Analysis Of Educational Services Distribution-Based Geographic Information System (GIS)

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Abstract: This study analyzes the spatial distribution of kindergarten facilities in the study area based on the Geographic Information Systems (GIS), in order to test an efficiency of GIS technology to redistribute the existing kindergarten and choose the best location in the future and applying the standard criteria for selecting the suitable locations for kindergarten. To achieve this goal, the data and information are collected via interviews and comprehensive statistics on the education facilities in Mukalla districts in YEMEN, which contributed to building a geographic database for the study area. After that, the Kindergarten spatial patterns are analyzed in terms of proximity to each other and used near some other land in the surrounding area such as: streets, highways, factories, etc. Also, measures the concentration, dispersion, clustering and distribution direction for the kindergarten, this study showed the effectiveness of the GIS for spatial data analysis. One of the most important finding, that most of the Kindergarten was established in Mukalla city, did not take into account the criteria that set by the authorities. Furthermore, almost district suffers from a shortage in the number of kindergarten, and pattern of distribution of those kindergartens dominated by spatial dispersed.

Keywords: Spatial Distribution, GIS, Kindergarten, Dispersion, Spatial Analysis, Geographic Database.

1. INTRODUCTION

GIS is useful in the analysis and evaluation of the performance of different services, and identify disadvantaged urban areas for the redistribution of services where it also serves as compared to what is already planned what is the reality of a particular area to determine property and legal responsibilities and contribute to building mathematical models of the slums by identifying where urban growth trends to limit the spread as well as the development of existing areas[1]. It is a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes[2], the GIS can be used for many different purposes in public services, especially in educational planning and management[3],[4]. Educational services is one of the most important public services that must be provided to members of any locality, as the education sector of the most associated with the construction of the future and the achievement of the renaissance and overall development sectors, because of its direct links to political reality and the economic social and cultural sectors, so governments are striving to provide educational institutions of all levels (kindergartens, kindergarten, universities) in order to accelerate progress and prosperity, where the Progress and people's development are measured by available services to the population, but not the amount of these services only, but the quality of these services and their conformity with international standard and Specifications in the planning[5]. The planning and distribution depends on several criteria like: the distance, population and other land use. Also taking into account the urban expansion in those areas and assessment of needs the future population in respect of educational services[6]. Spatial resolution problems usually involve a wide range of possible alternatives and multiple, conflicting and equal evaluation criteria.

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Alternatives often evaluated by a number of individual's decision-makers, managers and stakeholders[7], [8], [9]. Improving educational effectiveness needs an increase the number of education facilitates quality and quantity, to satiate children with knowledge and skills in the curriculum, despite the poor quality of education at all levels, urging an improvement at the primary level, where the children basic attitudes and approaches to learning, improve the quality of education for children in kindergarten are a prerequisite for the development of the necessary human resource base to meet the demands of the changing technology of the twenty-first century, provides a brief history of primary education in developing countries[10]. There are many ways to improve the education:" ways to help children learn ways to perform managerial and other institutional functions better; ways to make access to education more equitable"[10]. In my opinion, this study is one of the few studies in the field of educational services using geographical information system integrated with data mining technology. However, most studies in this area have focused only on the spatial analysis of the reality of the services. An equitable distribution of services will be reached and raised the level of efficiency in the distribution of the service in the study area.

1.1. PROBLEM AND MOTIVATION

Since the establishment the schools and kindergartens in the study area over the past years, which mostly focus on hustle and paralyzed traffic in many themes and main streets, due to lack of geographical distribution of kindergarten, and some populated areas there was not enough kindergarten to accommodate the growing number of population, and the kindergarten did not take into account the criteria and requirements for kindergarten construction, especially new one. So, must apply the "principle of equality" in the distribution of educational services in order to reach all residents in urban and rural areas, and be far from roads and industries risk.

1.2. STUDY IMPORTANT

The importance of this study helps us to analyze the present situation of educational service distribution, the main purpose to use GIS to distributional education services is to assist a decision maker take the right position of kindergarten, to ensure the equitable distribution of educational services for all

residents. This study is the first study of the spatial distribution of educational services (Kindergarten) with use GIS in Hadramout province.

1.3. RESEARCHHYPOTHESIS

- The possibility of the use of geographic information systems, which has accurately and quickly resolved the problem of the distribution of educational services.
- Most kindergartenin the area of distribution of random, unorganized, it doesn't take into account the standard criteria in distribution planning.
- Most areas need more kindergartensuffer from a severe shortage.

1.4. DATA AND METHODOLOGY

The research methodology divided into five stages:

1. General Survey and theoretical: This stage includes a survey of the study area, concepts, models and theories that are related to the subject of this study.
2. Data Collection: This stage includes collecting the descriptive and spatial data depending on the formality statics, reports, interview and observation.
3. Data preparation: This stage includes data processing, coding and data entry, and dropping data collected on digital maps and tables to carry out an analysis this data by using (Orange2.7,WEKA3.6) data mining and ArcGIS10 software.
4. Spatial and Quantitative Analysis: On this stage, the current reality of the educational service distribution was analysed, and identify the problems and vulnerabilities faced with developing proposals and appropriate solutions and perceptions of the future.
5. Results and conclusion: This stage evaluates the results and developsrecommendations, in order to get rid of the problemsof the educational services sector. Finally, view the study's conclusion and ambitious feature of this study.

1.5. STUDYAREA

Mukalla City, capital of Hadramout province, it is located on the Arabian Sea coast in the south of Yemen, as shown in figure 1, Mukalla is one of the most important Yemeni commercial ports, and it contains most of the fishing centers as well as many fishery factories. Many public markets and beautiful coasts where you can enjoy swimming and lying under the sun. It is located between latitude 140 25.843'N to latitude 140 34.460'N and longitude 49 1.469'E to longitude 49 14.355'E. After the reunification of North and South Yemen in 1990, Mukalla city witnessed a major change, especially with the distribution of land in the four-year period between 1990 and 1994. In year 1994, the city's population was about 116000 which have increased to present populations of 180000 (estimates of year 2004) with an annual growth rate of 3.8%[11]. Around 16% of the total population in Hadramout lives within this city. After 1994, the city observed a significant construction boom, financed mainly by Yemeni expatriates and local investors, as well as Saudis with Yemeni origins. The Mukalla city has developed over the years in linear fashion along the coastline in an east-west direction, covering a distance of 161,749 km2 between Fowah to the west and Rayan to the east, but with only 5% of the population. Still, it is estimated that over 80% of the population live in the city center, located about 4 km deep from the coastline and around 4 km in the east-west direction.

Figure1: *Political Map of Republic of Yemen, and map of study area - Mukalla city extracted from Google maps (May-2014)*

2. DATA COLLECTION

The required data were compiled; it is included spatial and descriptive data from several different places:

1. Ministry of Education (MoE) Collecting needed data on existing kindergarten's location and descriptive data about kindergarten such as (kindergarten name, number of children, Etc.)
2. Ministry of Statics (MoS) collecting data about population density for several years distributed to districts, also the proportion of the annual population growth.
3. General Authority for Land Survey and Urban Planning (GALSUP), we obtained an AutoCAD Soft copy map about Mukalla district with zone boundary.
4. The Field survey, through interview, observation and Survey the kindergarten locations accurately with using a GPS device.

3. DATA PREPARATION

The data preparation means Cleaning and reshaping the data and takeout them with suitable form to be analyzed and processed. It is very important phase before the start of process data processing and the extraction of knowledge must be undergoing data preparation, after the completion of the data collection process, the data is prepared and cleaned, and Create a geospatial database, that is contained on Layers to raising landmarks (Raster layer, shape layer and vector layer) as follows :

Raster layer: Image satellite for study area, with extension ".TIF" in 2013, WGS1984, UTM Zone 39N.
Shape layer: includes kindergartenand land uses as (Points), Main road as (Lines) and districts as (Polygons).
Vector layer: change AutoCAD File of study area boundary into ArcMap Layer.

4. GIS AND EDUCATION FACILITIES PLANNING

GIS is a system for storage, analysis, management and presentation the data and maps associated attributes as spatial information that is spatially referenced to the Earth's surface[12], It relates to all the features and the process that occurs on the surface of the Earth. Information is the hearth of geographic information systems, where store the enormous amount of data and analysis[13]. GIS is applied in many developed countries in the world, the trend towards for use of geographic information systems and educational facilities mapping to support decision-making, especially in the Ministries of Education[14][15]. Educational services planning includes a wide range of educational planning and management issues, it relates the resource allocation and efficiency in the delivery of services and improve the efficiency of learning, mapping is a tool commonly used to detect relationships among the education facilities and the distribution of the population of school age. The availability of the GIS database comprehensive framework and spatial planning as well as non-spatial data has become a tool to assist in the planning and decision making, mapping of kindergarten along with information on administrative boundaries and physical layers such as the network of main roads and the reality of the earth in terms of geographical coverage[16].

5. THE IMPORTANCE OF KINDERGARTENS

Kindergarten is the earlier stage of primary education, where it plays an important role, especially when forced women to the labor market, it was necessary to have a substitute for the care of children, especially in the early years of age, in addition to the presence of children in this role during the day reduce the burden on the mother and enable them to do household duties[17]. In Yemen, the education divides before university education into three stages (kindergarten, elementary, secondary), the Kindergarten education very important at the age 5-7, the role of kindergarten is very crucial to a child's overall mental and academic growth. There are many reasons that make it so. An effective kindergarten background will come in handy when the child moves on to the big levels[18]. Table 1, shows the standard criteria for kindergarten, for example, each 300 children must have at least one's kindergarten with an area of 4500-15000M2, this area includes buildings, recreational spaces and services.

6. THE SPATIAL ANALYSIS OF KINDERGARTENS

The study area divided into two sectors (Eastern sector and Western sector) as shown in figure 2, each sector contains many districts, to manipulate the quantitative and spatial analysis such as the absorptive capacity of kindergarten, distribution style, transfer time and land uses with using the Spatial Statistics tools (Spatial Analyst and Analysis Tools) that are available in ArcMap10. The distance is analyzed from each kindergarten to it is neighbors, and the proximity of land uses, such as (highway, main road, fuel stations and workshop); also determines the distance between population Mean Center and kindergarten in the same district to calculate transfer times for kindergarten[19].

Table 1: Shows the International standard criteria for education facilities

International Standard/(Criterion)	Kindergarten Aged (5-7)
Distance from residence to kindergarten (Kilometer)	0.2-0.4
Distance from residence to kindergarten (Minute)	4-8
No. of Children / kindergarten(children)	100-300
No. of Classroom / kindergarten(Class)	1-4
No. of Children / Class(Children)	15-20
Kindergarten Area(M2)	4500-15000
Children Portion of Area/Kindergarten Area (Children)	8 (M2)

6.1. KINDERGARTEN CAPACITY

In this step, the regional requirements of kindergarten are analyzed the kindergarten currently available, shown below in table2, and based on the standard criteria in table1, the big differences are found between the available kindergarten and standard required. As shown in the table 2, Almost district in the study area suffers from a shortage of kindergarten, districts that are located in eastern sector needs 12 kindergartens, and district in the western sector needs also 12 kindergartens.

Table 2: Shows the distribution of kindergarten and population density according to statistics supplied from the Ministry of Statistics and Ministry of Education.

Sector	District	Exist kindergarten	Standard Required KindergartenN/S[a]	Needs remain of kindergarten	Population	
					2014[b]	N:=Aged 5-7 (23%)[b]
Eastern 2Sector	Mukalla	2	9	7	47933	2876
	Bajaman	1	2	1	12032	722
	Aldees	6	10	4	49998	3000
Western Sector	Monwra	1	3	2	15708	942
	Alomal	3	13	10	68573	4114
Total		**13**	**37**	**24**	**194244**	**11654**

a: No. of students per kindergarten, as in table1 from (800-1000) students.

b: Sources: Depending on the population diversity of 2004 and an annual increase of 3.8%, MoE, http://sahel.education-hadhramaut.info/view/158.aspx: 12/10/2014.

6.2. DISTRIBUTIONSTYLE

MEAN CENTER TOOLS (MC)

The Mean Center tool uses to compare distributions of different type of feature (Point, Polygon) It computes the average X and Y coordinates of all feature (shape, Point) in the study area, and generate a new point indicate the center. The Mean Center tools used to determine the central point of population density and kindergarten. In the context, the distance has been measured between the population concentration and the mean center for kindergarten, almost of the districts has the difference distance between 125-640 meters, as shown in figure 3.

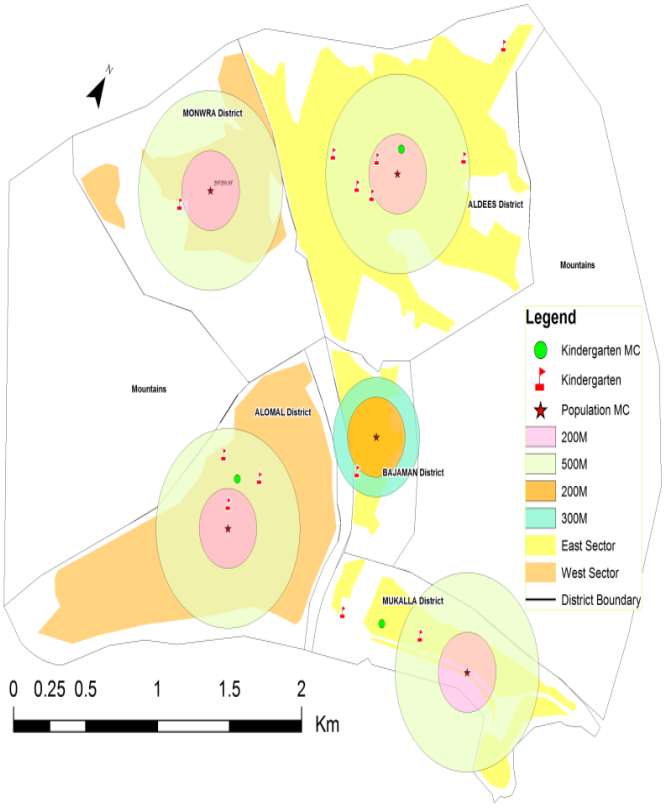

Figure3: Shows the distance between population Mean Centreand the kindergarten Mean Center in four districts

6.3. TRANSFERTIME

To know the distance and time between kindergarten facilities and resident density center, there are several tools of spatial analysis available to use, here we was used the Point Distance tools and obtain some results as follow:

POINT DISTANCE (PD)

The Point Distance tool determines the distances from the input point features to all points in the near features within a specified search radius Multiple Ring Buffer, another useful technique is using a buffer zone which informs us about the coverage area of a particular school or kindergarten [20]. The Point Distance tools are used to determine the distance from each point (kindergarten) to a population Mean Center for districts, when the maximum distance and transfer time to kindergarten was calculated to specify the scope of influence in time or distance as shown in the table 3 below, the results was obtained, they are many kindergarten away distances between 18 to 20 minutes, especially in districts (Mukalla and Mukalla), as the normal human walking 100 meters per two minutes[19], that is influence with standard criteria in table1, the default distance should not exceed 8 minutes.

Table 3: Shows the maximum distance and time between kindergarten and mean centre of populationdensity

District	Max. Distance	Transfer Times
Pop. Mean Center	Meters	Minute
Mukalla	914	18
Bajaman	216	4
Aldees	979	20
Almonwra	223	4
Alomal	371	7

6.4. Land Uses

The land usessuitablemapping and analysis is one of the most useful applications of GIS for spatial planning and management[21],[22],[23].

MULTIPLE RING BUFFER

Creates multiple buffers at specified distances around the input features, these buffers can optionally be merged and dissolved using the buffer distance values to create non-overlapping buffers [20],[24].This technique or tool used to decide the correct kindergarten location based on residence districts. For example, what is the distance of fuel station from kindergarten buildings, due to the fact that fuel stations are risky and dangerous for the kindergarten and the residence? Therefore, they should move away from the main roads and highways, as shown in the table 4 and figure 4.

Table 4: Shows the distance between kindergarten and land uses with a scope from 50m to 100m.

District	Exist kindergarten	No. of kindergarten according to their nearness to land uses					
		Fuel stations (Meters)		Main Road (Meters)		Workshop and Industrial area	
		1-50M	50-100M	1-50M	50-100M	1-50M	50-100M
Mukalla	2	-	-	1	1	-	-
Bajamar	1	-	-	1	-	-	-
Aldees	6	-	-	3	1	1	-
Almonwa	1	-	-	-	-	-	-
Alomal	3	-	-	1	-	-	1
Total	13	0	0	5	2	1	1

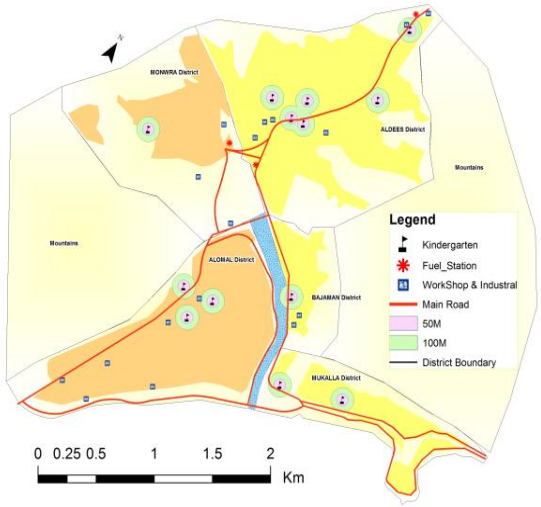

Figure 4: *Map illustrates the kindergarten's scope between 50m to 100m.*

Source: *Designed by the Author, by using ArcMap10.*

7. RESULTS

The Results of the spatial analysis showed, the number of Kindergarten available in the study area is 13 Kindergarten distributed on two sectors, the eastern sector includes 9 kindergarten, and the western sector includes 4 kindergarten, there is a shortage in the kindergarten required 24 additional kindergarten, as show in the table 2, these requirements are considered the population density in 2014, when looking forward until 2015 with an annual increase 3.8%, the kindergarten needed to be 53 kindergartens. The transfer time from the population density center to kindergarten in the districts the table 3 Illustrates, many kindergartens are observed exceed the distance of 900 meters, mean the children need around 20 minutes to get to their kindergarten, although the standard time, according to table 1 that time does not exceed 8 minutes of Kindergarten. Finally, kindergartens that located close to the land uses, such as (fuel station, main road and workshop), as shown in the table 4, there are 9 kindergartens of the total 13 kindergartens located near to the land uses with a range (50-100) meter, there is a kindergarten in Aldees district located near the workshop and industrial area in the range of 50 meters, only Almonwra district is far from all land uses that are a danger and inconvenience to the children, also seven kindergarten located near from main road between 50-100 meters. The geographical database was created in this study that can be referenced in the future by researchers for the development of educational services in the study area, through the mechanism based on machine learning for distribution of the educational facilities such as kindergarten.

8. RECOMMENDATION

The results of the study indicated the existence of randomness in the distribution of kindergarten in Mukalla city due to the absence of proper planning and reference to planning regulations. The study showed the lack of efficiency and capability of such services. The Kindergarten dominated the spatial random dispersion, the author, propose many recommendations as flow:

1. Use of geographic information system to determine the distribution patterns, in order to avoid repetition of the error in the distribution.
2. Increase the number of kindergarten and the observance of the standard criteria in the distribution.
3. Rehabilitation crew followed all public services ministries to use the GIS.
4. Provide maps and a database of public facilities in the study area such as (education, health, parking, gardens, public spaces, etc.).
5. Dimensions kindergarten of dangerous and nuisance land uses.Use of geographic information system to determine the distribution patterns, in order to avoid repetition of the error in the distribution.

9. CONCLUSION AND FUTURE WORK

Spatial analysis based on GIS to improve the distribution of educational services, the GIS has the ability to analysis the current locations of educational services to be addressed and improved, and developing proposals for distributing the new kindergarten to help the decision-maker to make deliberate scientific decisions. Whereas, Yemen is a developing country that has a rapid urbanization growth rate of 3.8 annually, according to the ministry of statistic, which requires an efficient planning for infrastructure to meet such rapid growth, that require an urgent plan to resolve such critical problem. This study is based on equity in the distribution of educational services with a view to achieving the best service to all residents, and takes into account all the quantitative and spatial criteria in the capacity of kindergarten within their area and the acceptable estimated distance. The education facilities must be placed in locations far from the land uses that have an influence on the quality of education, and the health and safety of children achieve an equitable, fair distribution of educational services, this phase was begun with collected and

repair data and the analysis. To find out the strengths and weaknesses in the previous distribution and propose solutions and recommendations to help decision makers from falling into the same mistakes of distribution in the future, also suggest an alternative location for existing kindergarten. This work needs a long time. So the study is divided into two phases. The first contained in this study, and the second phase will be implemented in the near future, a proposal framework or pattern based on data mining algorithms and machine learning techniques to choose the best location for an exists and new educational facilities.

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