

CHAPTER ONE
INTRODUCTION

Chapter 1 : Introduction

1.1 Introduction

The modern digital technology is considered as the most important techniques used in the field of information technology, it has inspired a scientific revolution in the application of digital technologies strides in the area of database management and geographical location, which is the fact that characterizes the information pertaining to a particular area. In addition, more than 80% of the information circulating in the daily work is concerned with situation.

Therefore, we find successful spatial planning should be focused on new technologies and take advantages of them and the majority that constitute an effective tool to give the full picture of the site. The availability of this new technology, the opportunity to take the right decision for the distribution of services appropriately and thereby raise the achievement level of services to the population. Moreover, determining the efficiency of the spatial distribution to inform decision-makers of the importance of geographic information systems in achieving the actual need for the distribution of services and establishment.

Geographic Information System (GIS) programs are distinctive in building plans and models based on the criteria for evaluating the spatial distribution of services and selection of spatial locations of buildings and new schools that approved by reducing transportation costs and the distance. Moreover, the work of the transport system in the locality will become better if the service locations at distances closer than places services, this can be applicable to all institutions and areas. Therefore, a model can be formulated, and generalized for other services.

Representing possibilities for developing a model of distributing schools, study of the reality of distribution and efficiency in comparison with the standards of distribution models to get out maps and suggest appropriate alternative sites, using GIS software program and take advantage of the properties related to the analytical program.

The research aims to formulate a model for the distribution of schools using GIS and benefit from the analysis in the study of the efficiency of planning the spatial distribution of primary schools and to identify the most appropriate locations for the

distribution of these services, the adoption of standards and the distance of the population.

1.2 Research Problem

Since the establishment of umm Rawaba city, primary schools have been established without considering how these schools are distributed. Lack of map showing the distribution pattern of the schools in the study area has made it very difficult for people to see at a glance how these schools are spread. This has necessitated the need to have a map that will show the distribution pattern of primary schools in the city. Also , it is clear that, the use of statistical analysis to determine how and where these schools are located has not been utilized.

1.3 Research Questions

1. Why the spatial distribution of non-school attendance is does not coop with modern planning standards.
2. Why modern systems not used to formulate a models when distributing schools.
3. Why School distribution do not depend on distance and population density?
4. Why information about these schools are not adequate and accurate?.
5. How can the staff, the worker and beneficiary access these areas with regard to the transportation difficult?.

1.4 Research Objectives

This study looks for achieving a number of Objectives:

1. Develop a study according to scientific bases of planning and distribution of these institutions equally to meet the requirements of the development plan for the locality.
2. Develop a model for the distribution of schools by using modern systems (GIS).
3. Assist the decision- makers to plan the distribution of schools based on scientific studies.
4. Provide sufficient and accurate information about these schools for processing and configuring to afford a good service.

5. Facilitate access to these institutions according to standards developed by graphical criteria.

1.5 Area of study

The use of geographic information systems in the distribution of pre-university schools of education in Um Rawaba locality.

1.6 Research Methodology

1. Objective approach: which means describing the phenomena, variables and dimensions of geography and geographic distribution of schools with data on the subject of education and educational policy at the Ministry of Education, and study the size of the population who are within the age of pre-university education in the quantitative description context.
2. Spatial analytical approach: through the application of appropriate analytical functions provided by geographic information systems in order to identify the distribution of current schools and neighboring schools on distance and population basis to develop an alternative scenario.

1.7 Expected Results

The outcome of the study expected to develop a model for the distribution of schools according to scientific bases and planning using modern techniques and redistribute these schools according to the distance, population, and to facilitate accessibility process. In addition to the availability of accurate information and scientific aim of proper planning when establishing such schools in the future, solve the crisis of overcrowded schools in certain areas, which participate in stability, and reduce conflicts.

Chapter Summary

This chapter describe the basic hierarchy of research. So include general introduction about GIS and it's important for planning and distribution, also contain the problem statement, which represented lack of use a modern systems (GIS) to formulate a models when distributing schools. The unbalance in the distribution of schools. Besides, research objectives, which contain Develop a model for the distribution of schools by using modern systems (GIS). also research methodology which include descriptive approach and Spatial analytical approach, final expected result which contain Develop a model for the distribution of schools by using (GIS), solve the crisis of overcrowded schools in certain areas.

CHAPTER TWO
BACKGROUND AND LITERATURE
REVIEW

Chapter 2 : Background and literature review

2.1 Historical glance about Umm Rawaba city

Umm Rawaba city located in the State of North Kordofan in Sudan at an altitude of 450 m (1476) feet above sea level, away from the capital Khartoum about 103 kilometers (187). It is an important commercial center and ground linking western Sudan and southern Kordofan to Khartoum and Port Sudan.[1]

2.1.1 Umm Rawaba city location

Falling domestic Umm Rawaba between longitudes 31.13° and 32° East and latitudes 12.55° , 14.5° North. It is bordered to the South and local Cress Dilling local West local Elrahed, local Northwest Barra and Shikan, Tandalti East. With an area of about 24610 km².

2.1.2 The history of Umm Rawaba

Consider Umm Rawaba modern cities in Sudan where its origins date back to 1912 when was built the line for the railroad in Sudan in 1911, to connects Khartoum with the Elobeid City. It was Umm Rawaba before the construction of the railway was managing agricultural area located in the town of Altiara 90 miles to the West. The British saw the transfer of the administration of the town of Altiara to the city Umm Rawaba, it the passage of the railway through taking advantage of the transportation services offered by the line to move products agricultural region such as Gum Arabic, peanuts, animal, livestock and export areas.

2.1.3 Topography

Geology, Umm Rawaba locate in area where Tertiary sediments third thoroughfare and IV Quaternary containing oil components (consisting of sand and silt) and adjacent area of sedimentary sequence with continental. Continental clastic known as Nubian sandstone dating back to the Cretaceous period extends until Egypt, Libya and Chad, the largest component of the groundwater on the African continent.[2, 3].

2.1.4 Climate

Semi-arid climate prevails in the region and can distinguish four seasons:

The rainy season, known as the autumn, starts from May until October, and rainfall reaches its peak in August where 450 millimeters. Moreover, rains for short periods are profuse and usually accompanied by whirlwinds.[3]

The harvest, in early December, and locally known as "Eldoret" season, humidity and low temperature at night. Winter starts in December to continue until mid-February, and characterized by mild climate and humidity comfortably. Summer is hot and dry winds prevail, especially in May. [3]

2.2 Operational Definition of Terms

1. Primary Education: the first stage of formal education in a range of basic subjects.
2. School: a place of teaching and learning of skills, knowledge and aptitudes.
3. School Location: the geographical location of the school.
4. accessibility (School Facility): are one of the basic educational requirements, and it is necessary to maintain safe and high-quality school facilities from the perspective of maintaining and improving educational levels in line with the developmental stage.
5. Pupil: A child at school, who is being taught in a primary school.
6. Pupil-Classroom ratio (Capacity) (PCR): The ratio of the number of pupils (students) to the number of classrooms.
7. UNESCO: United Nations Education Scientific and Cultural Organization.

2.3 Literature Review

2.3.1 Definition of Basic Education

United Nations Economic, Scientific, and Cultural Organization (UNESCO) define basic education as the first nine years of schooling; the first five or six years are often identified as primary education and the rest as lower secondary education. It

also includes basic education for youth and adults who did not have the opportunity to complete a full cycle of primary education.[4]

This is the education which every Sudanese receives between the ages of three (3) and fourteen (14) years. It consists of the Early Childhood, Primary, Junior Secondary, as well as Adult and Non-Formal Education. The agency, which coordinates the affairs of this sector, is The Ministry of Education and education foundation.

2.3.2 Principle and General Objectives of Education

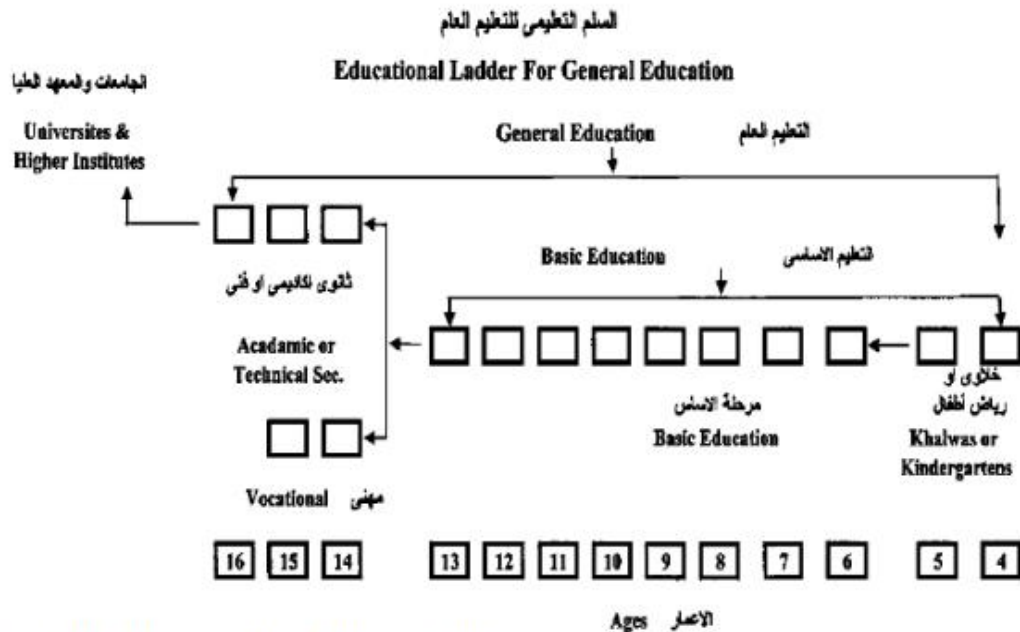
Education in Sudan has the following general directives to provide equilibrium of character by satisfying physical, spiritual and intellectual. needs and inculcating good conduct and cooperation to enable each member of the society, to fullfill his/her role in life, to assert the respect of humanity in the social system through empowerment of the leaner with the knowledge that enables him/her to know his/her rights and duties. and to act accordingly, and to be self- reliant in the acquisition of knowledge, to develop a spirit of patriotism and caring for sudan's cultural heritage together with awareness of the cultural links with african, Arab and islamic nations.

The objective of general education as stated in 1992 Education act and the educational strategy are as follows:

- 1- To instill in the young people religious ideas, beliefs and morals, and social values so as to build a responsible character.
- 2- To develop the thinking abilities of learners through experience and science and to strengthen their bodies by physical education.
- 3- To encourage self-esteem and national pride and to develop a sense of patriotism and loyalty within an improved spirit of national unity.
- 4- To build up a self-reliant community and to activate the spiritual and material energies and encourage ambition.
- 5- To encourage creativity and to build up the individual's abilities and skills through technological training so as to fullfill the goals of comprehensive development.
- 6- To develop environmental awareness and promote the preservation of natural resources.

Structure and organization of the education system

Sudan: structure of the general education system



Source: Federal Ministry of General Education, 2008.

Figure 2-1: Structure and Organization of the education system.

2.3.2.1 Structure and Organization of The education System.

In Sudan, there are four main levels of education.

First: kindergarten and day-care. It begins in the age of 3-4, consists of 1-2 grades, (depending on the parents).

Second: elementary school. the first grade pupils enter at the age of 6-7 .and It consists of 8 grades, each year there is more academic efforts and main subjects added plus more school methods improvements. By the 8th grade a student is 13–14 years old ready to take the certificate exams and entering high school.

Third: upper second school and high school. At this level the school methods add some main academic subjects such as chemistry, biology, physics, geography, etc... there are three grades in this level. The students ages are about 14-15 to 17-18.

Higher Education: there are many universities in Sudan such as the university of Khartoum, even foreigners attend universities here, because the reputation of the universities are very good and the living expenses are low compared to other countries.

After all, the education system in Sudan went through many changes in the late 1980s and early 1990s.[5]

2.3.3 Universal Primary Education (UPE)

Universal Primary Education (UPE) is a goal stated in many national development plans and pursued with vigour by governments of most developing countries. Primary education consider as the first step in laying the foundation for future educational opportunities and lifelong skills. Through the skills and knowledge, imbued, primary education enables people to participate in the social, economic and political activities of their communities to their fullest potential [6].

2.3.4 Primary Education (Basic Education)

Children are admitted to basic education school at the age of 6. Basic education lasts eight years (grades 1 to 8) and is compulsory since 1998. In 1992, the former 6-3-3 system(adopted in the 1970s) with admission to school at age 7, was replaced by eight years of basic education followed by three years of secondary education, lowering the school entry age to 6 years. Basic education is divided into three stage: grades 1-3, grades 4-6, grades 7 to 8. More than 50% of schools are co-educational. At the end of grade 8 pupils sit the final exams and if successful receive the basic education certificate.

2.4 Laws and other basic regulations concerning education

The general education Organization act of 1992 covered general education objectives, examination regulations, education policies and general administration.

According to this act, approved curricula must be applied nationwide, Arabic is the language of instruction and religious education is compulsory. The general education planning and Organization act of 2001 abrogated the education act of 1992; it

stipulates the right to education for all children of eligible school age without any discrimination.

The basic education school regulation of 1992 concerns pupil's affairs such as: rules of intake, class size, school uniform and general conduct, the duties of head teachers and deputies, reward and punishments based on religious value, educational and out-of school activities, modalities concerning examinations, promotion and repetition, etc.

2.4.1 Rules of Basic Education in Sudan

Pre-university education system (general education) divides the two stages are basic and secondary vocational and academic types. The base is the basic rule for generations and where compulsory education applies to children (6-13 years) for both genders, or where the eight years under the law, meant to push students to develop their personalities to their sides and actual physical, intellectual, moral, spiritual and social.

The Foundation phase supported by considerable attention from urban planners in finding the right place to put it. Because of its Importance in the community, and effective role in disseminating Culture and society, both economically and culturally. Therefore, school has been throughout history the attention of many researchers and planners as a cultural hotbed of radiation within the urban space. Moreover, this school should be imposed for multiple criteria when you create for purposes of educational activities and accepted formulas possible. "Documented requests subject to criteria and standards are measured levels of technical or social may be used to access the planning objectives ".[7]

Educational use is one of the most important land uses in the structure of the contemporary city, being a direct role in the lives of many age groups, as well as their role in bringing about practical progress, economic and social development so it is necessary to establish criteria of distribution best suited to educational institutions at all levels. Primary education is one of them.[8] To create such schools there are global and regional standards to followed are as follows:

2.5 International Standards for Education Services Distribution

2.5.1 Capacity

They are standards that measure the efficiency of the teaching service through the population index for age and number of students. the distribution depends on primary schools located in residential locations to the concept of neighborhood unit for every district population (2000) primary school for boys and another for girls and be in a separate building and appropriate distance from other schools. Since enacting laws education compulsory education at age 6-11 and the approximate number of beneficiaries of the school an estimated 400 people per school that does not exceed the absorptive capacity of class 30 students compared to regional standards (the Republic of Iraq, Ministry of education, the General Directorate of educational planning, 2006, p. 7)".

2.5.2 Accessibility

An educational system is inclusive of all supportive facilities, teaching staff, and an environment that is conducive for learning. Access to educational does not only mean attending school but also the near to the transportation network such as roads, sufficient number of teaching staff, adequate classrooms, good playing facilities etc. Access to quality educational facilities is therefore a critical determinant of the economic status of the populace. It is concerned with the ability of population to obtain reasonably specified quality educational services. In general, access to quality education is an important concern for developing countries as is a significant factor that contributes to the economy of a given country. With its spatial analytic capabilities, GIS provides a good platform for a deeper geographical analysis of education accessibility.[9]

Spatial planning for the social infrastructure to determine the appropriate locations based on the principle of accessibility. So we find the distance factor is important in the process of the spatial distribution of educational services. easy access to people's ability to travel the distance to access services at fixed locations within the space, which represents half of Qatar outdoor service for elementary school 500 meters

and time period the student access to school and that an estimated 10 minutes depending on the physical structure. (The Republic of the Sudan, Ministry of education, General Department for education) and regionally (the Republic of Iraq, Ministry of education, the General Directorate of educational planning, 2006, p.)

2.5.3 Environmental Considerations

Environmental considerations are important criteria in the distribution and building educational institutions. To choose appropriate places for schools, many factors such as security, health and safety are very essential. Consequently, the service should be acceptable and beneficial. So need to study the existing buildings and their surroundings. Environmental considerations for primary schools are:

1. Suitable location.
2. It should not be on the main street of the main communication routes, but on branched street for maintaining safety of students of the dangers of major roads.
3. To be located away from noise sources, factories, rail, commercial markets, ponds, swamps, graveyards, slaughterhouses, abattoirs, hospitals and near areas of student housing, parking and relief centers (fire and ambulance).
4. Be close to the parks and playgrounds or sports arenas to contribute school service.

2.6 Related Study

In another study in (*Yola North LGA, Adamawa state by Aliyu, 2013*) clearly depicts the process of using thematic map and nearest neighbor analysis in determining the distribution pattern of the post-primary schools. The study reveals how the schools were located on digital map and shows that random pattern of distribution exists within the study area. The potentials of GIS technology in database design and creation has been demonstrated, and found to be more efficient than the manual approach[10].

The study of (*Olubadewo, Abdul Karim and Ahmed, 2013*), indicates the use of technology (GIS) for education planning have proved to be very important in the decision making in Fagge L.G.A by providing the planners integrated geographic scenario of location of school. The Thematic map and nearest neighbor analysis shows that the distribution of primary schools in the area is more concentrated than other

areas, while the buffer zones show that schools are closer to roads and Markets. The database shows there are 222 classrooms, 12,693 pupils and 558 teachers in the areas at which the result shows a perfect significant relationship between the number of teacher and pupils. The tool of the analysis (Nearest Neighbor) was used to analyze the pattern of the distribution and the result shows the schools are dispersed.[11]

In the study of *(Sule, Abdullahi and Bungwon, 2012)*, private primary school locations in Kaduna metropolis were determine by the use of handheld GPS receiver. Thematic map, nearest neighbor and Buffer zone analysis reveals that, the schools are not evenly distributed, as some areas have the schools concentrated at particular places while some areas have none, and some settlements are deficient in private schools while others have excess[12].

(AL Haji Mohammed, Firal Wasif, 2010)[13], "assessment and planning of educational services in the town of Tubas, using geographic information systems", as an attempt to overcome the random distribution of services that do not take into account the planning standards to suit the size of the population. This study, aimed to assess the reality of the services in the study area by comparison with national, regional, international levels, and the distribution of educational services. By using geographical information system technology. And to highlight the role and importance of planning in the distribution of educational services. The study used descriptive analytical method, through analysis and assessment of data collected from stakeholders. And compared this data to the planning standards in addition to using field surveys to identify the level of satisfaction with the educational services through the distribution of a questionnaire to a sample of students, managers and kindergarten, and then analyze the data by (SPSS) . Has been using geographic information systems (GIS) to produce maps showing the distribution of educational services by the relevant neighbor's method and scope of the impact of the service. Then suggest other sites ideal population need and care for future growth. Assumed in the study that there is no relationship between the average density and the average density of educational services. In addition, do not take into account the international planning standards in educational services building. The results showed that the city of Tubas are lacking in educational services, and the distribution of the combined type. Also showed that, the scope of influence of kindergartens, covered parts of the study area with houses that fall within the scope of the service only 20% of the total households, 75% of

kindergartens do not achieve even the minimum share of total space required estimated at 2.5. All lower and upper basic school and secondary education does not meet even minimum world standard on the total area per student and built."

All previous studies focused on the reality of schools, distributed geographically, and finding the right place for the new school.

(Shugair, Heba Mohamed Hamouda, 2009)[14], "distribution and planning of educational services in Salfit by using GIS technique", this study aimed to conduct a survey on educational services, and to study the compatibility of these services and their specifications with local and international standards. Moreover, develop a clear vision for the distribution of these services and study the obstacles to the use of these standards. To achieve this, the researcher studying concepts for planning of educational services and geographic information systems which used in spatial analysis of these services. The study relied on its approach to descriptive analytical framework of analysis of data collected from stakeholders, or through a questionnaire, which distributed to schools and kindergartens in Salfit, also measured satisfaction of these services through the distribution of questionnaire to a sample of students, Directors of schools and kindergartens. Moreover, has been used geographic information systems (GIS) and statistical package for Social Sciences (SPSS) in order to prepare the necessary plans and computerization of the data collected. The results showed that the Salfit district lacks a licensed nursery of the Ministry of Social Affairs. In addition, 25% of conservative caucuses lack kindergartens, 59% of children aged 4 and 5 years do not go to kindergarten. Moreover, the results showed that there is a random distribution of educational services, lack of standards based planning and especially kindergartens which suffer from irregular distribution and concentration near each other. It also showed that educational services in the study area does not meet global spatial requirements."

(Yousef, Jumaa Tahir, 2007), "spatial analysis of educational services in the city of Nablus, using geographic information systems technology", aimed to study the reality of educational services in schools and kindergartens in the city in terms of its efficiency, distribution, and suitability for urban expansion and population growth of the city .

The study also addressed a comprehensive survey of all schools and kindergartens in the city with the aim of providing a database about these locations. In addition to providing data on the number to students, teachers, the architectural characteristics of

the buildings and escort service. Also, measure the satisfaction of these services. Through the results of the questionnaire that was distributed to a sample to students. By using SPSS and GIS forms such as neighbors and buffers. The results showed that there is a random and poor distribution of the schools and kindergartens in the city. This random and poor distribution due to lack of prior planning and non-conformity to standards of planning. As well as, the results showed weakness in the efficiency and effectiveness of these services.

(Ali Karim shaysh, 2007), "prepare the maps of distribution of schools in the city of Kut by using of geographic information systems", this study aimed to use these systems in the assessment of the current situation of schools at all levels of primary, middle and secondary levels, according to a set of natural, human and social standards . Also the use of geographic information systems in the distribution of current locations and to residential districts in the city to prepare updatable digital maps for school locations and methods for distribution of these schools, and then propose amendments to certain locations according to their relevance to the criteria adopted by the researcher. To achieve that, the researcher relied on the available data in the Directorate of education, in addition to field survey to determine school locations accurately. Using global positioning system (GPS) and updated available data.

The results showed that there was an aggregate in the distribution of the schools. This aggregate distribution is like the clustered, random in some of status while dispersed in the other status.[15]

(Mahmood, Kamran, 2006),[16] "the current distribution, ideal for middle schools in Erbil City: a comparative study using GIS" revealing the reality of the geographical distribution of secondary schools in the city of Erbil, and wallboard for schools in the city. Suppose that the distribution of school non-attendance, distribution of boy's school is different from the distribution of schools for girls, and the use of geographic information systems technologies are necessary to resolve such problems, because of its techniques from the accuracy and speed up of performance. In addition to, its outcome that set up schools for girls than boys schools. He also found that using a regression model, you can predict the variables number of students, and capacity and surplus and deficit, and the number of schools in the region, where the availability of data. I finally found that using statistical means either the computer, the process is complementary to the use of geographic information systems."

2.7 Discussion of Related Study

Most of the previous studies has used the descriptive approach and the spatial analysis. The data was collected using questionnaire, interview and documents in addition to use modern technologies such as GPS.

These studies was relied on analysis tools that existed in geographical Information systems programs such as ArcMap. While other studies used SPSS program together with some of ArcMap tools in order to know the current distribution of educational services and re-distribute it when it's inconformity with education standards.

Table 21- : show these studies and the analysis tools that used by each study.

Study	Analysis tools				
	Name of Tool	Nearest neighbor	Buffer zones	SPSS	GPS
Yola, et al (2013)	Yes	No	No	No	No
Olubadewo, et al (2013)	Yes	Yes	No	No	No
Sule, et al (2012)	Yes	Yes	No	No	No
Ali Haji, et al (2010)	No	No	Yes	No	No
Shugair, Heba Mohamed Hamouda (2009)	No	No	Yes	No	No
Ali Karim shaysh (2007)	Yes	No	No	Yes	No
Yousef, Jumaa Tahir (2007)	Yes	Yes	Yes	No	No
Mahmood, Kamran (2006)	No	yes	Yes	No	No

Referring to the above table we found that, most of the studies relied on the analysis of buffer zones and nearest neighbor (Sule, Abdullahi and Bungwon, 2012), Yola North LGA, Adamawa state by (Aliyu, 2013)). Some of these studies used SPSS either with other tools such as buffer zones, nearest neighbor (*Mahmood, Kamran, 2006*), (*Yousef, Jumaa Tahir, 2007*). While (*Ali Karim shaysh, 2007*) used GPS tools

nearest neighbor for analyzing. All studies, does not consider the directional distribution in analysis.

While this study was depended in the analysis on using, three standards buffer zone, nearest neighbor and directional distribution. In addition, use GPS device in collection data.

Use this tool led to the study added accuracy and distinguishes it on previous studies.

Chapter Summary

This chapter was divided into five parties. Part one historical background about the area of study, part tow Operational Definition of Terms, part three contain national policies of education, part four the rules and regulations of primary education in Sudan, whereas part five discuss summarize the related and previous studies.

CHAPTER THREE

METHODOLOGY AND TOOLS

Chapter 3 Methodology and tools

3.1 Study Approach and Tools

In this study, the researcher used descriptive analytical method, which based on the study of phenomena as they are on the ground. Then described qualitatively and quantitatively accurately. Also spatial analysis approach used through the application of appropriate functions provided by the analysis of geographic information systems in order to identify the spatial variations of the locations of schools, and the causes in order to access the interpretation and explanation of these spatial differences. To conduct the work, the researcher has used some necessary software on top of GIS software ArcGIS 9.3 and its accessories from the company ESRI. The study dealt with a number of methods and procedures as follows:

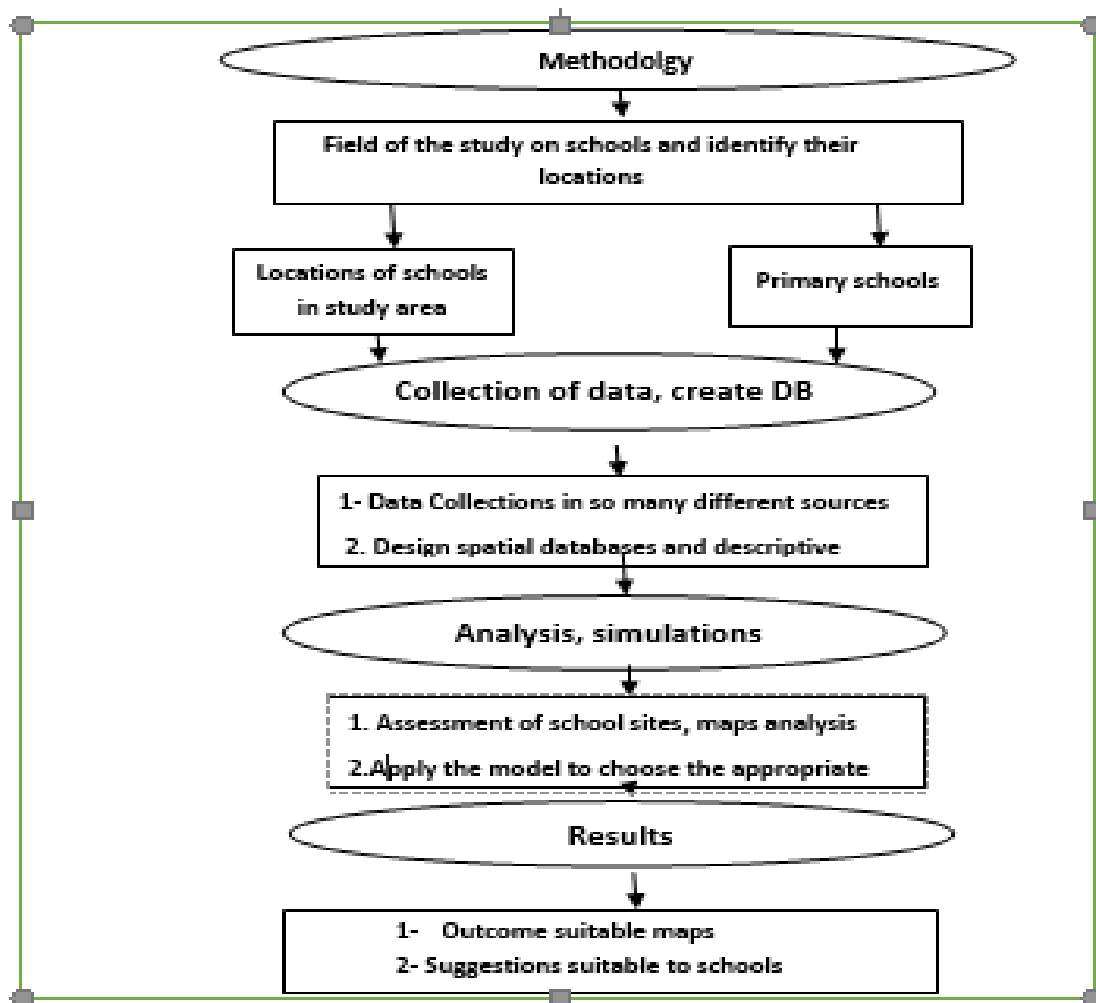


Figure 3-1:method of the application steps methodology[10]

Figure (3.1) above reveal of steps the application methodology, which starts field study to determine the location of schools, then collecting data from different sources, database design, followed by analysis, represent assessment of location of schools, analysis of maps, to create the best model in the form of appropriate maps the perfect sites.

3.1.1 Field of Study

The study focus mainly on data that has been collected from the field, which include two main sections. The first limited to the city of Umm Rawaba schools and the second on personal interviews and visits exploratory. With respect to the first section, Data has been collected from 27 different schools, this phase has required a number of field visits to identify the location of schools through the written description in the ministry's data and ensure their cross-device (GPS).

This phase followed by the use of satellite images in high definition. In addition, corrected geometrically to determine the distribution of schools directly from the field. Also Umm Rawaba city map to describe some school location and take a sample of these schools and their locations on the map as it is on the ground.

After the completion of the identification of all schools surveyed, we would use ArcGIS9.3 program to determine the locations of these schools in the correct positions as shown by the figure (3.2). In the form of bullets, by using projection technique.

Department to ensure alignment and link text data (tabular and obtained by a researcher from the number of schools in each district, the address of the school in every district and determine their coordination's). Spatial data (geographical phenomena represented on maps such as schools, neighborhoods and others in the form of layers, and each layer is a special map and representing a particular type of data).

Also, use the directional Vector pattern (shape file) in this study, which includes three types of data: the raster data to put the schools in the form of points. The line data, to develop, roads and streets. Finally, spatial data for districts in a manner draw polygons.

This phase is most challenging part of to collect data from the ministries and government agencies. Some schools known by the name of the neighborhood, others address such mysterious mention the neighborhood name only, and some vague mention such as name of the school not only the title without a phone number, which led to the delay in the search. In addition, it has been using a GPS device to take the coordination of the school and to ensure of its location several times and then represent the school location's bitmapped symbol in the middle of the figure, which represents the school and on the satellite image geometrically corrected. Moreover, write the entire school data in the database of the school in the GIS program.

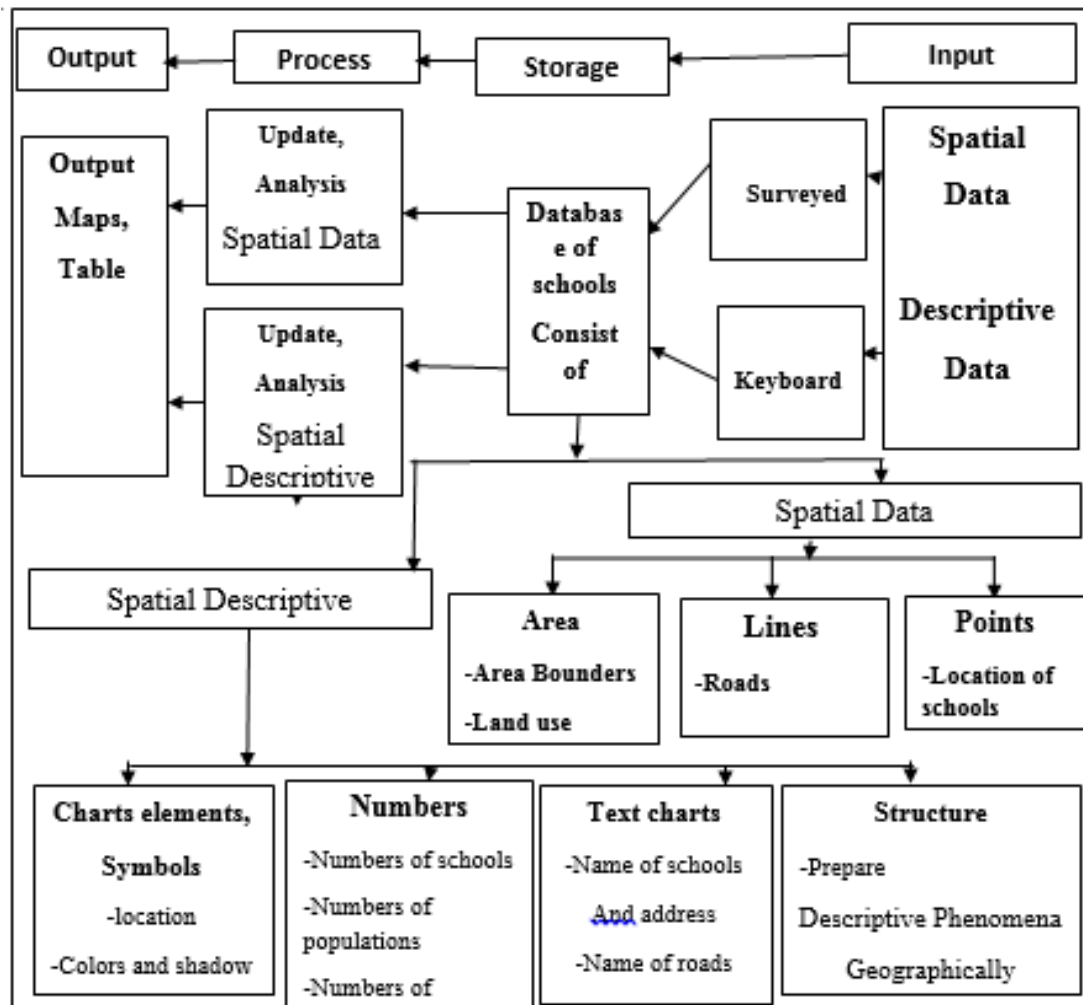


Figure 3-3:steps of Design geographic information database for schools of umm Rawaba city.

Figure (3.3), above explain the steps of designing geographical database for schools, that begin with entering spatial and descriptive information for schools from the field study, then saving data for schools spatial which represent different elements(such as points which represent schools, the lines of roads, circle for the area). Metadata can be represent in the form of map, this map shows school name, address, name of the road, numbers, symbols to illustrate the site.

3.1.3 The GPS Satellite System

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S.department of

defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 h a day. There are no subscription fees or setup charges to use GPS. The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. They are constantly moving, making two complete orbits in less than 24 h. These satellites are travelling at speeds of roughly 7,000 miles an hour [17, 18].

3.1.4 How GPS Works

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic.[19]

3.1.5 Data Collection from land Registry Office of Umm Rawaba city

Figure (3.4) below was obtained from land registry office of Umm Rawaba city. It illustrate the distribution of districts in the city. So we use it to identify the names and addresses of primary schools in the city that was obtained from the ministry of education in Umm Rawaba and also was gathered by using GPS. See Table (3.1, 3.2 and 3.3) .to show coordinate xy and See Figure (3.5) to show locations of schools in the city.

Collection of coordinates from field using GPS: The coordinates of the schools were collected using a hand held GPS. Making use of the list of schools and their addresses already obtained, trips were made to the various schools and coordinates collected. The procedure of using the hand held GPS followed at each school is as follows:

The 'key was pressed until the receiver turned on. The welcome page appeared while the unit conducted a self-test. Once testing was completed, the satellite page

appeared and when sufficient signals had been acquired, the satellite page was replaced by the position page.

The 'mark' key was pressed to mark or obtain the coordinates points. The 'mark' position page appeared with a default 3-digit name for a new waypoint in the upper left portion of the page.

The waypoint was saved with the default name and symbol. The saved waypoints were retrieved by accessing the main menu and highlighting a waypoint option; 'waypoint' to retrieve only one and 'waypoint list' to retrieve all.

3.1.6 Plotting of Coordinates in The map

After acquire the points with GPS device, which represent locations of schools and information from ministry of education, ARCMAP 9.3 software had been used, to identify these points on the program (table: 3.1, 3.2, 3.3 and Figure 3.4).

3.1.7 Create Maps

To identify the best locations and existing sites for schools, number of maps were created based on the information gathered from the field study, government departments, In addition, other maps will be generated in the form of layers for each category of school classes (figures below).

Table 3-1: Show the boys schools, location and its coordinates.

Name of school	location	Easting	Northing
Abu Zir	Othman ibn Afan	31.21745	12.91978
Omer Gabat	Al Gouds	31.20982	12.91872
Adeeb	Abu baker north	31.20611	12.90871
Al Azahry	Abu baker south	31.20730	12.90367
Al slam	Al slam South	31.22714	12.88859
Amar Ibn Yaser	Hamuo	31.21711	12.90658
Osama	Atron	31.22085	12.90152
AlImam AlMahady	Tayba	31.23110	12.90095
khalid	Hamuo	31.21754	12.90563
Musaab Ibn Omeer	Al Safa	31.22378	12.90866
Al Gadysia	Al Gadysia	31.22250	12.91761

Table 3-1: above Show the boys schools, location and its coordinates which obtained by GPS devices from surveys of the field study.

Table 3-2: Show the girls' schools, location and its coordinates

Name of school	location	Easting	Northing
Khadija	Osman Ibn Afan	31.21119	12.91956
Nusseibeh	Osman Ibn Afan	31.21676	12.91993
khauola	Abu Baker North	31.20410	12.90714
Asma	Omer Ibn Alkhataab	31.22056	12.91184
Al houmyra	Abu Baker South	31.20773	12.90374
Al Zahra	Atron	31.22368	12.90197
Al khansa	Hamou	31.21421	12.90600
Hmaem AlSlaam	Al Slaam South	31.22705	12.88948
Um Al Moumenen	Tayba	31.22586	12.90248
AlBoulk	Ali Ibn Taleeb	31.21246	12.90010
Al Gadysia	Abu Baker south	31.22250	12.91761

Table 3-2: above Show the girls schools, location and its coordinates which obtained by GPS devices from surveys of the field study.

Table 3-3: Show the co-schools, location and its coordinates

Name of school	location	Easting	Northing
Maaz	Tayba	31.23824	12.89997
Al Shorog	AlSam	31.23373	12.88805
Al Seer Aabadi	Hamou	31.21429	12.90601
Neem net	Atron	31.22161	12.90144

Table 3-3: above Show the co-schools, location and its coordinates which obtained by GPS devices from surveys of the field study.

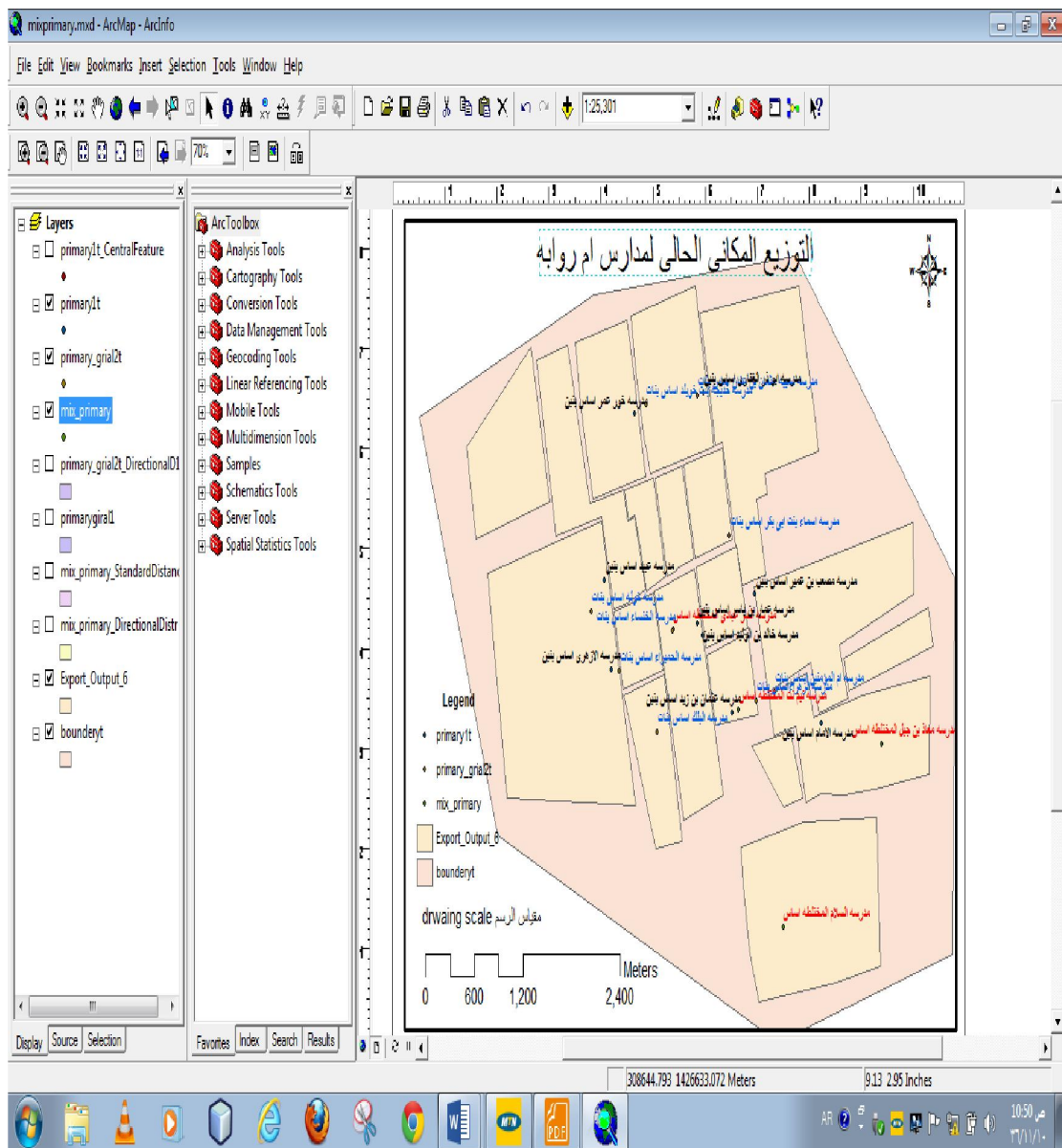


Figure 3-4: illustrate location the schools of umm Rawaba.

3.1.8 Processing and Analysis

The research used the tools and methods of Spatial analysis where provided in geographical information systems, including: Proximity and includes a number of other posts from that Buffer. Also analysis of styles such as Average Nearest Neighbor, as well as Measuring functions including the measurement of a Central Feature and Directional Distribution. The study also sought to determine the sample application or appropriate measurement site.

3.1.9 Geographic Information Systems

"The idea of geographic information systems to develop a set of tools for organizing and storing spatial data and then restore, analyze and then view, represent a means of organizing and storing spatial data retrieval and analysis [20]".

Geographic Information System is a discipline for capturing, storing, analyzing, managing and presenting data and associated attributes which are spatially referenced to Earth. Geographic Information System is to analyze object and event on the earth and visualize them with real coordinates on the map. In another definition of GIS it is abbreviation of three words:

Geography + Information + System. Geography relates to all the features and process that occur on the surface of the earth. Information is the hearth of GIS, where vast amount of data are stored and analyzed [21]. Therefore GIS makes geographic analysis and location analysis easier, so users of GIS application increases and the scope expands.[22]

"Focusing of GIS techniques to link phenomena on the Earth's surface by coordinate system and stored in the computer memory and link metadata with those phenomena through databases and analyze it and show the relationships between them, and then display a specific scale spatial information on the screen and printed on paper ".[23]

"It worth mentioning that Geographic information systems is the modern technology in the field of processing and analysis and modelling. GIS software package can carry out analysis, linking and matching, representation and modelling of various phenomena and monitor developments and especially the urban studies. urban studies are in continuous changing, so that the software can repaint, moreover it has capability for deletion, modification, addition, as well as showing geographical phenomena. ".[24]

The most important characteristic of GIS software is the ability to analyze information and data alongside their involvement with other systems. To link information directly to their location on cadastral maps geographical or diagrams with easy modification, update, and data transfer to spatial imagery in the form of maps.

"Beside mentioned capabilities, GIS can be used to address and identify a set of planning standards, and analyze a set of equations that contained the program with the ability to link with other systems such as engineering drawing programs and spreadsheets, databases and image processing software [25]".

Also GIS facilitate planning and provide a network of spatial information that could revolve around urban plans for different sectors, on the one hand, the concentration of strategists and decision-makers relevant operational urban development matters and planning on other.

The advantages of GIS that related to this research:

1. Support the update of the spatial databases and metadata, which facilitate the establishment of background information.
2. Provide the researchers with information needed, queries of metadata spatial.
3. Design a digital system for the services used with land uses.
4. Knowing the deficit and shortcomings in distributing of services that will be useful for planning.
5. Help the administration in planning and decision-making scientifically.
6. Design modeling maps that help in improving the relations between the organizations and make appropriate decisions.
7. Dealing with all the activities related to the management of information and make the best decisions.
8. The ability to analyze spatial and descriptive information and understanding its relationships then showed it as a digital format.
9. Improve the performance of planning organizations, government agencies that contribute in the development.
10. Provide specific, scientific and accurate answers for the phenomena of population growth to the planners and decision-makers.

3.2 Geographical Distribution of Primary Schools in Umm Rawaba

This paragraph deals with the spatial distribution of schools according to the current plan of the Ministry of education. And inflicted their data in tabular form

including all relevant information on education in the city.

Table 3-4: the total number of students, schools, capacity for city of umm Rawaba.

Percentage decrease	decrement	Percentage increase	increment	capacity			Numbers of schools			Number of students
				Both school	girls	boy	Both school	girl s	bo y	
4.92	0582/11840	16.92	2003 /11840	800	54	564	5	12	12	13247
					00	0				

Table (3.4) above shows the rates of increasing and decreasing of the schools of Umm Rawaba city:

The capacity of a standard for the classroom of school shows an increase in the number of students at a rate of 16.92% in some schools, and decrease at a rate of 4.92% for some schools, according to the Information which collected from Ministry of Education in city, depending on the following equations:

Notes:

1. **Capacity** (Pupil-Classroom ratio) = classes no * 50
2. **Percentage increase** = The increase in the number of students / capacity* 100
3. **Decrease** = decrease in number of students/capacity * 100.

Table 3-5:Boys school for the city of Umm rawaba.

Name of School	location	Number of Classes	Number of Students	Capacity	increment	Percentage increase	Decrement	Percentage Decrease
Abu zir	Othman ibn afan	15	861	750	111	14.8		
Omer Gabat	Al gouds	17	970	850	120	14.12		
adeeb	Abu baker north	14	773	700	73	10.42		
Al azahry	Abu baker south	9	677	450	277	50.44		
al slam	Al slam suoth	9	642	540	102	18.89		
Amar ibn yaser	hamuo	8	474	400	74	18.5		
Osam	atron	9	488	450	38	8.44		
Al imam almahady	tayba	10	392	500			21.6	108
khalid	hamuo	8	379	400			0.25	21
Musaab ibn omeer	Al safa	7	231	350			34	119
Al gadysia	Al gadysia	3	103	150			31.33	74
alhuda	hamuo	2	95	100			5	5
total		111	6085	5640	795	135.61	92.18	327

Table (3.5) above shows the rates of increasing and decreasing in boys' schools of the city of Umm Rawaba:

It is clear that there is an increase in the capacity of the schools, compared with regional and global standards, estimated to 30 students per class. That is to say, 240 to any student of the school, which confirms that there is an increase in the number of students of some schools and a shortage of some schools based on the following notes, this described in the analysis of following paragraph.

Notes:

4. **Capacity** (Pupil-Classroom ratio)= classes no * 50
5. **Percentage increase** = The increase in the number of students / capacity* 100
6. **Decrease** = decrease in number of students/capacity * 100.

Table 3-6:Girls school in the city of Umm Rawaba.

Name of School	location	Classes Number	Students number	Capacity	increment	Percentage increase	Decrem-ent	Percentage Decrease
Khadija	Osman ibn Afan	13	1001	650	351	54		
Nusseibe-h	Osman ibn Afan	16	890	800	90	11.25		
khaoula	Abu Baker north	14	821	700	121	17.29		
A sma	Omer ibn Al khataab	9	549	450	99	22		
Al houmyra	Abu Baker south	10	555	500	55	11		
AL zahra	Atron	9	504	450	54	12		
AL	Hamou	8	476	400	76	19		
Khansa								
Hmaem	Al slam	8	548	400	148	37		
Al Slaam	suoth							
Umm ALmoumenen	Tayba	8	411	400	11	2.75		
AL boulk	Ali ibn Taleeb	8	312	400			88	22
Al gadysia	Abu baker south	3	107	150			43	28.67
AL huda		2	109	100	9	9		
TOTAL		108	6283	5400	1005	195.29	131	50.67

Table (3.6) above shows the rates of increasing and decreasing of schools for girls' of Umm Rawaba city:

It is noted that there is an increase in the capacity of the schools, compared with regional and global standards, estimated to 30 students per class. That is to say, 240 to any student of the school, which confirms that there is an increase in the number of students of some schools and a shortage of some schools based on the following notes, this described in the analysis of following paragraph.

Notes:

7. **Capacity** (Pupil-Classroom ratio) = classes no * 50
8. **Percentage increase** = The increase in the number of students / capacity* 100
9. **Decrease** = decrease in number of students/capacity * 100.

Table 3-7: Co-schools in the city of Umm Rawaba.

Name of School	location	Number of Classes	Number of Students	Capacity	Increment	Percentage increase	Decrement	Percentage Decrease
Maaz	Tayba	11	753	550	203	36.9		
AL shorog	AL slam	3	98	150			52	34.67
AL amal	Atron	2	28	100			72	72
AL seer Abadi	Hamuo	-	-	-	-	-		
Neem Net	Atron	-	-	-	-			
TOTAL		16	879	800	203	36.9	124	106.67

Table (3.7) above shows the rates of increasing and decreasing in Co- schools of the city of Umm Rawaba.

The table stated an increase in the capacity of the schools, compared with regional and global standards, estimated at 30 students per class. That is to say, 240 to any student of the school, which confirms that there is an increase in the number of students of some schools and a shortage of some schools based on the following notes, this described in the analysis of following paragraph.

Notes:

10. **Capacity** = classes no * 50

11. **Percentage increase** = The increase in the number of students / capacity* 100

12. **Decrease** = decrease in number of students/capacity * 100

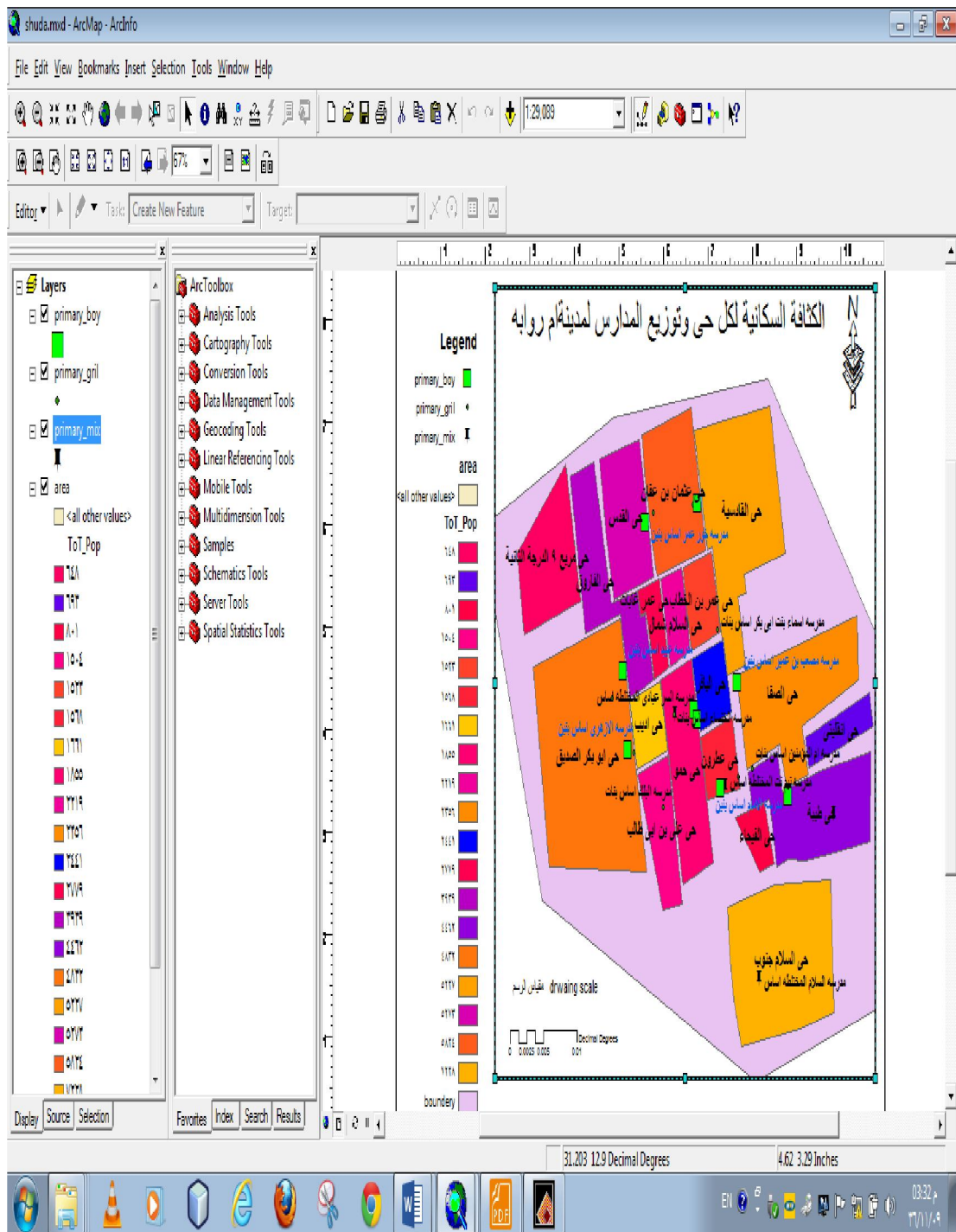


Figure 3-5: Spatial Distribution of Population Density in each School and each District.

Figure (3.5) above shows the spatial distribution of neighborhoods Rawaba city, each neighborhood and its populations and the number of schools in it.

3.3 Discussion

The researcher found 29 primary schools in the city of Umm Rawaba run in (235) buildings of local materials and steady number of them (200) building fixed materials and number (35) local materials as shown in table (3.5, 3.6 and 3.7), figure (3.5).

The researcher discovered the number of pupils in primary school in the city of Umm Rawaba for the school year (2013-2014m) Report (13247) Student / demanded. Represented (23.31%) of the total population of the city's number is (65833) people. according to statistics central Statistical Organization displayed in table (3.5). This means that the ratio is reasonable compared with the number of students in the locality and the age of Education's (320274) student / demanded by (50.46%) and the proportion of the concentration of population in the city to provide a proportion of services. Number of students is divided into (6524) student represented by (49.25%) and the number of female students (6723) by (50.75%) of the total number of students.

From the above analysis, the number of girls were more than the number of boys at schools.

Also there are many areas free of schools represented by 8 areas such as *Faiha, Angaliti, north AL slam, Omar Ibn Al-Khattab, Morabaa 9, Omar al-Faruq, Omer gabat, Al-Baqir and adeeb* no schools although they are densely populated.

The researcher discovered that the distribution of schools does not spread between residential neighborhoods and shops, as found the variance of the distribution, through the preparation of thematic maps of schools were located at the traditional areas such as *Hamou, Atron*, northern part of the neighborhood, *Abu Bakr Siddiq, Othman Ibn affan*. As the four schools for boys, girls, mixed neighborhoods *Hamou, siddiq*. Moreover, three schools for boys, girls, mixed all of *Atron, Othman Ibn affan*.

In contrast, the disperse pattern of reviving *al slam* area, *Al SAFA, Al Qadisiyah, Ali bin Abi Talib, Jerusalem, Omar Bin Al-Khattab* by one school either for boys, girls or co-school as indicated figure (3.5).

3.4 State Ministry of Education Basic Schools Bistribution Criteria

3.3.1 Distribution by Criteria Capacity

The researcher concluded the total classroom for elementary schools is represented (111) separate schools for boys, (108) separate schools for girls and (16) separate school co-educational are distributed unevenly, the relatively modern schools in neighborhoods planned is lower than in conventional neighborhoods. The number of students per class supposed (30 students per classroom) compared with global and regional standards (compared with some international standards, like American, and regional like Iraq, Palestine, Iraq). So it is estimated to absorb around schools $(235 * 30 = 7050)$ student; (3330) students of schools for boys and (3240) for girls ' schools, 480 to co-educational schools, only that the current number of students reached (13,399) student to be distributed; (6058) students of schools for boys, (6283) freshman girls ' schools and (800) student of co-educational schools. It thus represents a percentage increase (44.74%) for current students (5927) student, which requires provision (25 schools) to accommodate them as standard 240 student/school as shown in tables (3.6, 3.7, and 3.8).

It note ratios and previous comparison according to the international and regional standards, and table (3.5, 3.6, and 3.7), the schools are experiencing an increase in the number of students, which means the pressure on services, which influence the performance and efficiency of functionality. As the increase represented (5927) student, a percentage 44.74% from the total number of students, which divided (6524) students for boys schools, with percentage (49.25%) from the total net increase, and (6723) for the girls' schools, with percentage (50.75%) from the total net increase.

The increase in distribution varied between schools to revive the city as represented (7) occupied the top rated schools in terms of the increase Azhari School, Omar gabat , Abu zar, al slam, Ammar, Obaid, Osama rate of (111, 120, 277, 0.102) respectively and an increase (50.44, 14.12, 14.8, 18.89, 18.5%) in the order. While such a lack of schools for boys (5) schools represented Nilai Musab bin Omair School, Imam Mahdi, and Qadisiyah rate of (119, 108, and 0.74) correspondingly per student and (34, 21.6, 31.33%) in the order.

While the girls' schools, which represented an increase (10) school, ranked the highest in terms of increased school (Khadija, al slam, Khawla, Asma, Nusseibeh) (351, 148, 121) and student with percentage (54, 37, 17.29%) order. While the shortage of schools for girls (2) represented the top school in the schools (Albulk, Qadisiyah) (88, 43) individually and student by percentage (29.12%) order.

When comparing students of Umm Rawaba city (13,399) student, with capacity of regional and global schools. Which represent (240) student for each school. According the education system in Sudan eight semesters, by capacity (30) student/scholar to each class, we conclude the city of Umm Rawaba, need to (55) school, while reality (27) school for boys and girls and co-educational schools, deficit (28) school, percentage triangle (50.91%), divide to (14) school for boys (14) school for girls.

3.3.2 Distribution by Standard Accessibility

The distance from the elements is important criterion in the analysis of geographical distribution of schools at all levels. It is essential to understand any place in the geographical space.[26]

Therefore the planning of schools, taking into account the development of the school in the Centre of the neighborhood and the subfolder. Indeed students walk to gain time and avoid delays caused by traffic jams, accidents or breakdowns for other. This means planners must take school near housing. And that each school adopt should serve beyond certain distances from housing, supported on the distance and time that go for student access to school on foot, select a range estimated distance of 500 meters, and most of the time estimated (10) minutes. The three ranges of distance and time(300,400,500) use to know the distances between schools and distributed correctly. The following maps display the distribution of schools in Umm Rawaba city.

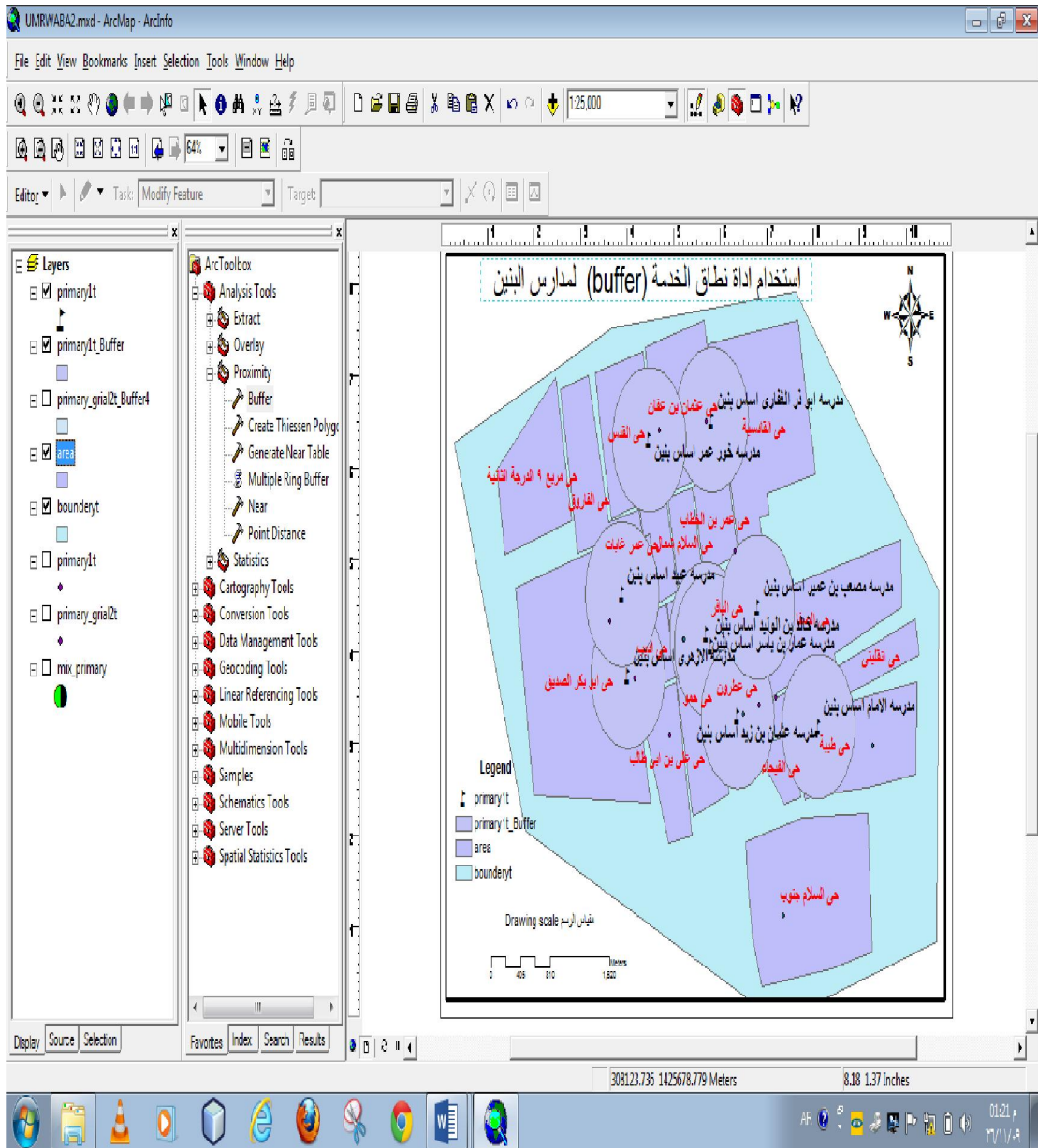


Figure 3-6: shows use tool (B Z A) for schools boys, distance 500m.

Figure (3.6) above shows using tool (buffer analysis) for boys school, distance 500 m, the shape reveal overlap in boys schools in some districts, indicating that there is a imbalance in distribution planning, so you must redistribute to solve this problem using this tool based on the distance, a student walk and estimated at 500 meters, 10 minutes.

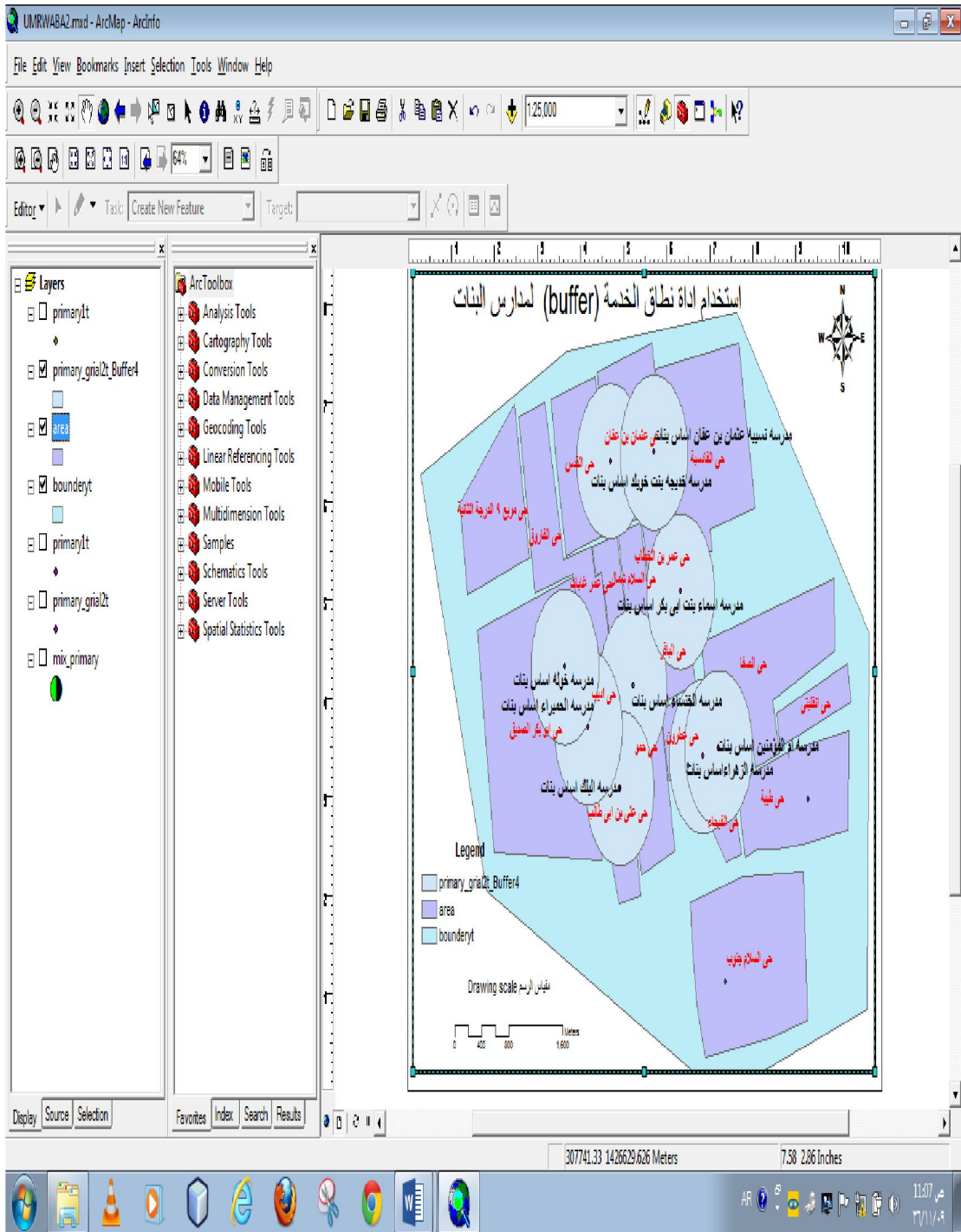


Figure 3-7: shows use tool (B Z A) for schools girls, distance 500m.

The figure (3.7) above shows use tool (buffer analysis) for girls ' schools, which displays the overlap of some schools in the neighborhood, and concentration on neighborhoods such as Abu Bakr Siddiq, Hamou, Adeeb, Atron, AlGouds, and some neighborhoods of schools such as Mourabaa 9 Angliti, confirming a bug in distribution when creating such schools. Must be redistributed based on this tool.

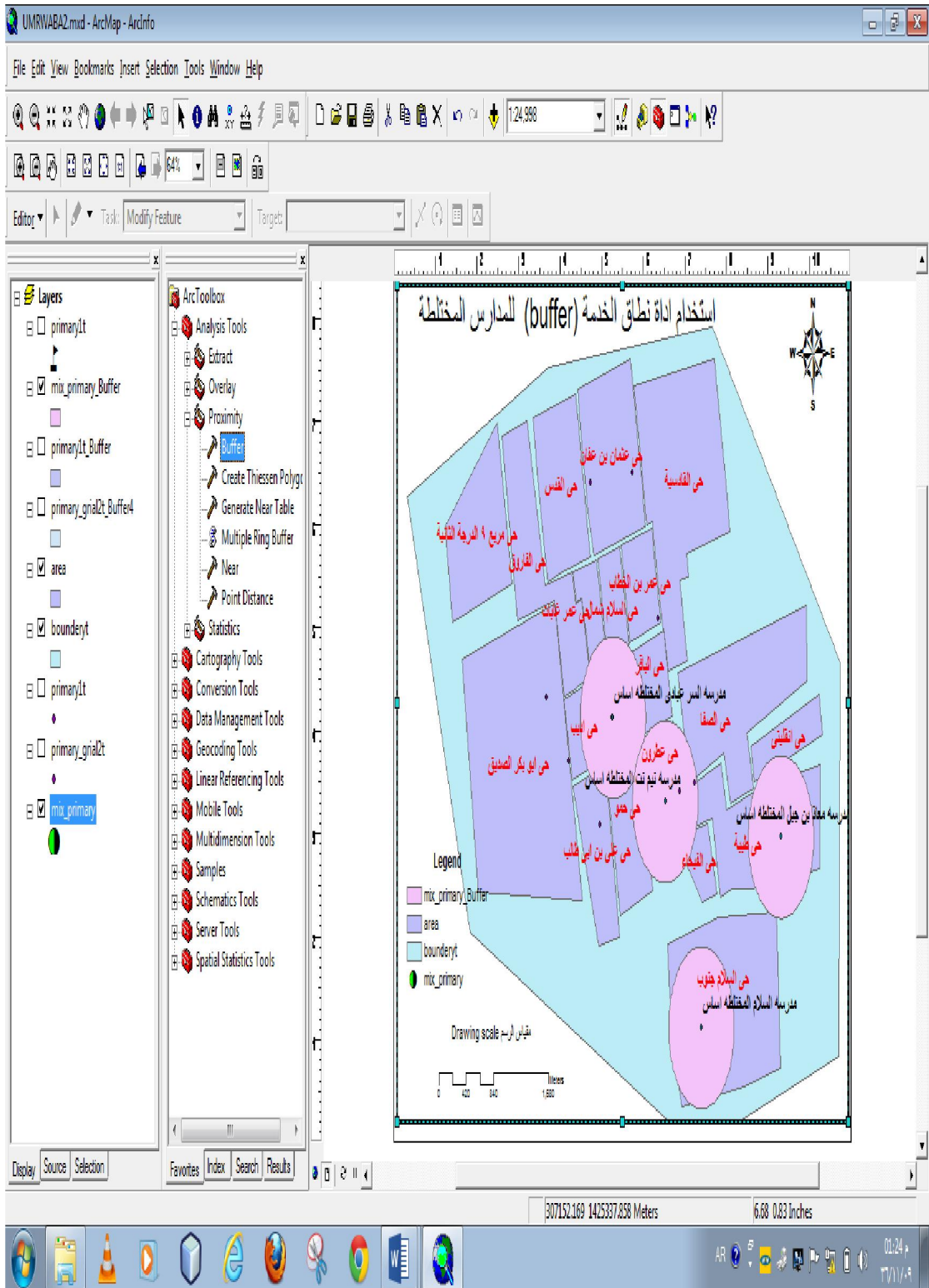


Figure 3-8: shows use tool (B Z A) for co-schools, distance 500m.

Figure (3.8) above illustrates the use of a tool buffer to co-schools, 500 meters and

shows that the distribution of co-schools and the city needs to increase co-schools free.

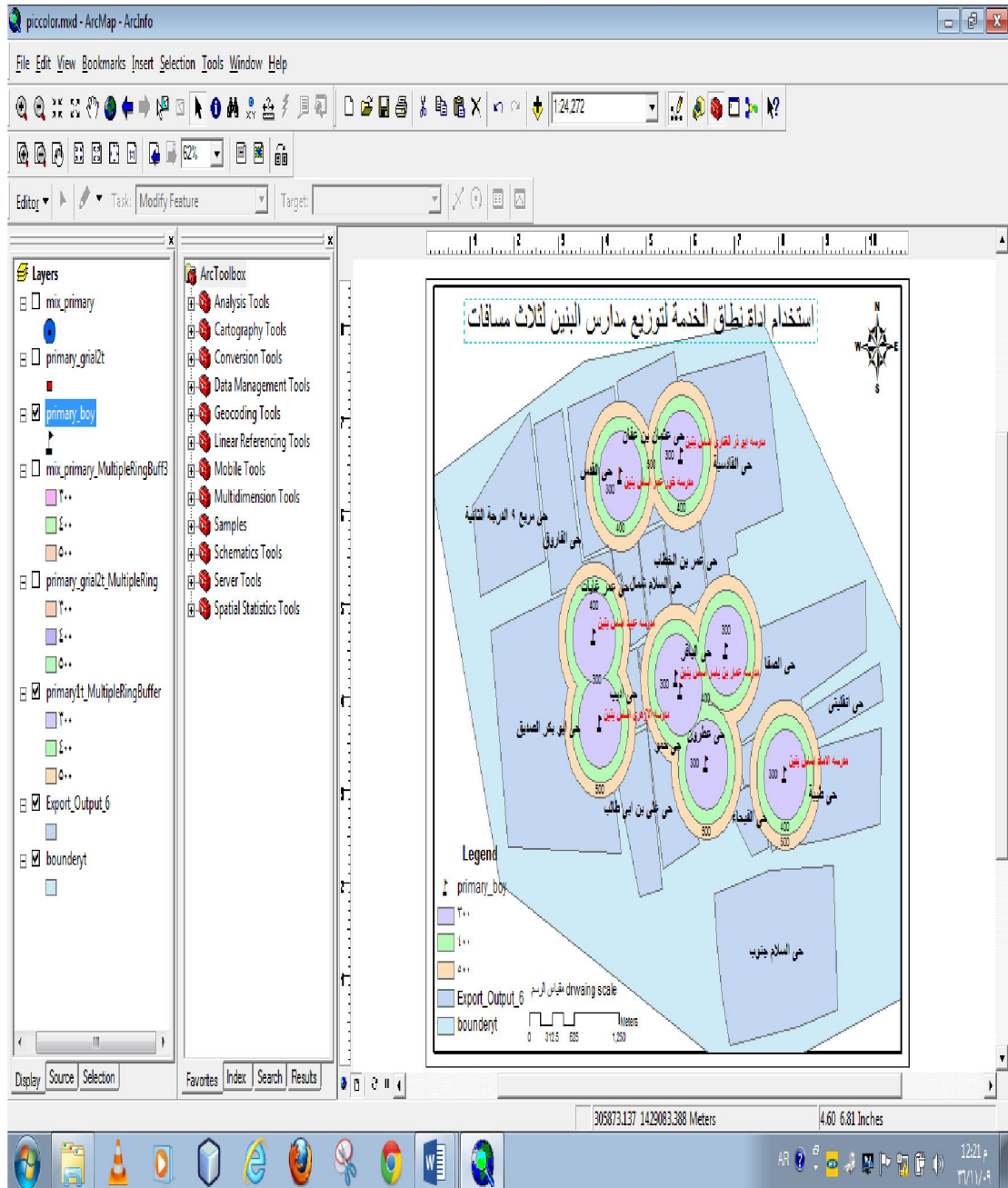


Figure 3-9: shows use (B Z A), schools boys, distances (300, 400, and 500) m.

Figure (3.9) above shows use buffer analysis to boys schools for three distance (300, 400, 500) from the figure it is clear that overlap of some schools in the respects of Abu Bakr, Al-Baqir, Atron, ALGouds, part of the SAFA, while there are respects where

there are no schools requiring redeployment based on buffer analysis.

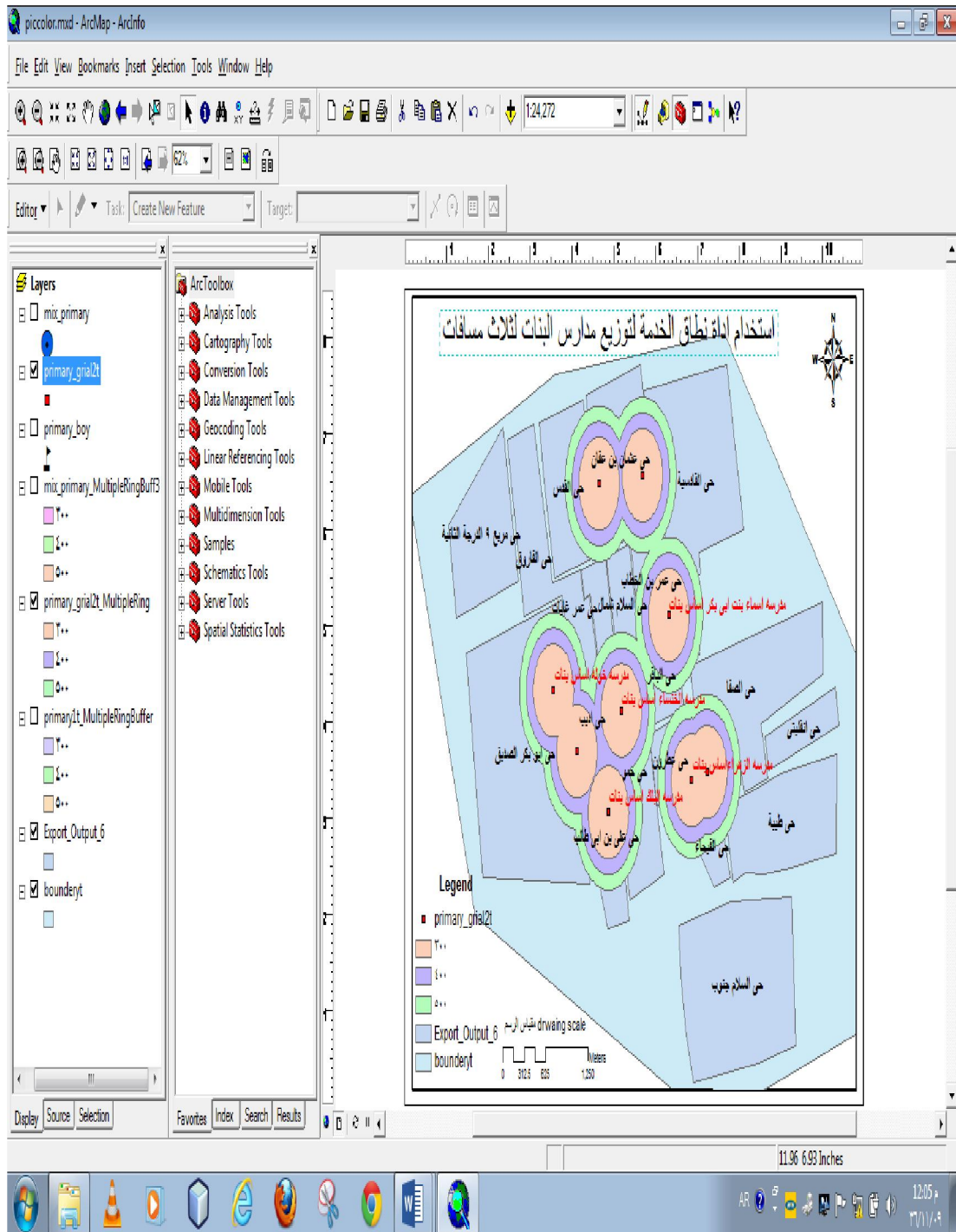


Figure 3-10: shows use (B Z A), schools girls, distances (300, 400, 500) m.

Figure 3.10: above displays use buffer analysis for girls ' schools, distances (300, 400, 500) from the figure, there is overlapping ranges of some schools in the respects of Abu Bakr, Adeeb, Ali Bin Talib, Atron, ALGouds, while there are respects have no schools which requires redistribution based on buffer analysis.

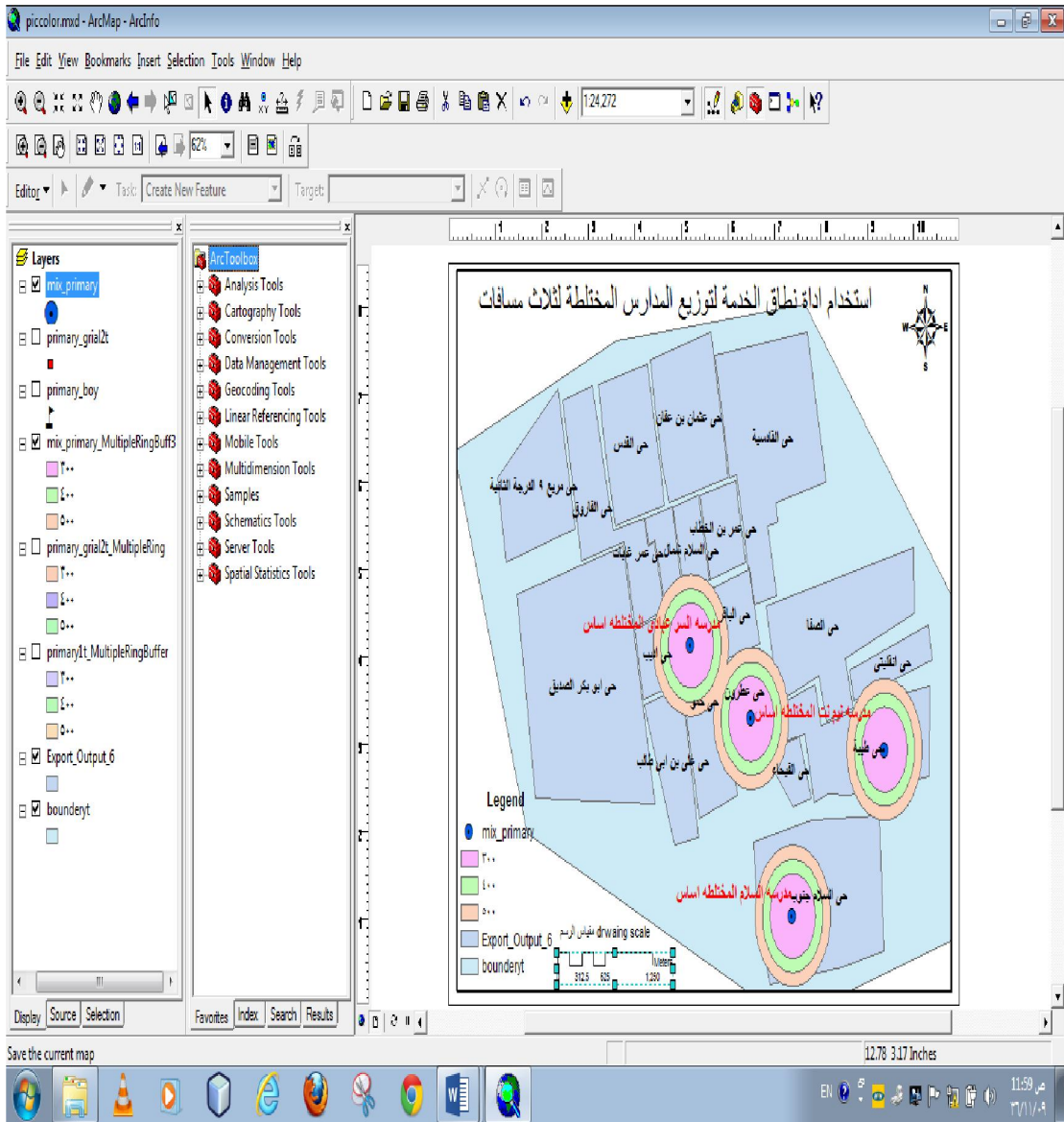


Figure 3-11: illustrates use tool (B Z A) for co-schools.

Figure 3.11: above illustrates use tool (buffer analysis) for co-schools for three distances and note from the figure that the overlap here few of any distribution of co-schools good, also from the figure we need to increase the number of co-schools, especially in peripheral respects and away from other schools.

3.3.3 Discussion Buffer Zone Analysis

As we mentioned above Figure (3.6, 3.7 and 3.8) model range easy access by standard distance to schools for boys, the following analysis is (analysis tools = proximity = multiplexing buffer in order to represent this distance has been adopting

distance 500 meters). As well as the adoption of the distance (300-400-500) meters from the school See figure (3.9, 3.10 and 3.11), accounting model maps easily access to school. The figure (3.6) is considerable overlap between the barricades and especially conventional zone and other areas. Indicating that there is a revival of more than one school, like Hamou Albagir, Siddiq, a reference to the distribution of farm schools within respects in the city center and the parties to the same importance in the distribution of schools and services, owing to a lack of vision to accommodate the planned expansion of the city.

This distribution are in accordance with the basis of horizontal distance dimension level from all sides at the same distance from the non-observance of the basis of extensions of main streets or sub streets and lengths. Since network analysis model was adopted to set up easy access to space.

3.3.4 Directional Distribution Analysis

The directive distribution explain if the spatial distribution for phenomena has a specific direction. So you can get an oval shape which express the properties of the spatial distribution for phenomena where the center of this oval shape will be conformable to the center of aggregation.

The directive distribution approach has been used to know the direction of spread the pointing distribution for school's location.

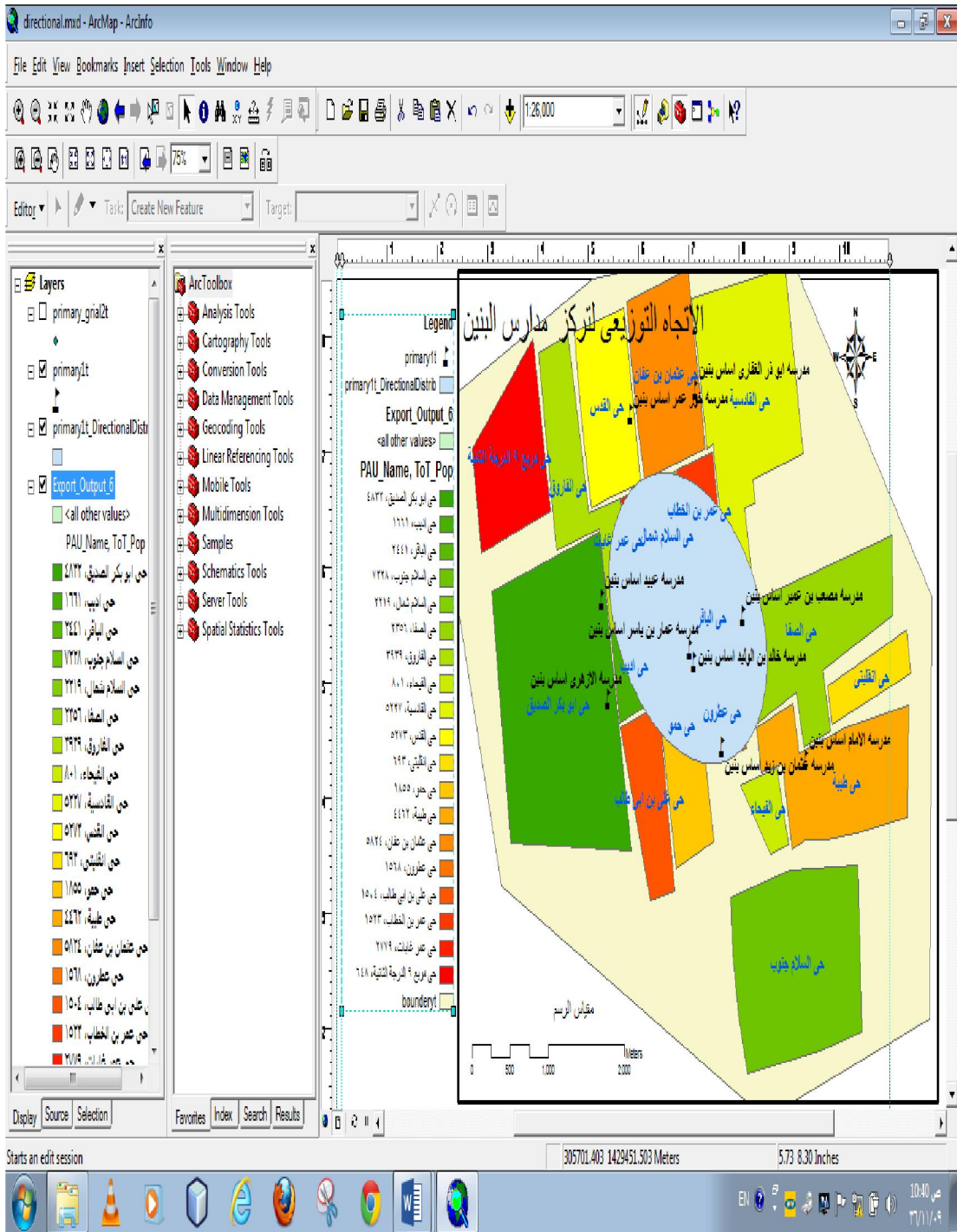


Figure 3-12: (D D A) reveal concentration of boys' schools, distance (500) m

Figure (3.12) above shows the direction for the distribution of boys' schools, which takes the form of the direction of the northwest, and tends to the southeast which shows a little concentration in the middle. So you must use this tool when creating new schools, to help decision makers and planners in the proper distribution in the future.

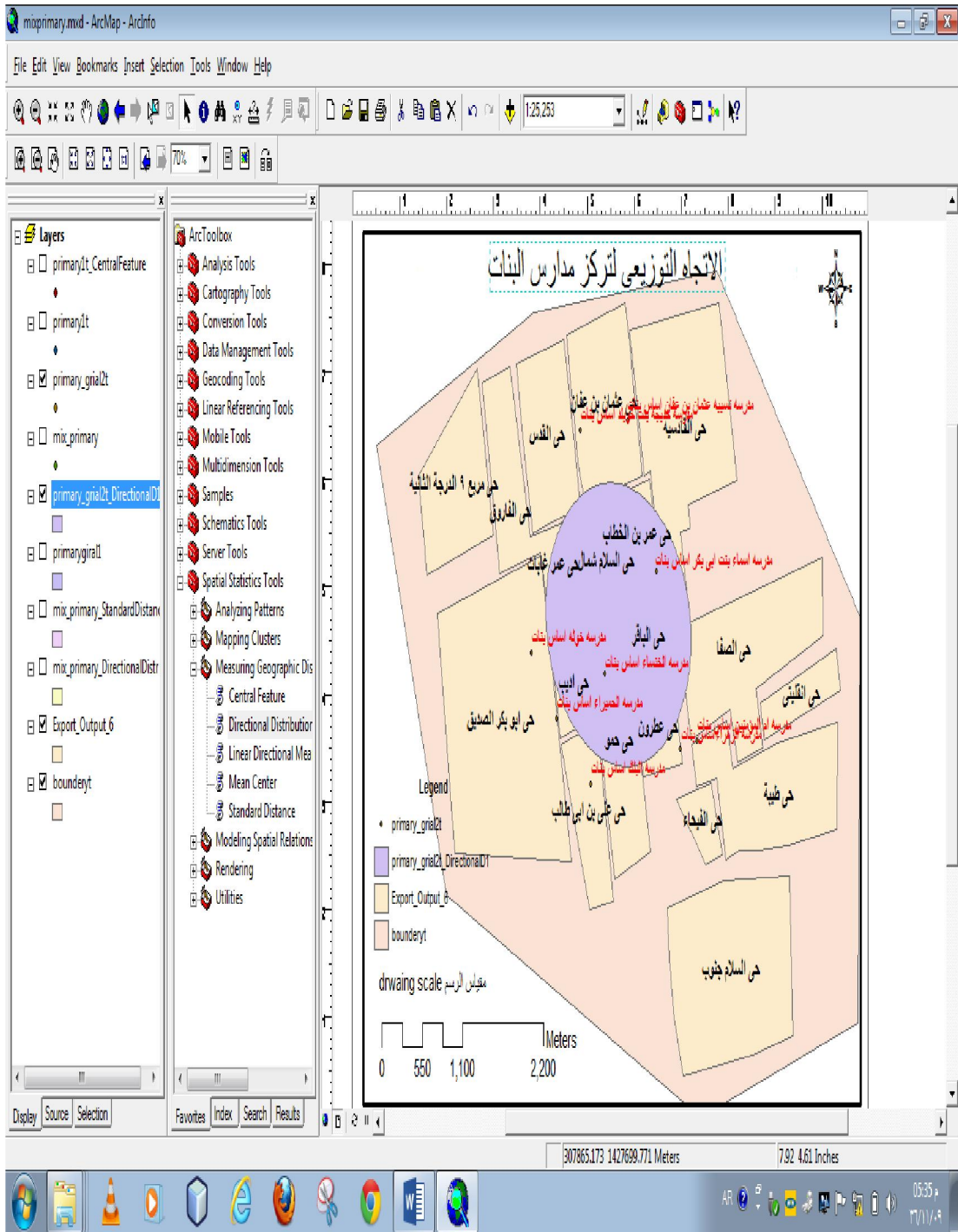


Figure 3-13: (D D A) show concentration of girls' schools, distance (500) m.

Figure (3.13) above shows the directions for the distribution of girls' schools, which takes the shape of the direction of North, South and it turn northwest bit, which indicates the concentration in the north. So it must use this tool whenever creating new schools, to help decision makers and planners in the ideal distribution in the future.

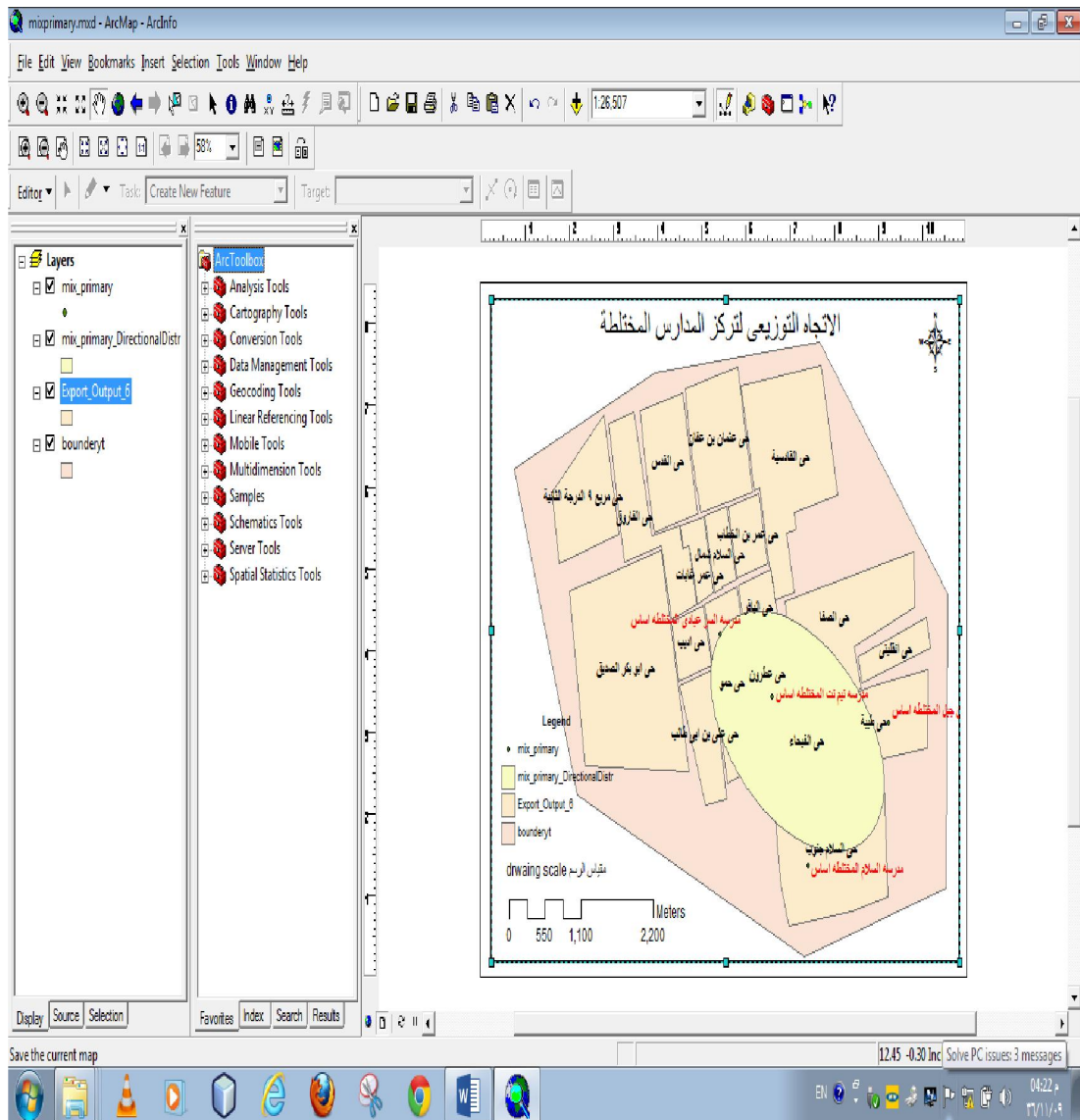


Figure 3-14: (D D A) show concentration of co-schools, distance (500) m.

Figure (3.14) Above shows the trend for the distribution of co-schools, which takes the shape of northwest direction from the middle, turn too much towards the east, which indicated to their concentration from Middle to Southeast. So you must use this tool when creating new schools, to help decision makers and planners in the ideal distribution in the future.

3.3.5 Discussion Directional Distribution Analysis

As shown in figure (3.7), the directive distribution for the boys school's locations was get an oval shape, the density in the distribution of this schools was

northwest and southeast direction for its spread in the city.

While figure (3.8) the girls' schools distribution take semi-circular, shape tends to the middle and slightly to the south. Figure (3.9) the co-schools takes oval shape in the middle for Northwest direction tends dearly to the southeast.

3.3.6 Analyzing Nearest Neighborhood.

The spatial analysis describes the pattern of spread of spatial phenomena through comparing between the real distribution of phenomena and theoretical distribution; the neighboring coefficient will be between (0 and 2.15).

Table 3-2: The values of neighboring coefficient

The value of neighboring coefficient	Branch Pattern	The value of neighboring coefficient	Pattern
zero	clustered	less than 1.0	Convergence\clustered
From zero to 0.5	Convergence but irregular		
From 0.5 to 0.1	convergence but tends randomly		
		0.1	Randomly
From 0.1 to 0.2	Divergent	More than 0.1	Divergent\regular
0.2	Regulate		
More than 0.2	Regular		

The Neighboring coefficient measurement has been applied automatically when the data has been entered and the abscissas of points has been laid for the schools locations on the digital map.

The nearest neighbor analysis displayed, the distribution of Umm Rawaba city schools seem it has a clustered randomly branch pattern but it is irregular. See

figure (3.15) and (3.16).

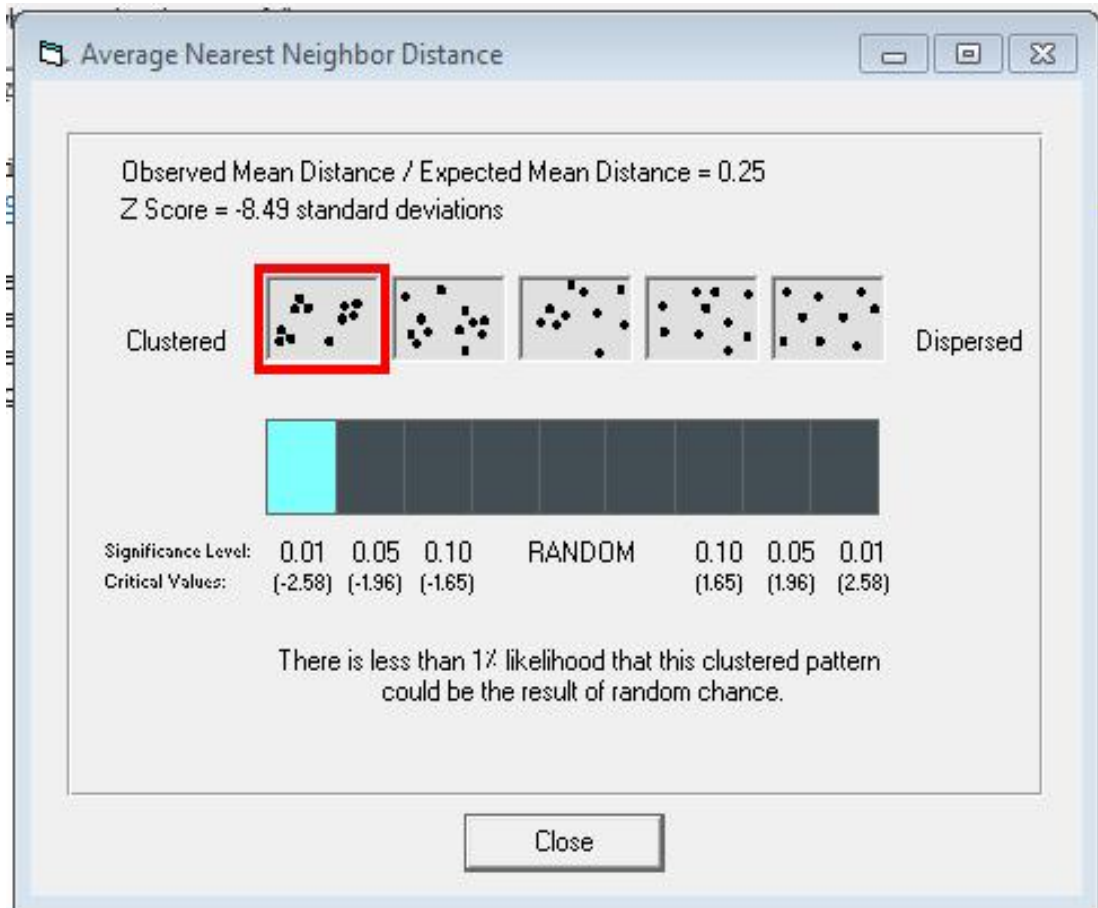


Figure 3-15: Nearest Neighbor Analysis of Primary Schools in Umm Rawaba.

Figure 3-16: Above Pattern Analysis reveal random distribution of umm Rawaba schools based on average Nearest Neighbor Distance.

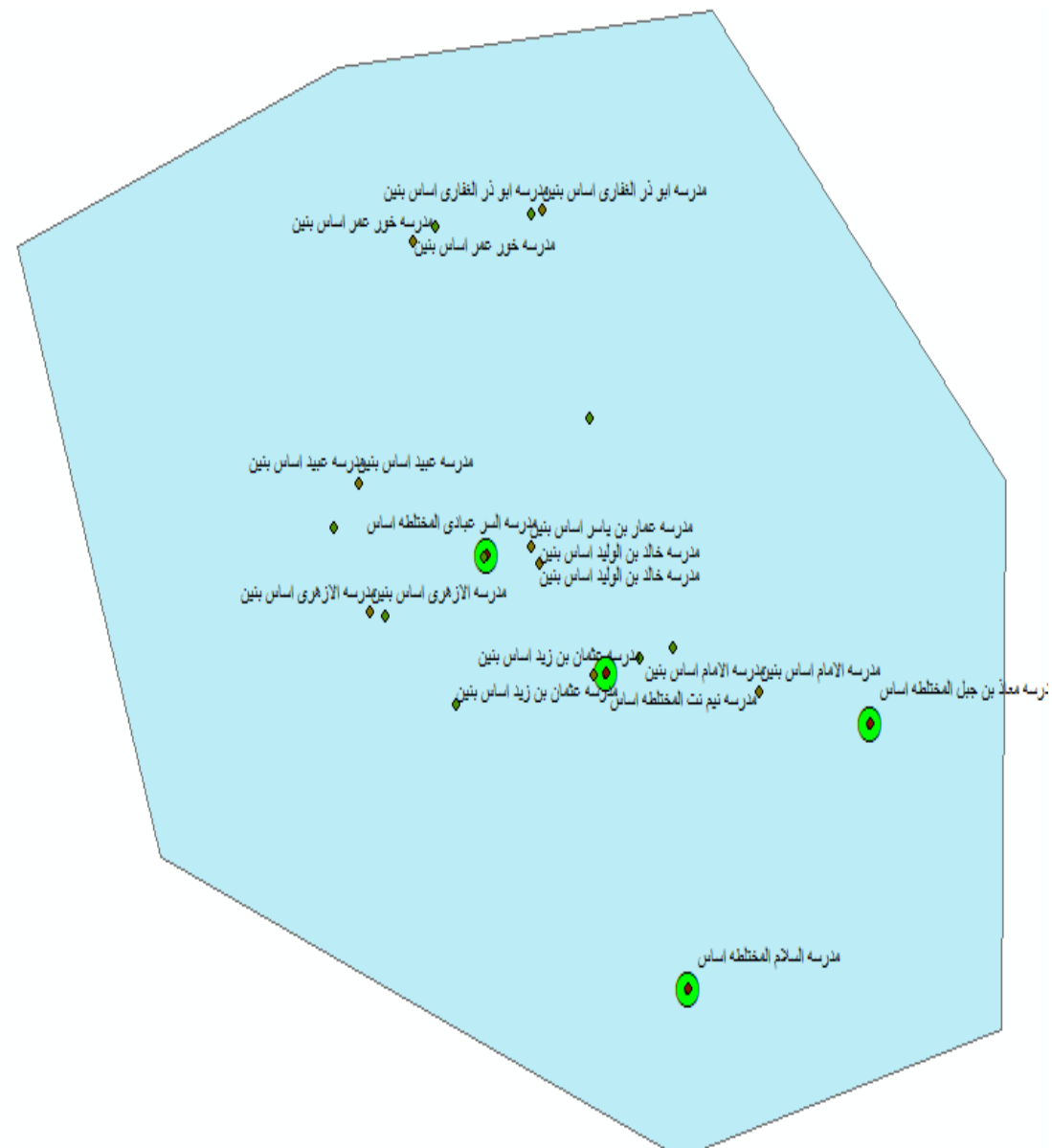


Figure 3-17: illustrate random distribution of umm Rawaba schools

Figure (3.16) above appearance random distribution of umm Rawaba schools based on average Nearest Neighbor Distance.

3.4 The best-suited recommended distribution model for primary schools model.

The most suitable model of distribution is an important topic and it is recently area of study especially with GIS, because it has help the planners to determine the best locations of schools distribution. After studying the standards of capacity, accessibility and environmental standard selecting the most appropriate site for primary schools, according to the criterion of absorption capacity, the total increase in students (5927 students). This increase presented the need to (28) of school capacity (240).

While environmental criteria, represent the conditions of moving the schools from commercial, industrial areas, the main streets, especially within the neighborhoods Hamuo and Faiha and focusing on creation schools in the new respects. Because its represent extension for the future of city. See figure (3.15).

Figure (3.16) below shows the best suggestion for school of umm Rawaba city, based on results of analysis mention above, also shows moving of some schools from main street according to criteria mention above (accessibility, Environmental considerations) and based on analysis tools discussion in paragraph(3.3.3, 3.3.5 and 3.3.6) .

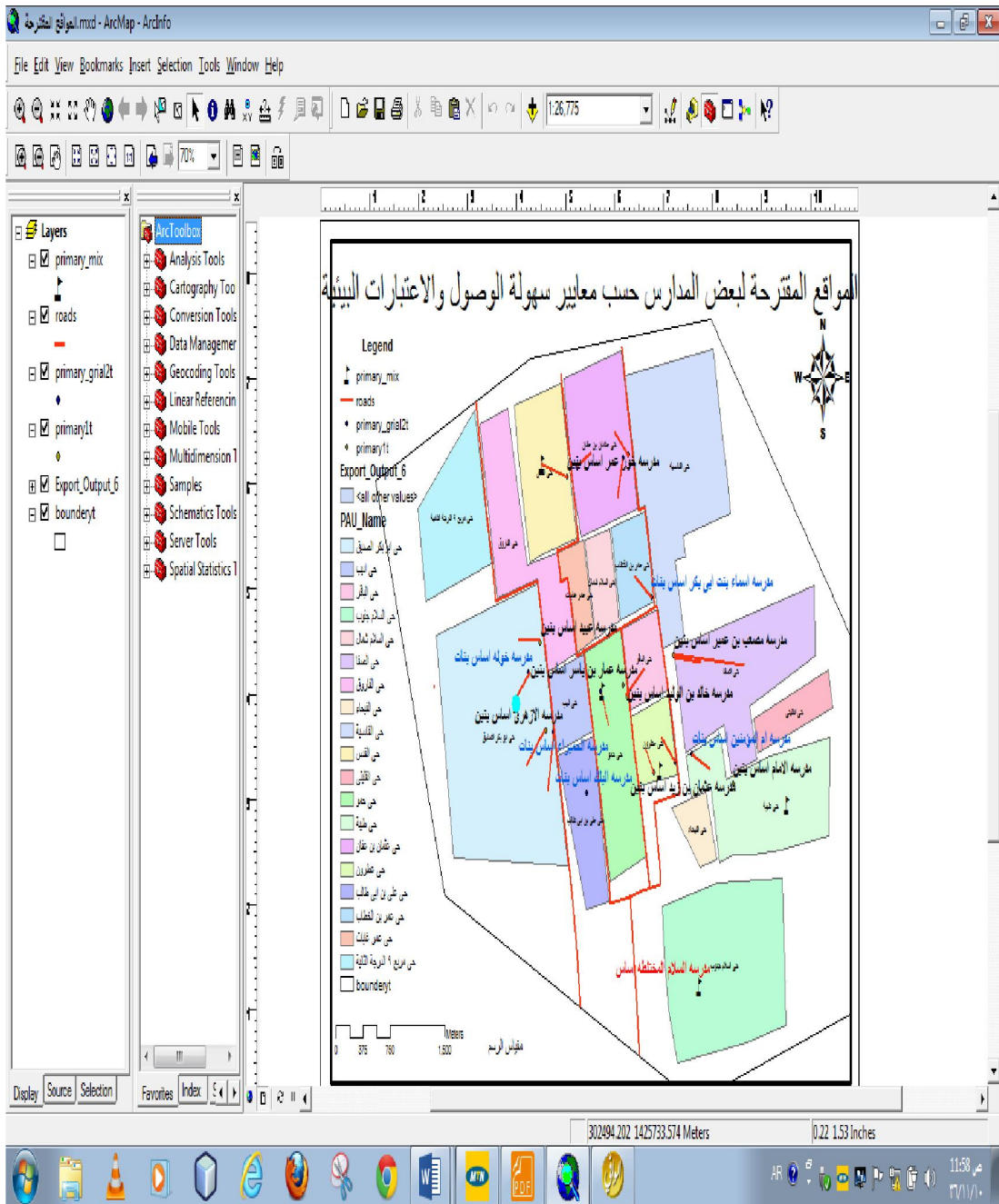


Figure 3-18: The best-suited recommended distribution model for primary schools model.

Also output of distance criteria represented an important resource for use in the preparation of the final model suited for the best distribution to the schools, so that consideration developing for these alternatives and proposals for planning the most appropriate distribution to schools are:

- Create new schools: (14) school for boys (14) school for girls as needed, based on the criteria mentioned above.

- Expansion of the old schools and rehabilitation:

This represents an increase in the capacity of schools in heavily populated places being less expensive than the previous alternative, as well as benefit in densely populated areas and low size and space conditions are available for schools.

The relocation of some existing schools, depending on the criterion of distance and time, to suit the ability to age and physical infrastructure for access to school walk for a distance of 500 meters and estimated (10) minutes.

From figure (3.18) Distribution model best suited for elementary schools in the city of Umm Rawaba also claimed. The researcher found that there are schools remain in places without change with the increase in capacity by increasing the number of classrooms and schools are proposing alternative sites according to the criterion of accessibility, environmental considerations, and population density.

Chapter Summary

This chapter clarify methodologies followed in this study. Two methodologies has applied. The first method, Objective approach: describe the phenomena, variables and dimensions of geography and geographic distribution of schools. The second method is spatial analytical approach: describe the current distribution of schools. This approach applied using the GIS functions like neighborhood, buffer zone and directional distribution.

CHAPTER FOUR
RESULTS AND DISCUSSION

Chapter 4 Results and discussion

4.1 Results and Discussion

As we discuss in section (3.2) the results showed that:

1. Develop a model for the distribution of schools in Umm Rawaba city using *ArcMap 9.3* software. This model help the planners and decision makers to make the appropriate decisions.
2. Developing this model is depend on set of criteria such as:
 - 2.1. Capacity: after analyzing the data that collected from the Ministry of education and survey of filed study, the results showed that, the number of schools in Umm Rawaba City does not fit with number of students. So the system suggest to Establish (28 schools) according to the regional and international standards. See Figure (3.12) and Table (3.1), (3.2), (3.3), (3.4), (3.5), (3.6) and (3.7).
 - 2.2. Accessibility: was applied by using buffering and nearest-neighborhood tools— as showed Figure (3.5), (3.6), (3.7), (3.8) and (3.9) respectively reveal overlap of buffer zones, the criterion showed that there was a disorder in the distribution of this school. This disorder appear in the concentrate of school in the oldest neighborhoods – as showed in figure (3.6), (3.7) and (3.8), so many of students walks long distances in order to arrive their schools, especially in the modern neighborhoods.
 - 2.3. Environmental distribution: as in section (3.3.4), this criterion applied using directional distribution analyzing to determine concentration of schools. Then suggest the redistribution of schools and move it from the noisy locations and main streets. See figure (3.12), (3.13) and (3.14).
3. Based on the above mentioned, we concluded that the best way of distribution of Umm Rawaba city's schools showed page (56), Figure (3.18).
4. The application of the closest neighbor and scope of the service and the direction of the service is the distribution analysis contributed to the representation of the capacity and accessibility standards and environmental considerations this made it clear that the imbalance has contributed to the distribution of access to the most appropriate models for schools.

Chapter Summary

From the above obtained results, it is bear that using Geographical Information Systems and Global Positioning Systems help in planning and decision making also in preparing the models for the distribution of the schools ideally, or suggest a new locations when a disorder is exist, also contribute in provide an accurate information for this schools by creating Database for it.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

Chapter 5 : Conclusion and Recommendations

5.1 Conclusion

The research investigates the spatial distribution of primary schools in Umm Rawaba city, compared the available primary education facilities with the set standard of UNESCO (1996), education standards and UBE.

The study clearly depicts the process of using Nearest Neighbor and Buffer Zone Analysis in determining the distribution pattern and catchment area of the public primary schools. The coordinates of the primary schools in umm Rawaba city, were obtained using handheld GPS and plotted using the ArcGIS software.

The map gave firsthand information of their spatial distribution, and other relevant information, which would provide information that would help in decision making and planning.

The database created shows at a glance how the attribute and spatial data were connected. Some of the tools carried out showed the capabilities of the GIS in manipulating data to solve environmental problems. Since the distribution pattern of primary schools in umm Rawaba is random, students would find it hectic to travel long distances to attend some of the day schools. This may result in financial implications that some of the students may not even attend school.

5.2 Recommendations

Based on the analysis of result, research findings and conclusion of this study, the following recommendations were made.

1. Nearest Neighbor, buffer, directional distribution Analysis is recommended for determination of spatial distribution pattern of schools, since it shows clearly how these schools are distributed.
2. Prepare a detailed digital database for all schools citywide and local, state and all academic levels allowing knowledge structure of the distribution of educational services.
3. Using GIS technologies in the educational planning processes to integrate with the Ministry of Planning for the selection of suitable sites for the establishment of schools.

4. Directing the planners and designers of schools to consider the distribution of educational services based on regional and international standards.
5. Establish new schools, based on the criteria like distance, access time and capacity, to meet the need for educational services in the city.
6. School's Spaces should be compatible with the number of classrooms, and prepare students where even higher functional efficiency.
7. Circulate the study to the rest of the services to put her in the right places.
8. Use tool reclassify to help in services distribution.

Chapter Summary

This chapter describe conclusion of the result discuss in pervious and some of recommendations suggested by the researcher.

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