of so many problems including the following major issues:

-The city public facilities are not very good managed and therefore the city is not getting the best of them especially in term of statistics recording and performance estimation, for example, there are no visiting records or statistics about the botanic garden or the museum of the city.

-The city doesn't lack the quantity of public facilities in many cases, in fact it's a problem of location and distribution of facilities and that's why we found lack of facilities in some places and excess of them in other places.

-Green spaces are an essential part of the everyday life of civilized people, therefore their existence is essential and the city has to take more care about those areas in term of both seriously taken statistics and expansion of the entirety green space of the city.

-The city attractiveness is highly influenced by both of local and general attractiveness assessment like in neighborhoods attractiveness or in state's touristic, economic, cultural and industrial potentials and that requires a further attention about the whole state's sectors to detect the strengths and weaknesses and react accordingly.

4.6 Conclusion

This chapter came as a natural complement of the previous chapter in order to discuss the results of the implemented city observatory of Laghouat. We criticized the way we conducted our work and how it should've been done. We also discussed the produced maps and compared the used thematic analyses as we found it was necessary to use both of them in order to complete each other. We evaluated the city attractiveness with regard to the available data, and we recommended what we thought it would be best for the city development assessment and for future decision making process.

General conclusion

The main goal of the present work was to understand the concept of the city observatory as an important tool of the spatial decision making support system, and how it should be established and used later to extract from it the needed information for a better decision making and a good management of the city. We have chosen to study particularly the public facilities of the city of Laghouat and assess accordingly the attractiveness of the city.

These facilities has an important role in the city of Laghouat people's life, providing the essential services and responding to their day to day needs as well as creating opportunities for them and helping them live a comfortable life to a certain degree. The city is equipped with a variety of facilities networks in almost every sector of administrations or services (Education, health, culture, sports, public safety, water, electricity, sewer, etc.) and that's influenced by the fact of being the capital city of Laghouat in a hand and the important potentials it possesses in another hand. However, this study was narrowed later due to the large number of facilities to five large sectors that we judged are most important for the city of Laghouat and its people, and they are: Education sector, public health sector, religious affairs sector, culture sector and sports sector.

In order to fulfill the set up goals in this thesis, we had to geo-locate every facility of the aforementioned sectors and create geographic maps for each sector as the cartographic display is an important component in urban modelling, we did that while trying to create an easy visual identification of the facilities location in the city using the mapping necessary elements in order to: Understand the distribution of public facilities and their location in the city; to identify the city weaknesses and strengths in term of facilities availability as well as their services' quality impact on the city's population; and to detect and respond to the existing need for establishing new facilities in a hand and in another hand to serve the expected growth in both of population and urban fabric.

For that matter, and considering the many encountered obstacles especially data collection and process, we used two similar kinds of analyses but with different methods; one of them is the only division and official method of the city: the district division analysis method and the other is the grid analysis method. We tried to benefit from advantages of both methods and cover the disadvantages of each by using the other method. We also tried to compare the results of those analyses with the regulatory official document of public facilities but due to the long time without being updated, the comparison was pointless.

Even though usually the final decisions on the allocation of public facilities are often political, due to the fact that their location choice is the result of choices of the planners, politicians, bureaucrats, and the citizens. We tried to provide a model of solution to the encountered problems concerning the case of primary schools in the city as we have chosen this

type of facilities as our application's model of the analyses methods and that's because of their large number comparing to other sectors and to the available data that allowed such analyses.

Eventually, we had a set of analyses and comments concerning the public facilities state in the city of Laghouat and their role in affecting the attractiveness of the city in both of its suggested parts: local attractiveness and general attractiveness; these results are the concrete results of our conducted research that we would like to present as a scientific solution in their academic context to be the basis of a technical debate and eventual selection.

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