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The Best School Site Choosing for Rural Areas of The Husseiniya District in Karbala Province Using GIS (Model Builder) Techniques

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Abstract

With the increments number of population nowadays, one of the most essential problems in rural areas is the number of students in each school which exceed the school capacity. Thus, it is important to increase the number of schools and to determine the suitable location of them. The aim of this study is to determine the most suitable sites for school using Geographic Information System (GIS 10.2) (ModelBuilder) in Husseiniya district, Karbala province. Land classification, slope, distance from the single schools, proximity to the inflated schools, work buffer 100 meters around the main roads and railways and removing them from the map, represent the main criteria used to evaluate the location suitability and the most crowded school. Schools with high number of students are calculated and evaluated (above 1000) used point density tool to calculate the largest schools inflated from students. The weighted overlay tool is also employed to weight the criteria. The results demonstrate that the developed GIS 10.2 is successfully able to determine the best school location in Husseiniya district depending on the criteria with high efficiency. The excellent performance of the developed program shows its high efficiency for best locations detection in various applications such as, Popular clinics and police stations.

Keywords: school site, geographic information system (GIS), remote sensing, multi criteria analysis, point density, weight overlay.

أختيار أفضل موقع لمدرسة للمناطق الريفية في حي الحسينية بمحافظة كربلاء باستخدام تقنيات نظم المعلومات الجغرافية (Model Builder)

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الخلاصة

أحد أهم المشاكل في المناطق الريفية هو عدد الطلاب في كل مدرسة التي تتجاوز القدرة المدرسية بسبب ازدياد عدد السكان في الوقت الحالي. وبالتالي، من المهم زيادة عدد المدارس وتحديد الموقع المناسب لها. الهدف من هذه الدراسة هو تحديد أنسب المواقع للمدارس باستخدام نظام المعلومات الجغرافية (جيس 10.2) (موديلبيلدور) في منطقة الحسينية في محافظة كربلاء. تصنيف الأراضي، المنحدر، المسافة من المدارس الفردية، القرب من المدارس المتضخمة، عمل عازلة 100 متر حول الطرق الرئيسية والسكك الحديدية وإزالتها من الخريطة، تمثل المعايير الرئيسية المستخدمة لتقييم ملائمة الموقع والمدرسة الأكثر ازدحاماً. يتم حساب

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المدارس التي لديها عدد كبير من الطلبة (أكثر من 1000) يستخدم أداة كثافة النقاط لحساب أكبر المدارس التي تضخم من الطلاب. وتستخدم أداة التراكم المرجح أيضا لتخفيف المعايير. وتظهر النتائج أن نظام المعلومات الجغرافية 10.2 المتقدم نجح في تحديد أفضل موقع للمدرسة في حي الحسينية اعتمادا على المعايير ذات الكفاءة العالية. ويظهر الأداء الممتاز للبرنامج المتقدم كفاءة عالية للكشف عن أفضل المواقع في مختلف التطبيقات مثل العيادات الشعبية ومراكز الشرطة.

1. Introduction

The school is the first breakthrough for the child, as well as through which built his character, and then can we say that our generation is conscious, make him the future generation, but how to build a generation if the school does not satisfy all educational and spatial conditions?? Of the total suffering experienced by the student, where in the majority of schools in Karbala shortage of books and the large number within the same grade could be up to 85 students as well as the lack of health groups and found where there is no water and many other issues, notably the shortage of teaching staffs, [1]. Parents complain about the suffering of their children, the students due to lack of attention of the state ministry of education and private schools.

In Husseiniya distract parents of students with limited income and cannot buy stationery as well as transportation costs due to the remoteness of schools, which lies 7-12kilometers in addition to the lack of the most basic school supplies of trips and lighting and cleanliness often find children sitting on the ground in summer and winter as if we were in one of the poor countries that live on the trickle of international aid, [1].

There is no study on schools but, there is a study on "Choose the best location for a modern village using statistical software and GIS techniques and analysis Spatial (Western Table - Karbala Holy), [2].

2. Iraqi standards

The choice of location for educational buildings depends on the planning basis commensurate with the type of educational institution the role it plays can be summarized as follows, [3]:

1. The geographical area, whether within the city limits (urban) or outside (rural).
2. Type of educational activity required to allocate space of different types and levels.
3. The specific capacity of the educational institution and the number of students and the nature of the study.
4. Spaces to be allocated and intended for service spaces such as play yards and green areas.
5. The space allocated to each student is (Square meters) students from the teaching rooms or the activity rooms, labs and laboratories as well as (Square meters) students from the public area. A feasibility study must be conducted to determine the expected and the interest required and achieved.
6. Knowledge of the educational system in the country so that the designer can assess the nature and size of urban spaces required for places of educational effectiveness depending on the age group and sex and nature of study.

3. Global standards

UNESCO department of schools according to the population into two categories: schools in rural areas, schools in urban areas, the schools in rural areas were criteria as follows, [4]:

- Set a higher distance between houses and school.
- Children on the going and return journey from school should not interrupt major roads, railways, hazardous rivers and other features that are considered locally in the village environment as a source of danger, and should not pass through them.
- Drinking water and on-site sanitation should be provided at an appropriate rate for students and teachers.

4. Study area and Data used

4.1 Study area

The chosen study area for this paper is the province of Karbala the District Husseiniya the rural area. Figures-(1,2) display the location of the province of Karbala and District Husseiniya, the District Husseiniya is comprised of 76 elementary schools in the district; the number of student 28446. The school district of Husseiniya also has employed teachers' 1639, [5], Table -1.

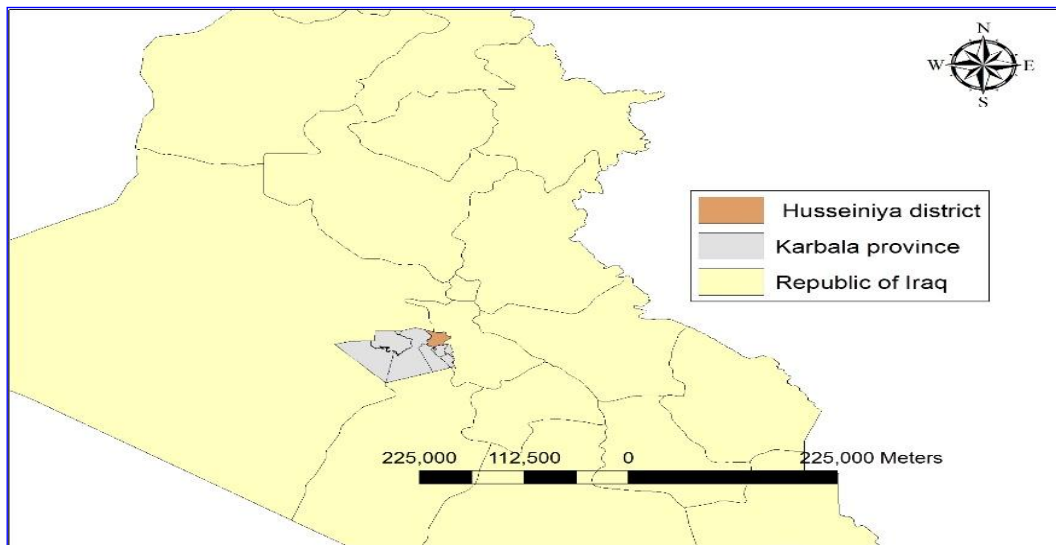


Figure -1 Husseiniya district, Karbala province

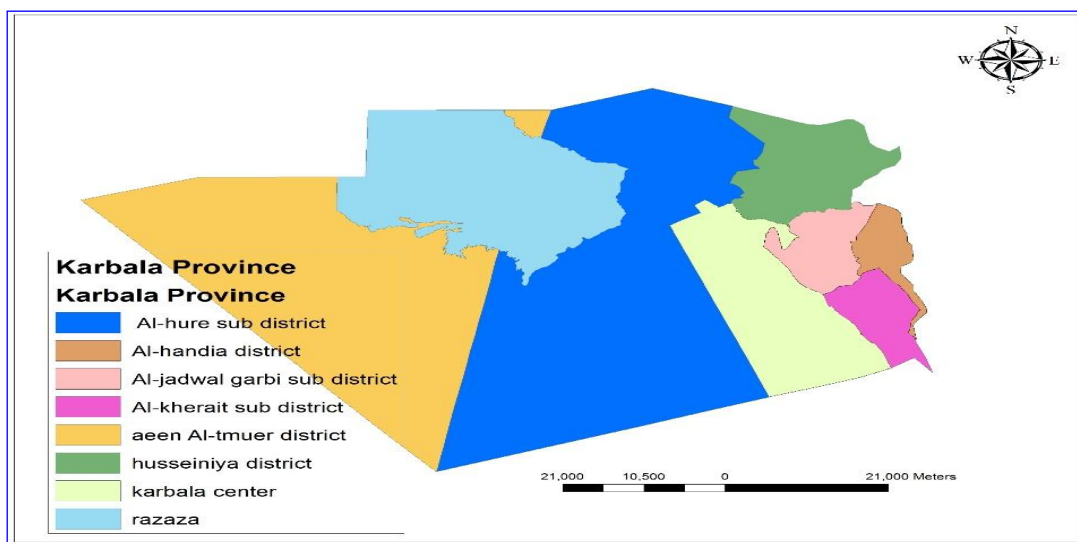


Figure -2 Districts and sub district of Karbala Province

Table -1 Number of schools in the study area

Type of Schools	Number of Schools	School independence		Time attending		
		Original	Guest	Morning	Afternoon	Morning / Afternoon
Rural schools	66	36	30	7	2	57
Urban schools	10	6	4	1	-	9
TOTAL	76	42	34	8	2	66

4.2 Data used and software

Without strong data it is necessary to fail any appropriate site analysis, so data has been collected from:

1. Collected the number of schools and the number of students in the district of Husseinia from the Directorate General of Education in the holy city of Karbala, Planning Department, a Statistical school record for the stage (primary education) in the holy city of Karbala for the academic year 2016-2017.
2. Collected maps and data from the municipality of Karbala and the municipality of Husseinia district from GIS department, The official borders of the province of Karbala and the districts in the form of a database.
3. Used the ArcGIS 10.2 (Model Builder), base map from ESRI ArcGIS to draw the main roads and train route.
4. Topographical map of the town downloaded from (The CGIAR Consortium for Spatial Information (CGIAR-CSI)) DEM, in order to work a slope tool in the Husseinia area and the appropriate slope for the establishment of a school.
5. Used the Quick Bird Image satellite for its high accuracy and classification the land the district of Husseinia.

5. Methodology of work

The entirety of this study was conducted using ArcGIS software via model Builder. Specifically, the toolsets used for this project consisted of buffer, Point Density, erase, selection by location, selection by attributes, union, Path Distance, slope tools, weighted overlay, con, Classification Supervised, and Reclassify. These techniques were chosen to provide the most optimal outcome for this site suitability analysis.

5.1 Model Builder

Model builder is an advantage in ArcMap that can be used to automate tasks. It is especially useful for batch processing, which can be created a model by drag and drop objects, tools, etc, and then running the model in ArcMap. Also can difficult code specifics like file paths into model for information to make it more flexible, and to save model and share it with others, [6].

Why would want to build a model?

Building model helps to manage and automate geoprocessing work. it can help with simple multistep tasks, such as adding new fields to a feature class and then calculating value for those fields. Models are custom tools that you create. they can be run multiple times, and you can apply different datasets each time you run them, also, they give user of your models a clear and concise representation of the geoprocessing work that will take place, [6].

Model Builder uses Colors to indicate the status of tools and variables. A white shape indicates that the tool still requires information from the user before it can be executed. Blue represents inputs, yellow represents tools, and green represents outputs, see Figure -3, [7].

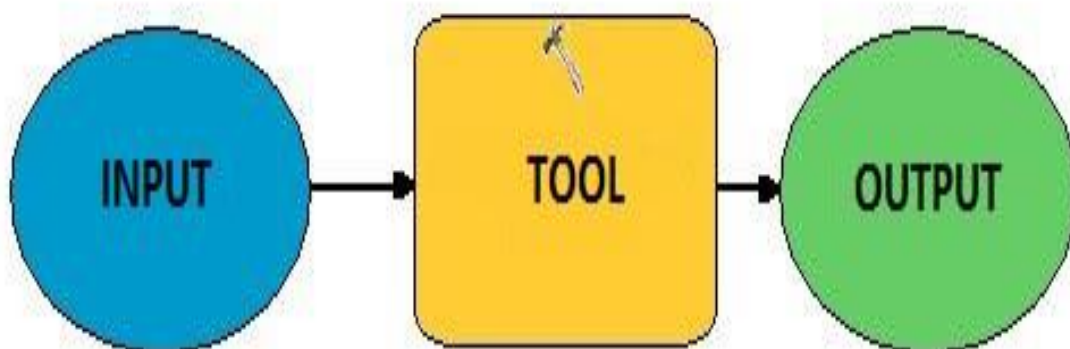


Figure -3 Model Builder Shapes.

5.2 The satellite Quick Bird

QuickBird is the highest-resolution multispectral commercial remote sensing satellite, offering best imagery from 60 cm resolution. Launched October 18, 2001 at Vandenberg Air Force Base, California, USA. Collects multi-spectral and panchromatic imagery at same time, provides the widest swath, largest on-board storage, highest resolution of any current commercial satellite, designed to efficiently and accurately image large areas with industry-leading geolocation accuracy [8]. The following Table-2 shows the design and Specifications the QuickBird satellite, [8- 10].

Table -2 Producing the design and Specifications the QuickBird satellite.

Specifications Design and	Details
Launch Information Date	October 18, 2001
Launch Vehicle	Delta II
Launch Site	Vandenberg Air Force Base, California, USA
Mission Life	Extended through early 2014
Spacecraft Size	lbs., 3.04 m in length 2400
Orbit at Altitude 450 km	Type: Sun-synchronous, am descending node 10:0 Period: 93.6 min
Sensor Resolution and Spectral Bandwidth	Panchromatic: cm GSD at nadir 61 Black & White: 405 - 1053 nm Multispectral: m GSD at nadir 2.44 Blue: 430 - 545 nm Green: 466 - 620 nm Red: 590 - 710 nm Near-IR: 715 - 918 nm
Dynamic Range	bits per pixel 11-
Swath Width	Nominal Swath Width: km at nadir 16.8
Retargeting Agility	Time to slew 200 km:38 sec
Onboard Storage	128 Gb capacity
Communications	Payload Data: 320 Mbps X-band Housekeeping: X-band from 4,16 and 256 Kbps, 2 Kbps S-band uplink
Revisit Frequency (at 40°N Latitude)	2.4 days at 1 m GSD or less 5.9 days at 20° off-nadir or less
Metric Accuracy	m CE90, 17 m LE90 (without ground control) 23
Capacity	km ² per day 200.000

5.3 buildup geodatabase

The geodatabase supports object-oriented vector and raster data. In this model, Contacts are represented as objects with properties, behavior, and relationships. Support for an Assortment of different geographic object types is built into the system. These object types include simple objects, geographic features, network features, annotation features, and other more specialist feature types. The model allows you to define relationships between objects and rules for Keep the reference and topological integrity between objects, the geodatabase provides a generic frame for geographic information. This framework can be used to define and work with a wide Assortment of different user- or application-specific models, [11].

5.4 Point Density Tool

Point Density tool it calculates a magnitude per unit area from point features that fall in a neighborhood around each cell, [12].

5.5 Criteria used in research

Is six criteria, divided into two parts, the first part consists of four criteria used for weight, namely, Raster, and the final product is converted to polygon, where the second part is a screening criteria, it consists of two criteria, which is the sort that is extracted from the final product of the first part.

5.5.1 Weight criteria

There are four criteria that are re-reclassified and collected in the weighted overlay tool, where we weigh each criterion according to the advantage of choosing the school site.

The first criterion is land classification, the second criterion is land slope, the third criterion is the proximity of schools chose from inflated schools of students and the fourth criterion faraway from single schools the few students, are re-classified according to the advantage of one of the ten and collect and weigh in the weighted overlay tool. Criterion weights that apply to specific criteria and order weights that apply to the ranked criteria, after application of the criterion weights, [13]

5.5.2 Screening criteria

In order to use the screening criteria, convert the final output from the weight criteria to the polygons where used raster to polygon tool, used first and second criteria used buffer tool.

The buffer is one of the most common spatial analysis tools, is a map feature that represents a uniform distance around a feature, creates a new polygon data set, where a specified distance is drawn around specific features within a layer, the distances can either be constant or can vary depending upon attribute values, their buffers may overlap, when features are close together, the user can choose to preserve the overlaps or remove them, [14].

6. Results and discussion

6.1 Location of some features in Husseinia

Entered the coordinates of the schools, length and width and created a shape file point, draw main roads and railroad shape file polyline Figure-4.

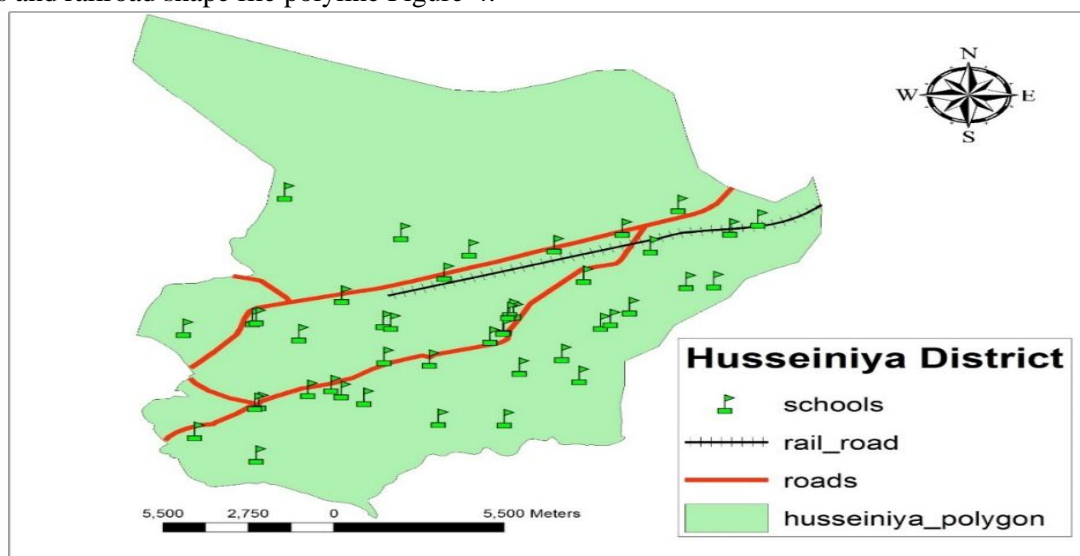


Figure - 4 some features in Husseinia.

Wrote Number of students, school names, number of double, triple and quadruple schools in attribute table, and through the final number of the school location for students to knowing inflation. After collecting the numbers of students in the original schools and the guest of field calculator got the final number of students per school site.

Final sum= number student in original school+ nu. Gust1+ nu. gust2+....In Figure-5.

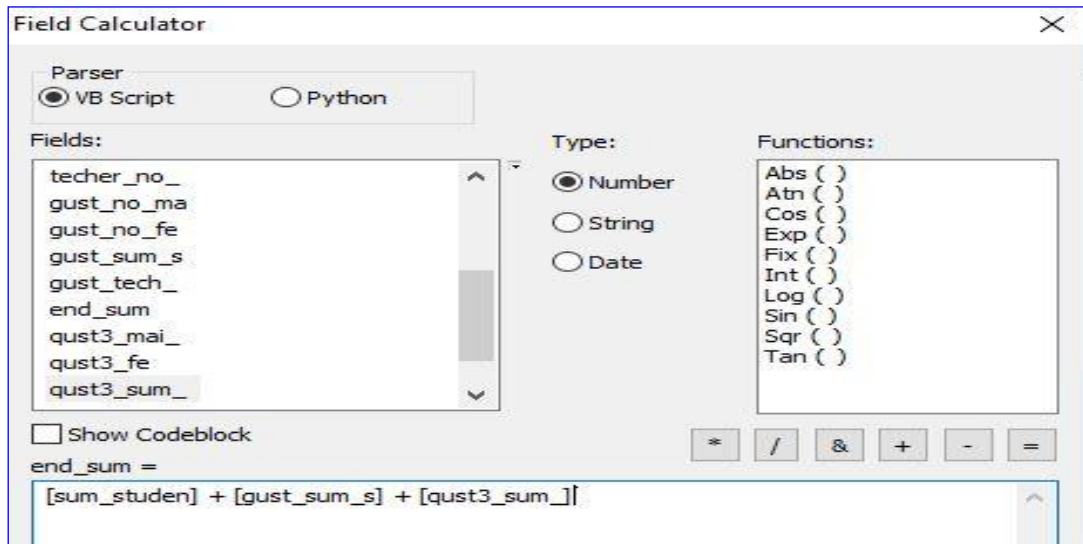


Figure - 5 Number students in all schools

6.2 Using point density tool to account for inflated areas of students

Used the point density tool to see the inflated schools in Husseiniya district on the map, using the number of students per school (point), Figure-6.

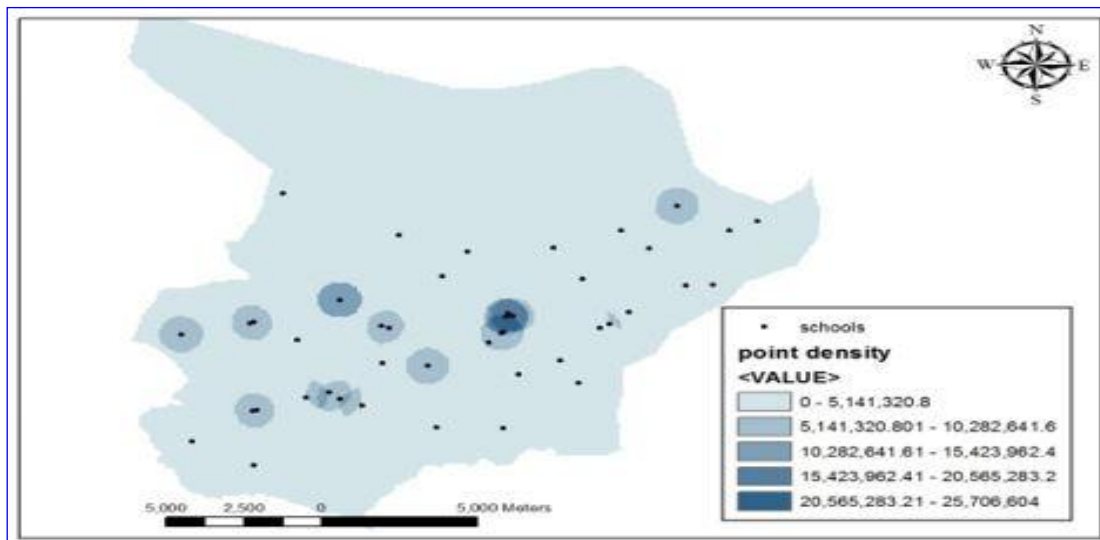


Figure -6 Point Density.

In the dark areas, the intensity of the student density was observed in the lower areas. The number of students per school was adopted in field (population filed) from point density. And from attribute table selected filed number of student and Choose statistic Figure-7.

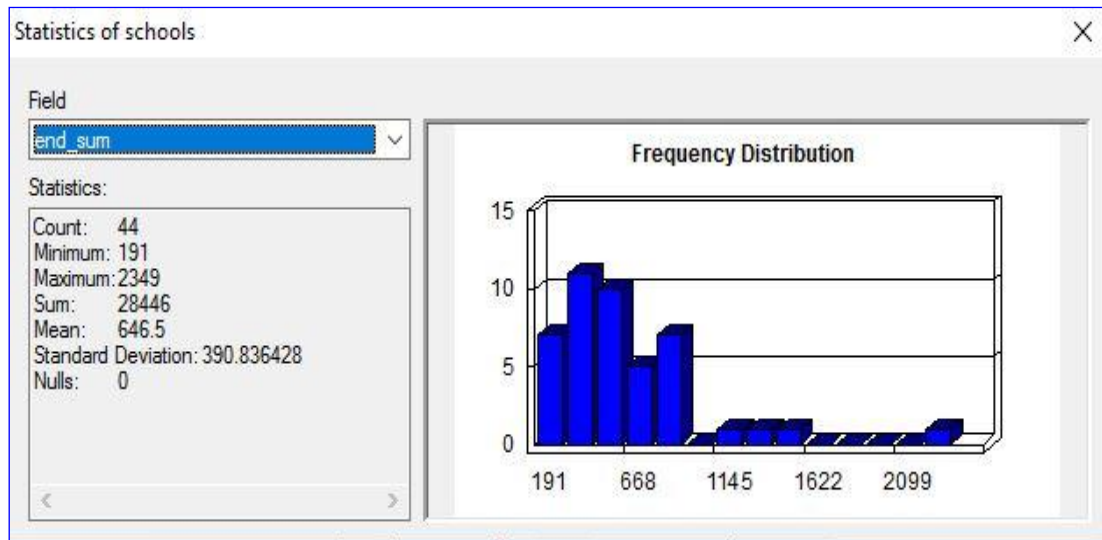


Figure -7 Statistics of Schools.

Observed number of school buildings (44), number of students in all schools (28446), minimum number of students (191), Maximum number of students (2349), One school noted the number of its students more than (2000) and three schools more than (1000) and five or six schools less than (200) and more than ten schools Mean Number Students (646.5).

6.3 Classification of a Quick Bird Image (Supervised)

To classify the image to land use and land cover, use Image classification from ArcMap program and use draw polygon to create training sample by drawing a polygon Figure -8.

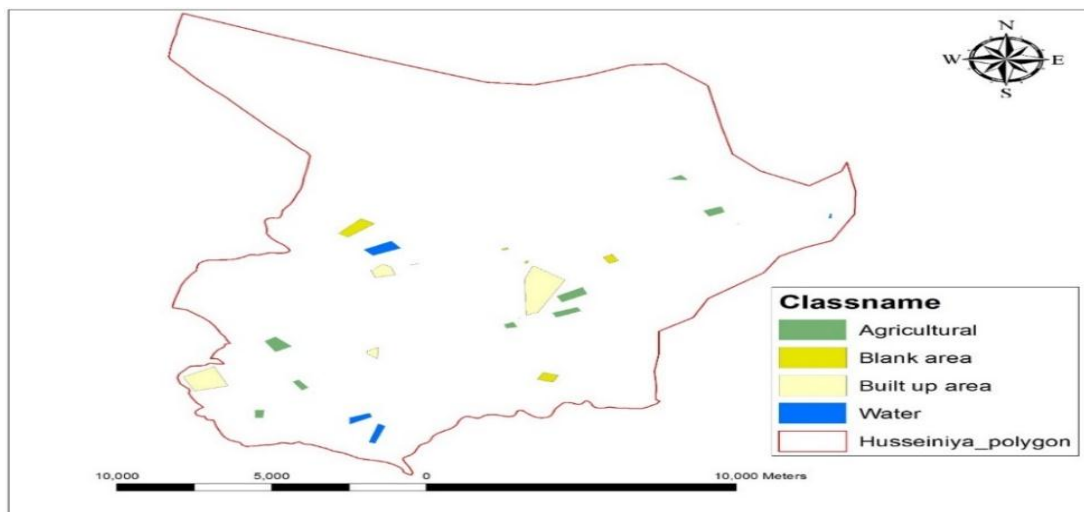


Figure - 8 Classification Husseiniya district Supervised.

These polygons refer to water, agricultural area, blank area, and built up area, then the program finds all pixels that have similar spectral reflectance characteristics and assigns them to the appropriate class, in Table-3.

Table - 3 Training sample manager

ID	Class Name	Value	Color	Count
1	Built up area	1	Light Yellow	9820446
2	Water	6	Blue	2484307
3	Blank area	12	Yellow	2248919
4	Agricultural	17	Green	4257455

Training sample manager allows seeing and changing the properties training sample for satellite image. And save this training sample from toll bar choose create a signature file, and use Maximum Likelihood Classification tool from Image Classification.

6.4 Weighted Overlay Tool

Where we re-categorize each criterion separately and we reclassify the land use and the slope of the land and the distance from individual schools and proximity to schools bloated and the classification of ten according to the advantage and collect them in the tool weighted overlay Figure -9.

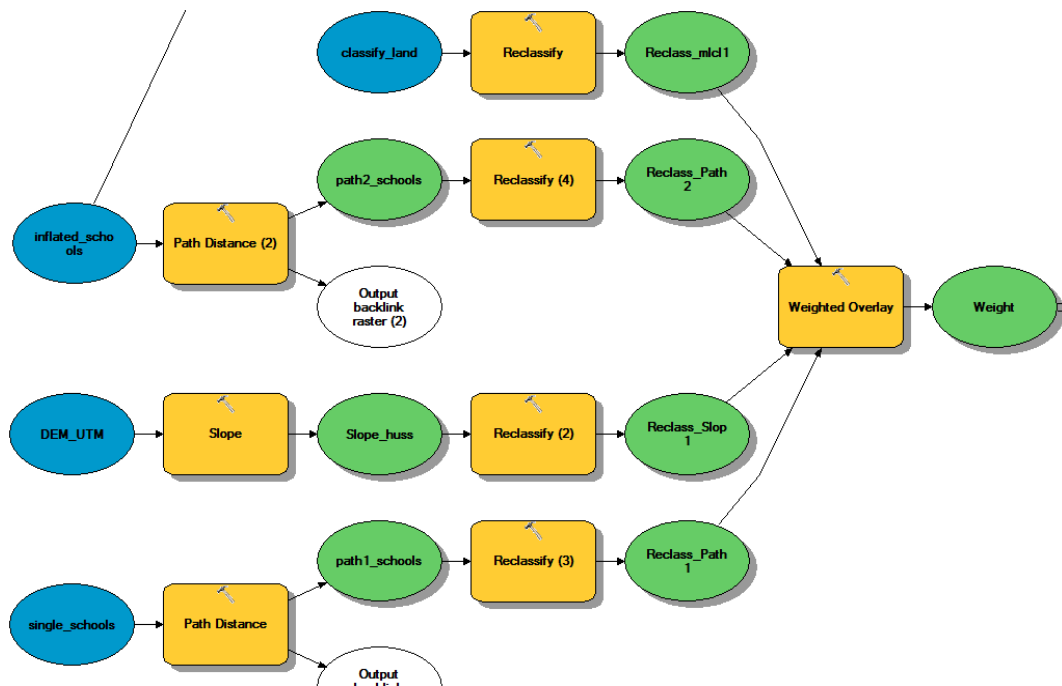


Figure - 9 weighted overlay.

Table - 4 Calculate Weighted overlay

Raster	% Influence	Field
Inflated schools	50	value
Single schools	26	value
Land use	12	value
Slope	12	value

See in Table - 4 the weights were determined according to the advantage: Land use 12%, slope 12%, distance from single schools 26%, and proximity to inflated schools 50%. Where this tool is to collect weights according to the preference to choose the best location for the establishment of a school Figure-10.

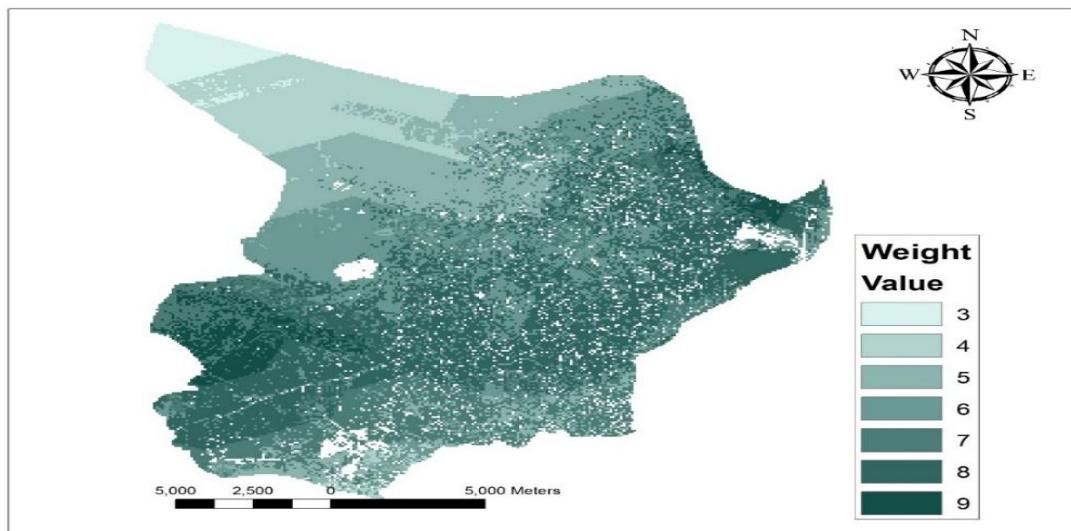


Figure - 10 Weighted overlay output.

It was noted that the light areas are not suitable given the number (3) and the dark areas are appropriate to give it the number of (9). It is considered the best.

6.5 Conditional and convert from raster to shape file (polygon)

From value selected (8) and (9) to get in order to obtain suitable areas, it is preferable to build schools (8, 9) and not to highlight the areas of preference of less than (8) In Figure -11 the output of con.

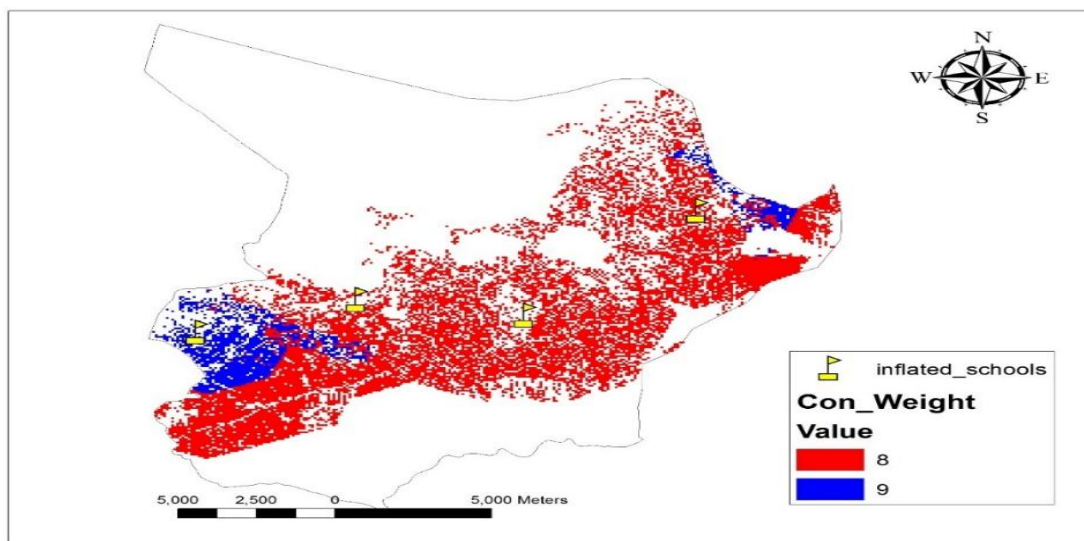


Figure - 11 Con Toll output.

The preferred areas (9, 8) appeared on the map and the remaining areas were surveyed from the map. Converted raster con to shape file (polygons) to calculate the spaces and subtract some areas, pull raster to polygon tool to model and connected with output of con.

6.6 work Buffer on main roads, rail road and Union and Erase from output of con

Pull buffer tool to model and pull Main roads, rail roads from geodatabase to model and connected together and pull union tool from Analysis tools, overlay to model and connected with output buffers main roads, rail road in Figure -12.

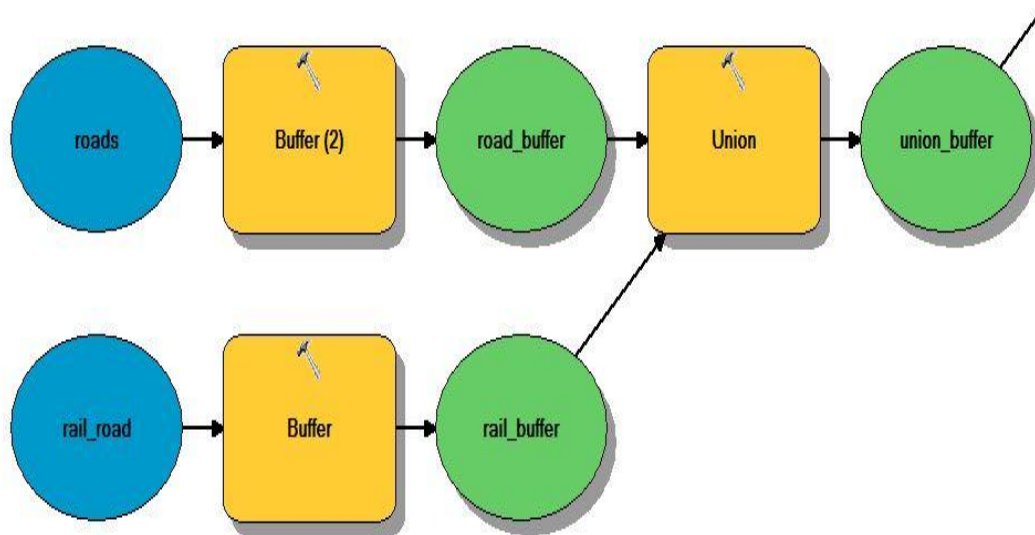


Figure - 12 Buffer and Union Tools.

Selected a 100-meter buffer around the main roads and railways and union together in one feature. And remove it from the map to establish a school site in areas far from the danger of highways, trains and noise. And pull Erase from Overlay to model and connected to output union and output con in Figure -13.

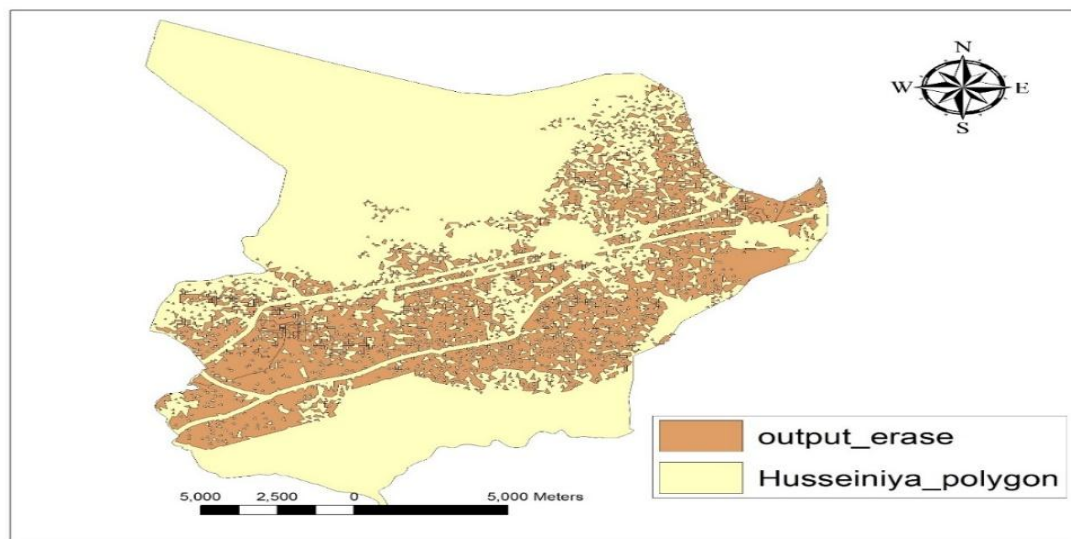


Figure - 13 Erase toll output.

Separated 100 meters from the main roads and rail from the map to choose the location far from the noise.

6.7 Site selection results

The purpose of the location selection is finding the best location resulting from a series of pre-determined criteria. After the GIS-based models, usually there are several results with maximum value depending on the same selection standards, so they are filtered out as the candidate locations from massive geographical areas. Then a deep evaluation with extra standards on these alternatives should be carried out to get the best location.

6.7.1 Inflated schools in rural areas

There are two schools in the countryside of the Husseiniya district are inflated.

i. Bada shraeef area

The site contains one building with two schools, with more than 1,400 students in Figure-14.



Figure - 14 Bada shraef area chosen best schools.

Because it is a rural area there are large areas suitable for the construction of a school was chosen two sites near the school bloated and the presence of streets near the schools, Table-5.

Table – 5 Area of best location chosen to build schools in Bada shraef.

Id	Shape	Length (m)	Area (m)
A	Polygon	434.109986	11216.79787
B	Polygon	386.421881	9220.190513

ii. Al-Wand area

It is one of the largest rural areas in Husseiniya district. It contains one building site with four schools with more than 1,400 students, because it is a rural area, decision makers can easily choose the location because of large empty and agricultural areas through output of clip in Figure - 15.

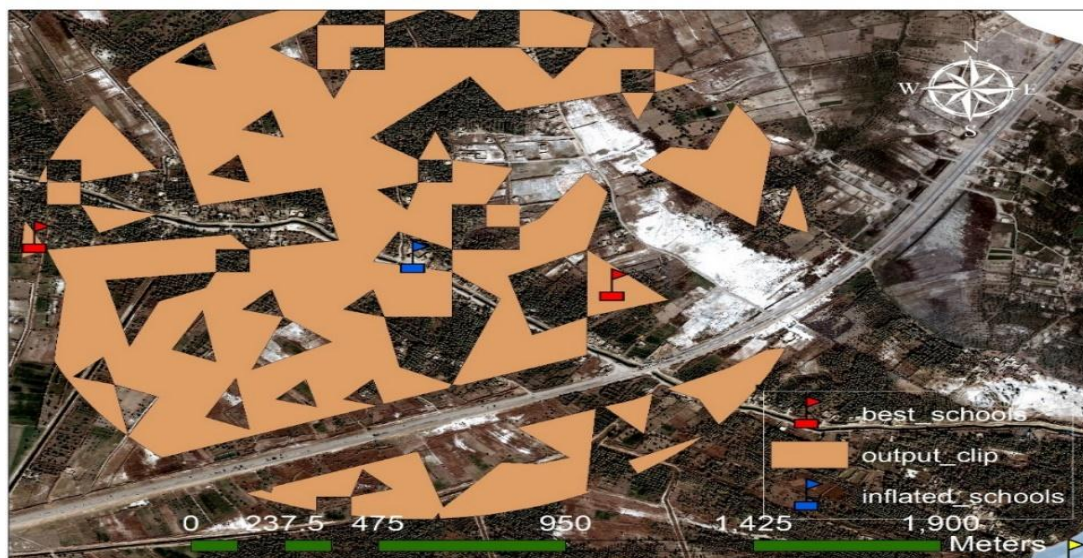


Figure - 15 Al-Wand area chosen best schools.

was chosen two sites near the school bloated and the presence of streets near the schools, Table - 6.

Table - 6 Area of best location chosen to build schools in Al-Wand

Id	Shape	Length (m)	Area (m)
A	Polygon	434.109986	11216.79787
B	Polygon	386.421881	9220.190513

Note that the areas are large and many in rural areas where students' homes are scattered far away from schools and not as in urban cities houses are clustered so it is difficult to choose the best place so chosen proximity places of the school bloated to reduce random selection.

7. Conclusion

1. The results showed the ability of GIS and remote sensing to analyze standards.
2. The analysis used land use, slope, distance from the individual schools with few students, proximity to schools where students were inflated, as well as after the school selected for the main roads and rail 100 meters, and was a deterrent to finding a suitable location for the school.
3. The selection of two sites in the area of Bada Shareef and two locations in the area of Al-Wand.
4. Easy to reach by pedestrians, flat ground level to reduce the cost of construction and large agricultural areas of the future potential expansion of the school.
5. The air is pure because it is open from all directions, close to the bloated schools of students.
6. Decision makers can choose other locations of the last outputs search.

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