

# **Use Geographical Information System (GIS) for Creating an Educational Map within the Context of UNESCO - Education for Sustainable Development Program - A Case Study in Red Sea State in Sudan**

Elawad. H Thowiba  
University of Dammam  
Faculty of Education-Computer  
Science

A. M Alsamani  
Al Neelain University  
Faculty of Computer Science

K. M Kheiralla  
Al Neelain University  
Faculty of Petroleum and  
Minerals

## **ABSTRACT**

This study aims at creating an educational map for the basic education in the Red Sea state in eastern Sudan within the concept of the sustainable development and UNESCO vision "education for sustainable development" which allows all persons to acquire knowledge, skills, trends and the values necessary for creating a sustainable future. The Red Sea State, despite its strategic geographical location as the public port of Sudan, is considered as the largest areas with high illiteracy and mortality rate of infant and mothers in Sudan according to reports of the national health information center in 2003. Furthermore, the surveys of the United Nations Population Programs in 2004 indicate to high rates of illiteracy and school dropout compared with a decrease in school intake. For these reasons we have selected this state in order to identify the reasons behind the problem and find out the necessary solutions using one of the most helping tools to adopt the required decision representing in geographical information system (GIS) for it has the ability to analyze a large amount of data and information in different pictures making it as an important tool for many sectors to help them in adopting the required decision regarding the designing of strategic plans and future project as well as creating effective and efficient recovery programs in light of the available actual data and information. No doubt, the education sector is considered as the most sectors requiring the application of this technology and utilizes it in planning of educational services and support the decision making process.

## **Keywords**

Education, Sustainable, Red Sea, Aqiq, Geographical Information System (GIS)

## **1. INTRODUCTION**

In a conference on education and development organized by the Arab Thought Foundation in 2010 in Beirut Prince Khalid Al-Faisal confirmed that "the human development is the strength of the sustainable development; and at the first degree, is the responsibility of the educational system which must bear the responsibility of contemporary development to raise the future of the nation in a collective effort" [1]. Hence, education is the high ladder and essential tool though which the community is developed and the key guaranteeing the creation of sustainable future. The sustainable development is defined as the development that meets the current needs without affecting the ability of the coming generation to meet its special needs as an inevitable human right which should be met in order to achieve the sustainable development and an indispensable tool for the good judgment and decision taking as well as enhancing democracy. Therefore, the information

should support and development the ability of individuals, groups, communities and countries to adopt options serving the sustainable development and create a change in the mentalities of the person to enable them make their world more peaceful, prosperous and secure. The education for sustainable development may contribute in developing rural and urban areas by expanding the scope of benefit of education and improvement of its quality. Therefore, it is necessary to consider the education as an investment giving its fruits in the long run [2].

The importance of this study stems from the importance of education since the provision and quality of educational services are considered as aspects of urbanization in the contemporary communities and one of the most vital subjects preoccupying the minds of decision makers. Therefore, the decision makers shall consider education as priority number one by proper and fair planning. The importance of this study is increased by the use of Geographical Information System (GIS) on the fact that is an effective and essential tool to adopt the modern scientific style in development of infrastructure (educational and health facilities etc) and utilizes them effectively. It is also considered as a tool for inquiry and analysis a matter which will contribute in placing clear, complete and precise information before the decision makers.

## **2. EDUCATION CONCEPT FOR SUSTAINABLE DEVELOPMENT**

The education for sustainable development is defined as the education aimed at helping the people to have the attitudes, skills, prospects and knowledge necessary for taking clear decisions and conducts themselves based on these good decisions in order to achieve the benefits for themselves and other people now and in the future in order to achieve the sustainable development.

And it is the education which is seeking to develop the skills of citizens to be able to take leadership roles in promoting sustainability in order to gain a better society is not only environmentally but socially, economically and politically also[3]. It is also the education which leads the people bear their responsibilities and encourages them to democracy and enable all individuals and groups to enjoy their full rights while they perform their assigned duties.

The United Nations decade for education for sustainable development (2005-2014) in which the UNESCO plays a pioneering role aims at merging the principles, values and practices of sustainable development in all aspects of education and learning with a view to treat the social, cultural,

economic and environmental problems facing the twenty first century [4].

### 3. GEOGRAPHIC INFORMATION SYSTEM

The Geographical Information System is computerizing system for capturing, managing and processing of spatial data. The spatial means the geographical features on the earth surface or any other industrial features such as buildings, roads or other natural phenomenon features such as web and ebb, pollution etc. [5] [6].

There are too many studies addressing the use of GIS in education and education systems for sustainable development was where almost all agreed that the geographic information systems relevant to the decision in support of the development of education and to promote the concept of education for sustainable development.

Fabiya [7] defined Geographic Information Systems as a unique integration of computer hardware, software, peripherals, procedural techniques, organizational structure, people and institution for capturing, manipulating, storing, analyzing, modulating, modeling and displaying geographically referenced data for solving complex human related problems.

Muhammad, Mansur Aliyu(2013) [8] said in a study conducted in Nigeria addressed by Relevance of Geographic Information Systems (GIS) and Remote Sensing (RS) to Environmental Education: A Panacea for Sustainable Development There is no doubt that one of the most important prerequisites for sustainable development is the availability of accurate, reliable, up-to-date and standard geoinformatics data particularly that of Geographic Information System and Remote Sensing on natural and cultural resources of the

country and It is important to note that, Geographic Information System and Remote Sensing technologies help to provide information and knowledge to policy makers and environmentalist on areas with severe environmental pressure which will provide efficient knowledge on how to manage

the environment

In another study conducted by Serena, Sanet & Christopher(2013) [9],they said GIS has been proven to offer theories, methods and applications to effectively support planning and decision-making for sustainable development through the production and maintenance of geographic information, distributed access to spatial environmental information, solving spatial sustainability problems, collaborative spatial decision-making and public participation.

### 4. DESCRIPTION OF THE STUDY AREA

Most of the educational facilities concentrate in Port Sudan the capital city of the state of the Red Sea, and in addition to the decrease of level of awareness among the population regarding the importance of education; while we find that few numbers of educational facilities scattered in other localities since the concentration of educational facilities in the capital city of the state will make it difficult for the citizens living in other localities to reach them. This was the main reason for spread of ignorance in the Red Sea state since we noticed that the citizens send their sons for work instead of education in addition to the poverty which prevents so many families not to care for education of their girls and send their sons only for

education. The Red Sea State is considered as the most states with high rates of ignorance as well as poverty and disease.

The Red Sea State lies in eastern part of Sudan and covering an area of 21887 km<sup>2</sup> (Fig. 1) bordering by Kassala State and Eritrea in the south, River Nile State in west, Red Sea in east and Egypt in the north and its surrounded from the north eastern parts by the Red Sea hills. The state is covered by 16 topographical sheets (1:100 000). The area of the study was selected because it is an area rich with multiple natural resources and high population density but the education in the state faces so many hitches and glitches delayed the development of the state.



Fig 1: Location of the study area

The number of population in the state is estimated at 1,396,110 people in 2008 some 300,000 person of which are living in the city of Port Sudan [10], the capital city of the state dominated by Beja tribe people. Due to the strategic location of Port Sudan, the population of the city increased rapidly in the last few years. The increase of the population is mainly attributed to the migration of people from the rural area and the migration from other urban areas for the young men seeking work, health and better education.

### 5. REALITY OF EDUCATION IN THE RED SEA STATE

The state works mainly for education of all and ensure provision of education for children everywhere in the state to enable them complete one course of primary education and eradicate inequality of education between the two races and eliminate of difference in level of education by the year 2015.

The rate of pupils attending the first primary classes up the fifth elementary class is estimated at 99.2% cared by 1484 of trained teachers (1013 female and 470 male teachers). The increased number of female teachers is attributed to immigration of male teacher to the oil rich Gulf countries in search for jobs.

The level of reading and writing knowledge from an age of 15 years of old and more is estimated at 52%. The percentage of female to male in knowledge of reading and writing from 15 years of old and more is 103 or (103 of women to 100 of men). The following table (1) shows the number of children attending the first class of each school grade as well as the percentage of boys attending schools compared to girls and the rate of completion of the basic education stage for students who completed the primary schools grade.

**Table 1. The School Grades and Enrollment Rate**

School Stage	Percentage
Children of primary school age enrolled in the 1 <sup>st</sup> classes of Basic education and secondary stage	48%-69.5%
Rate of enrollment in the basic education stage (girls compared to boys)	67.4%-71.4%
Rate of completion of basic education stage	18.2%
Children of secondary school age currently enrolled in secondary schools or high institutes	29.2%

The researcher distributed the schools into different categories as follows: basic education schools for girls, basic education school for boys, mixed basic education schools, boys secondary school, girls secondary school, mixed secondary school. There are (62) basic education schools for boys in the state of which (30) in Port Sudan, (7) schools in Sawakin, (7) schools in Tokar, (7) in Sinkat and (2) schools in Haya one school in Halayeb and one school in Aqiq and one school in Qaneb (Fig. 2).

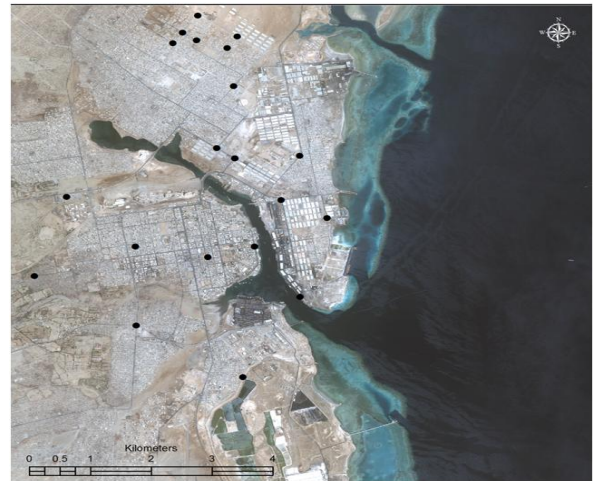
We shall discuss as an example the locality of Halayeb according to the last population census in 2008 revealed that there is 33,705 of male under sixteen years of age. Supposed that 10,000 of which (more than a half) are at the age of school, is one basic education school is sufficient for them? Actually they need at least (5) five basic education schools for boys. The situation applies to other localities i.e Qaneb and Aqiq.

Regarding girls schools there are (65) girls schools in the state of which (43) schools in Port Sudan, 2 in Aqiq area, one (1) school in Halayeb, six (6) schools in Haya, two (2) schools in Sawakin, six (6) schools in Sinkat, three (3) in Tokar and one in Qaneb area (Fig. 3).

We will take for discussion Qaneb area where the number of female under age of 16 years is estimated at 21,563 girls according to the last population census in 2008. Suppose that one fourth of them is in the age of basic education, this number requires at least (6) six basic education schools for girls.

Meanwhile, the number of mixed basic education schools is estimated at 195 schools most of them are Kindergartens and Khalawi (Quran Kindergartens).

As for secondary schools there are (17) secondary schools for boys 10 of which in Port Sudan, 2 in Haya, One in Sawakin, 4 in Sinkat while no secondary schools in other localities. The state consists of 21 girls secondary schools 16 of which in Port Sudan, two 2 schools in Haya, one 1 in Sawakin, two 2 in Sinkat with no girls secondary schools in remaining localities of the state. There are 7 mixed secondary schools five of which in Port Sudan only.



**Fig 2: Distribution of Educational Services in the Capital of Red Sea State**

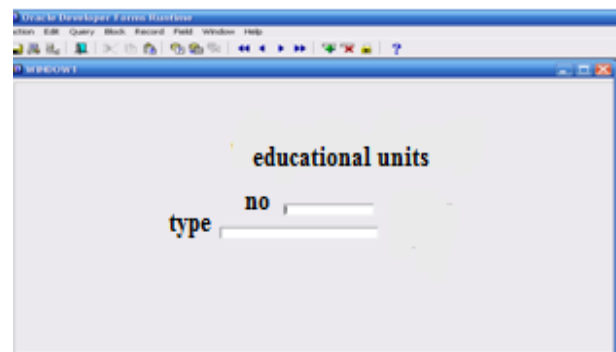
## 6. BUILDING THE EDUCATION CHART

The first phase is left for analysis of data bases which the phase responsible for analysis of the units entered in the formation of the system as a description of the inputs, analysis of processes and deliverables such as tables, files, entry screens, inquires, analysis of Charts used in the system. However, the second phase is left for designing (Design Phase) in which we have designed the required screens through which we shall collect the required information needed for the Geographical Information System. The data base and entry screens designed by using oracle data base management system[ 11 ],[ 12 ] the entry screens shall be clear and easy to use and provide the mechanism necessary for entry of information and data as quickly and easy as possible through the use of menus and selection boxes as well as other helping tools. Each designed table shall have at least one data entry screen (input screen) for entry of information in the data base table. Hereunder you find examples of these data entry screens (input screens).

## 7. DATA ENTRY SCREENS

### 7.1 Educational Facilities Screens

The number and type of the facility is entered through educational facilities screen. They include basic education schools for boys and girls and secondary schools for boys and girls and mixed schools (Fig. 3).



**Fig 3: Entry of Educational Facility Data**

## 7.2 School Screen

For entry of number of locality as well as number and type of the school (Fig. 4).

Fig 4: Schools Data Screen

The Charts and required classes were designed. Hereunder are examples of some Charts with categories and classes of the schools at different educational classes in the state (Figs. 5, 6 & 7).

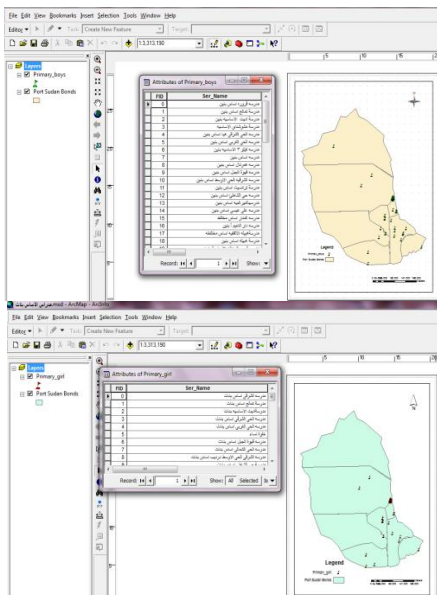


Fig 5: A Chart showing the Girls and Boys Basic Education Schools

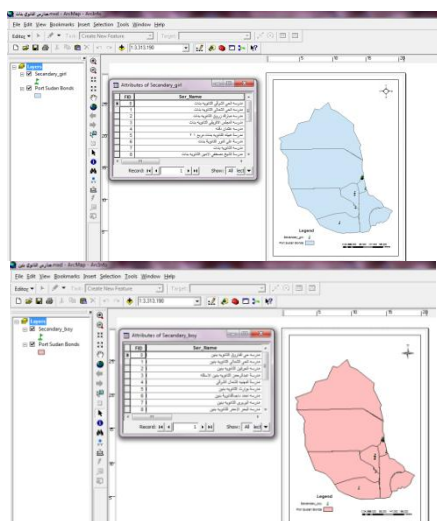


Fig 6: a Chart showing Boys and Girls Secondary schools

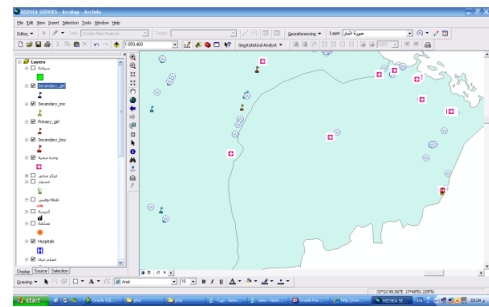


Fig 7: a Chart showing Aqiq province as an area proposed to increase the educational facilities

We have selected Aqiq area (locality) as a suggested area for increase of educational facilities (schools) where the total number of its population reaches 78,922 persons distributed between age categories of (0-16 years) and from (17 years) and above in Table (2).

Table 2. Population reaches distributed in Aqiq area

	0-16 Years	17 Years & above	
Male	32,820	Male	25,615
Female	14,431	Female	20,557

Aqiq locality is dividing into two administrative units Aqiq and Qarourah where there are only two basic education schools in Qarourah and one Secondary School in Aqiq. These numbers of schools are completely not suitable for the number of population in Aqiq locality, therefore Aqiq is considered as a model area for establishing more educational schools since there are good number of health facilities and water sources.

## 8. CONCLUSION AND RECOMMENDATION

Therefore, this study tackles creation of educational chart for general education in the Red Sea in Sudan using the GIS connecting it with the data bases namely linking the data with its spatial location. According to this study we recommended the following:

- Aqiq locality was selected as suggestive for the decision makers to increase the number of schools (educational facilities) according to the last population census and the number of health facilities and provision of water sources in the area. The provisions of all these facilities are considered as good indications for the possibility of increasing the educational facilities to control the transpiration and movement from one area to other areas.
- Taking the locality of Aqiq as a model and applying it on all other localities facing the same problems which are almost all other localities of the states.
- Increasing number of schools, proper food program in parallel with education to eradicate the poverty and encouraging citizens to educate their children instead of sending them for work.
- Taking into consideration the close relationship between education and sustainable development representing in (economic development, social development and environmental development), so

development could not be achieved without provision of qualified human resources and that education or learning process is the core basis of the sustainable development.

- Generalizing and spreading of education ensuring the provision of equal chances between girls and boys, giving more attention to training and vocational training capable of graduating qualified and skilled technicians in order to decrease the rates of unemployment and poverty.
- Disseminating the knowledge and importance of geographical information systems (GIS) for its benefits and the effective tools the GIS may provide in analyzing, and processing large amount of data and information in different aspects making it an important tool for so many sector to help them in decision making process in designing strategic plans.

## **9. ACKNOWLEDGMENTS**

Thanks and appreciations are due to: the local government in the Red Sea State for providing the data, advice and support all over the period of this study. I wish to thank the University of Dammam, and especially appreciate the assistance of the staffs of the computer science.

## **10. REFERENCES**

- [1] [http://alwsa21.blogspot.com/2013/05/blog-post\\_21.html](http://alwsa21.blogspot.com/2013/05/blog-post_21.html). 2013. Relation between sustainable development and education.
- [2] High Level Meeting of Education & Environment Ministries 2005. The Economic Committee for Europe-Environmental Policy Committee. Vilnius, Lithuania.
- [3] Education for Sustainability, Australian conversion foundation, issue 8, 2001.
- [4] <http://www.unesco.org/new/ar/education/themes/leading-the-international-agenda/education-for-sustainable-development/>. 2014. Education for Sustainable Development (ESD)
- [5] Sami Jazmati, Sami Maqdesi. 2002. Geographical Information Systems, Arab Orient House, Lebanon Beirut.
- [6] Guidelines for Developing a Successful and Sustainable Higher Education GIS Program- An ESRI ® White Paper • August 2008.
- [7] Fabiyi, S. 2004. “Application of Geographic Information Systems (GIS) and Land Information Systems (LIS) in Urban and Regional Planning”. 2004 MCPDP. NITP and TOPREC: Ada, Osun State, Nigeria. Federal Republic of Nigeria (2004). National Policy on Education, Lagos NERDC Press.
- [8] Muhammad, Mansur Aliyu, Relevance of Geographic Information Systems (GIS) and Remote Sensing (RS) to Environmental Education: A Panacea for Sustainable Development in Nigeria, Academic Journal of Interdisciplinary Studies, MCSER Publishing, Rome-Italy, Vol 2 No 10 ,October 2013 75.
- [9] Serena Coetzee, Sanet Eksteen & Christopher Grundling, Sustainable Development: The Contribution from GIS Education in South Africa, South African Journal of Geomatics, Vol. 2, No. 3, June 2013 246
- [10] Census Bureau Statistic. 2008. Red Sea statistics Office.
- [11] Ramez Elmasri, Shamkant B. Navathe, Fundamental of database systems, Addison-Wesley, sixth edition 2010.
- [12] Lance Ashdown, Tom Kyte, Oracle Database Concepts, 11g Release 2 (11.2) MAY 2014.