Geomatic Techniques Based TOPSIS Method for Blajo Canal Evaluation

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Abstract
Water is one of the world's most important natural resources and has recently revealed several emergencies that are becoming national concerns. This research focused on the Iraqi water crisis because a huge percentage of Iraq's water is flowing from outside sources. particularly the problem of water shortages in the Wind River, using a GIS-integrated TOPSIS method to evaluate the Blajo Canal. Present channels were evaluated by TOPSIS, an MCDM technique that takes into account the separation between the positive and the negative points between the different options. The excellent alternative should lean toward the favorable while avoiding the passive. The results indicated that the Blajo Canal was spatially placed in alternative number 4, ranked number 3 by the TOPSIS method. This site is therefore close to arable areas and meets the criteria, although it is not the best place for it when compared with other alternatives.
Keywords- Geomatics, Remote Sensing, TOPSIS, Water, Civil.

1. Introduction

The water crisis has been one of the profound problems facing Iraq in connection with unrest with neighboring countries, which have several rivers coming from somewhere inside Iran. In addition, major developments on the rivers from their lands have been constructed. It has also cut off Wind River water, watering huge agricultural plots which have resulted in arable areas being diminished and plantations of dry-season crops without drinking water, and has created Blajo Canal for managing the water reduction in the wind for irrigating agricultural land by the Ministry of Water Resources. The expansion of food production to feed people is one of the world's most important challenges. Global growth and production and imbalanced consumer patterns are caused by irrigating soil, water, and various basic sources to cause great pressures on the combined water body of the world (Degirmenci et al. 2005).

In determining how successful the canal is, the spatial location of the water supply channel is very important. The methodology for assessing its decision based on TOPSIS was therefore explained, as one MCDM approach to evaluate both the distance from the favorable point of each alternative and the distance from each passive point of each alternative. The right choice should indeed be the shortest from the perfect positive arrangement, and the longest from the perfect negative.

The examples of processes for TOPSIS were given by Majid Behzadian, et al (2012). Hwang and Yoon (1981) recommended that the categorization of reasonable options would be centered on the smallest route from the favorable ideal.

The research zone is located in Khanaqin/Diyala province and is positioned 57 km west of Baghdad, one of the provinces bordering internationally. The boundary lines of the study area are rich in different cultures, as shown in **Figure 3**. Farm watersheds are normally drained and built to allow water from property and Irrigation and agricultural production will take advantage of lower water levels in the area. The information about irrigation management that the supervisor supports and is distinguished geographically by the most relevant irrigation information that will be provided. Through the use of space data systems is of major importance for the development of irrigation resources so that reliable information is easily obtained and no data can be needlessly centralized data and reciprocal collected and documented. Since it is useful to produce information that is the foundation of the way of knowing. Drainage may be a popular method used in developed countries for water conservation. Even so, food production and development persist at the threshold of this evacuation in most developed countries to become a sustainable investment. Many motives combined represent part of the alarming gap between advanced and developing economies (Smedema et al. 2002). While the software package for the geographic data system generates beneficial and colorful maps, the geographical information systems are a map. In the irrigation management business, the GIS can be almost certainly employed at an incredibly high capacity, such as planning, a database integrity unit, GIS, and so on. (Fipps and Eric et al. 2003).

The objectives of this research are to utilize the GIS-integrated TOPSIS to reassess and evaluate the most relevant areas for the canal. In the vicinity of agricultural areas, the place should ideally be selected to be more acceptable. It is not easy to choose the right place for this task. Other relevant concerns, research facts, and the government intentions as well as previous involvement in the mission would be taken into account in the investigative process. The expertise of the territory of these irrigation pathways is minimal, and the configurations of the canal situations are puzzling, making surface locations a substantial tool for the understanding and awareness of field hydrology systems. The main aim of the current field of study:

a) Determine the parameters allowing the placement of the channel to be determined.

b) Start creating the main research GIS maps that will be used as grounds for strategy development for examination.

c) In the end, an assessment has been carried out of the actual canal site.

2. Methods and materials

2.1. Data

Spatial data such as satellite imagery and fieldwork can show that certain soil connection between plants is unique to soil salts so that saturated and dry areas are distinguished. In addition, data on the use of the land area is needed to detect real advantages for projects. The information available on land use is generally used for analysis.

Details showing water bodies, waterways, and land types in the study area were spatial data DEM, land usage/territory, water body, and soil type using LandSatOLI imagery satellite. In the survey, experts were selected by survey and literature review to determine criteria values. Indicators are chosen positions of the related channel. Expert questionnaires and review of literature specified indicators. There are 4 criteria and 5 alternatives in this study that are categorized using TOPSIS (Table 1).

Table 1. Indicator of properties

	indicator	interpretation
1	River Slope (percent)	The slanting territorium could be a test, typography should be explicit. If the sides start to flow over topographic lines, the Spill Water System works best. Overload deflection can change frame run times. The Voyagers and Center Turn Frameworks are an over-the-spot of the rough and truly sloping ground. (Nosenko 1976, Worqlul et al 2019, 2018).
2	Residential (km)	Near to canal (You et al., 2011).
3	Proximity to fertile Area (km)	Such areas are regarded as the main aim of any drainage system. closeness to fertile areas which should be watered is therefore beneficial.
4	Soil type (unitless)	Soils with a low or medium ability for infiltration (De Jong, 1979).

2.2. Model builder

The validity location concept was described employing the ArcGIS10.4 model constructor. It was based on multi-criteria evaluation (Shihab and Al-Hameedawi 2020, Malczewski 2000).

2.2.1. TOPSIS Process

TOPSIS knows the difference between each alternative as one of the MCDM methodologies, the positive and negative ideals. The quickest route of the favorable ideal would be the top choice and the longest way to the critical ideal.

Normalize the matrix:

$$r_{ij}(\mathrm{x}) = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{t} x_{ij}^2}} \qquad i = 1, \dots, t \quad ; j = 1, \dots \ , n$$

I. Where I represent the criterion index I = 1... t), m represents the no. of locales, and j is the option index (j= 1... n).

II. Find weighted matrix, as in the formula below.

$$u_{ij}(\mathrm{x}) = w_j r_{ij}(x) \qquad i = 1, \dots, t \quad ; j = 1, \dots \ , n$$

III. Find the favorable and passive ideal solutions, as shown below:

$A^{+} = (u_1^{+}, u_2^{+}, \dots, u_n^{+})$

$A^{-} = (u_1^{-}, u_2^{-}, \dots, u_n^{-+})$

So that

$u_j^{+} = \{(max\, u_{ij}(x) \mid j \epsilon j_1), (min\, u_{ij}(x) \mid j \epsilon j_2)\} \; i = 1, \dots, t$

$u_j^{-} = \{(min\, u_{ij}(x) \mid j \epsilon j_1), (max\, u_{ij}(x) \mid j \epsilon j_2)\} \; i = 1, \dots, t$

Where j_1 and j_2 is the passive and desired standards.

IV. TOPSIS Distance

The TOPSIS approach captures every alternative based on the how comparable the optimist ideal is to the particular degree and how far it is from the unfavorable ideal. In this step it is thus calculated by using the following formulas, the ranges between each alternative and the professional and the ideal solutions.

$$dis_i^{-} = \sqrt{\sum_{j=1}^{n} [u_{ij}(x) - v_j^{-}(x)]^2} \quad , \quad i = 1, \dots, t$$

V. Find relative closeness of alternatives to the ideal ones.

At this point the following formula achieves relative closeness to the optimal situation of each option. When the proportional level of similarity is close to 1 that the optimal solution can be shortened to the negative ideal.

$$C_i = \frac{dis_i^{-}}{(dis_i^{+} + dis_i^{-})} \quad , \quad i = 1, \dots, t$$

3. Results and Discussion

The aim of the study and installation of the path of the irrigated canal via GPS calculations is to fix the lack in water and to compensate the river following its drying process, and due to leasing the water supply from Iran which will lead to international disputes. The Wind River is irrigating about fifty thousand hectares in the Diyala, so that the government has established a Blajo Canal for irrigation, providing water and irrigating the drought-afflicted agricultural lands.

3.1. GIS Integrated TOPSIS approach

The decision matrix was first normalized (Table 2).

Table 2. The standardized matrix

Alternatives	River Slope %	Residential Area %	Prox. to fertile Area %	Soil type %
Al1	7.39	64.92	64.9	60.41
Al2	44.5	7.91	37.0	32.99
Al3	29.8	50.88	8.02	30.54
Al4	65.59	50.73	42.93	8.05
Al5	52.11	50.71	49.51	66.99

Thus, the following table shows the weighted normalized decision-matrix (Table 3).

Table 3. The weighted matrix

	River Slope %	Residential %	Prox. to fertile Area %	Soil Type %
Al1	0.98	15.93	15.92	14.790
Al2	9.11	1.94	1.09	8.49
Al3	6.94	12.19	1.79	5.94
Al4	15.96	10.19	10.794	3.01
Al5	11.99	10.198	12.610	16.90

The favorable (A_n+) ideal and the passive (A_n-) outcomes are represented by the weighted matrix of a decision where J is linked with the favorable characteristics and J' with the adverse characteristics. The difference can instead be determined among outcomes. Table 4 represents both desired and passive ideal values.

Table 4. The favorable and passive ideal values.

Indicator	Positive-ideal %	Negative-ideal %
River -Slope	15.96	0.98
Residential	15.93	1.9
Prox. to versatile Area	16.02	0.98
Soil- type	9.7	1.91

Consequently, the highest value is the best. The condition is reasonable if it is less than 1. Each option is ranked by the TOPSIS method. The difference between favorable and passive potential solutions is shown in Table 5.

Table 5. Distance to desired and passive threshold

	favorable- ideal %	Passive- ideal %
Al1	9.49	19.39
Al2	9.89	9.33
Al3	19.06	9.23
Al4	19.69	9.91
Al5	0.0791	0.1929

If the closeness level is near 1, this shows that the alternative has less distance between the favorable ideal value and the passive ideal value. The relative similarity between every option and its optimum value and ranking is shown in Table 6.

Table 6. The Ci value/ ranking

	Ci %	Ranking
Al1	59.16	2
Al2	39.14	4
Al3	29.75	5
Al4	49.3	3
Al5	69.42	1

3.2. Appropriateness of the Land for a Drainage Network

The agricultural drain mechanism is a system in which the quality of crops is improved by draining water into the soil. The most significant point with regards to the selection method for the relevant areas should be recalled as the fact that the methods of assessment using the extraction technology have not included non-agricultural areas leaving only the agricultural areas. The classes are reclassified in such a way that the corresponding datasets are fused so that the areas of the irrigation plan can be classified by a precise map.

This was not possible, however. They needed to be identical to the same degree to combine them into their current form. You must first adapt these to a common scale to combine the data sets. The Ci values are shown in **Figure 1** below.

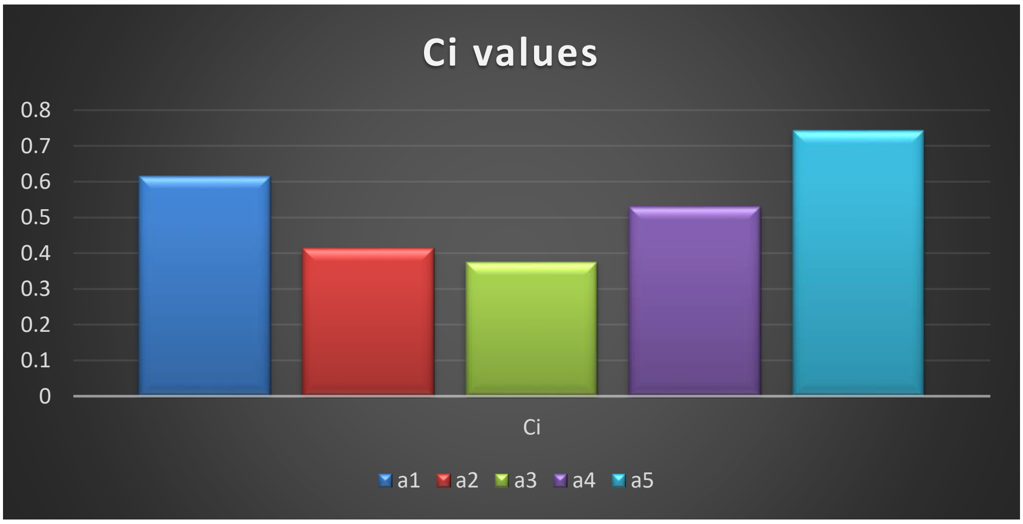
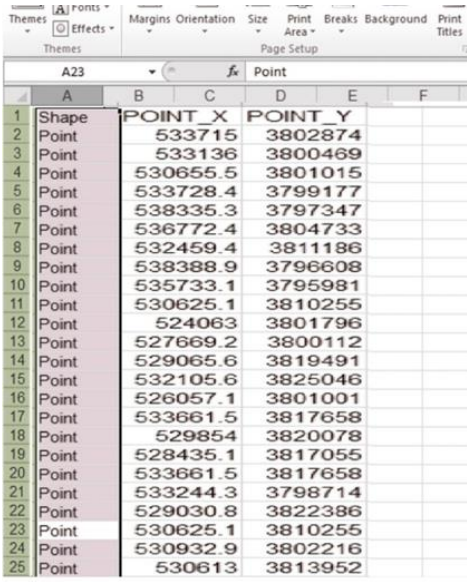


Figure 1. The Ci results

The evaluation of the Blajo Canal project was ranked number 3 according to the TOPSIS process in Alternative a 4 **(Figure 2, 3, and 4**). This place is near to a fertile region and complies with standards but is not perfect for other options.

Canal planning and preservation and related processes. Stakeholder involvement is essential in ensuring long-term progression and frameworks' appropriateness. In the bulk of irrigation projects, rural users are the main players.

However, other investors are also essential venture capitalists, should take account of their views. The desire of stakeholders and the potential of farming groups should also be taken into consideration in creating a balance. The Commission's commitment to the program is important.



Shape	POINT_X	POINT_Y
Point	533715	3802874
Point	533136	3800469
Point	530655.5	3801015
Point	533728.4	3799177
Point	538335.3	3797347
Point	536772.4	3804733
Point	532459.4	3811186
Point	538388.9	3796608
Point	535733.1	3795981
Point	530625.1	3810255
Point	524063	3801796
Point	527669.2	3800112
Point	529065.6	3819491
Point	532105.6	3825046
Point	526057.1	3801001
Point	533661.5	3817658
Point	529854	3820078
Point	528435.1	3817055
Point	533661.5	3817658
Point	533244.3	3798714
Point	529030.8	3822386
Point	530625.1	3810255
Point	530932.9	3802216
Point	530613	3813952

Figure 2. Excel-sheet of existing canals

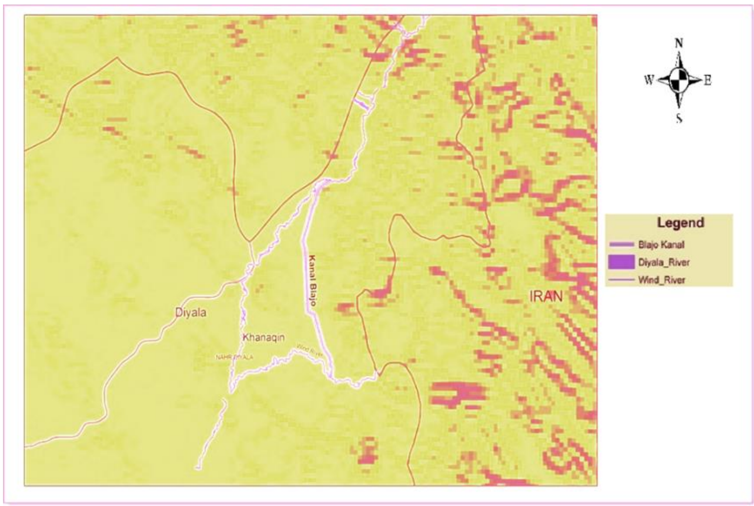


Figure 3. Blajo Canal

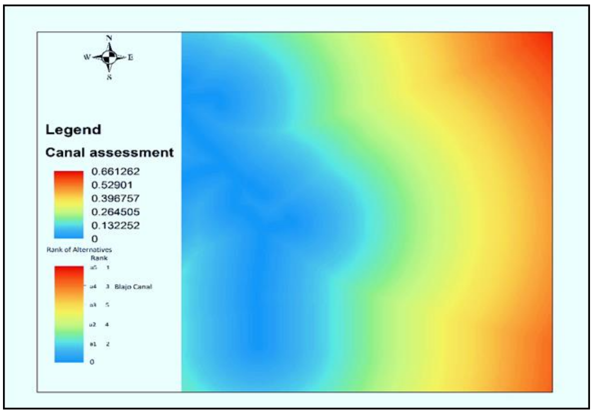


Figure 4. Land-use suitability

4. Conclusion

The more accurate the standards are, the more logic the assessment is, in selecting indicators, through which the irrigation channel was assessed, carried out using literature and expert opinions. Using spatial analysis by building a model with ArcGIS software, it was concluded that there are better places than the Blajo Canal that can be built according to TOPSIS preferences. In alternative, a4, the evaluation of the Blajo Canal project was classified number 3 by the TOPSIS process. The next feature of this site is close to arable fields and standards, but compared to other options it is not an ideal location.

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