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Application of TOPSIS Method for Multi-Criteria Decision Making for Poultry Fields by Using GIS in Hilla District

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Abstract

Statistical methods and statistical decisions making were used to arrange and analyze. the primary data to get norms which are used with Geographic Information Systems (GIS) and spatial analysis programs to identify, the animals production and poultry units in strategic nutrition channels, also the priorities of food insecurity through the local production and import when there is no capacity for production. The poultry production is one of the most important commodities that satisfy human body protein requirements, also the most important criteria to measure the development and prosperity of nations. The poultry fields of Babylon Governorate are located in Abi Ghareg and Al_Kifil centers according to many criteria or factors such as the population, production ratio, rivers, distance between fields and streets, and the field's spaces which identify by using TOPSIS method and GIS.TOPSIS and GIS are used to analyze the factors and limiting them to the main factor to know the most important influential factor. These factors consist of the natural and human changes which affect the actual ability to identify the defects according to statistical methods such as the nearest neighbor, the standard distance to build educational data bases aimed to facilitate the information exchange and analysis. The output data of TOPSISdivided into (supreme importance, most important, important, and less important)

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1. Introduction

This research relied on Statistical Methods and Multi-Criteria Decision Making (MCDM), which is a suitable strategy for tacklingissues when choiceproducersdiscover it troublesome to decidethe leadingelective based on numerousvariablesthat need to be taken into consideration. The TOPSIS method was adopted to select poultry fields through several criteria and alternatives. Geographical information systems (G.I.S) were used to determine their places and coordinates and to draw geographical maps. By calculating the Euclidean separations between the electivebeneathassessment and the ideal (positive and negative) options. Undesirable deviations are measured utilizing the positive and negative deviation factors that are distinguished for each measure and speak to over-achievement and non-fulfillment of choices, separately (Akoz and Petrovic, 2007). In spite of the fact thatgenerationarrangingissues are broadlyutilized (Wheeler and Russel, 1977), the mostshortcomingought to be carefully distinguishedwithin thearranging environment as a relationship between criteria, in reality, on the off chance that, for illustration, there are two criteria that are closely related and represented by Idlefigure, this inactivefigure will have a solidimpact on the gathering step. There are a few approaches that endeavor to bargain with conceivableconnections between the watchedstandards (Grabisch, M 1989; Bondor, C. I 2012; Antuchevi cieene 2010. Among them, an curiously approach is an amplified version of TOPSIS (Wang, Z.-X.2014). (Vega, A., Aguar´on2014) The removeestimation calculation takes under consideration the covariance lattice between the parameters. The issue of the ponder was spoken to in an pressinghave to befind poultry areas and incrementgeneration units for them to contribute to keynourishment channels and the stepping stool of food security needs through neighborhoodgeneration or consequencewithin thenonappearance of conceivable outcomes for disseminating poultry areas in Babylon Governorate. The issue of selecting locales and comparison between them can be depicted as Multi-criteria choice making (MCDM) issue.

2. Statistical methods

Those interested in the science of decision-making call for adopting modern methods of strategic decision-making using scientific methods, (Saaty 1980) presented the decision-making process to analyze and formulate alternatives and proposals and reach the best ones that help in decision-making and determine priorities to obtain the best decision, using the TOPSIS method, which is A useful method for verifying decision-maker evaluations which reduces bias in the decision-making process (Saaty 1980). And the process in which the goal or task and criteria are determined and alternatives are selected according to the criteria, and then a binary hierarchical comparison is made to make a decision to choose the best alternative. (Saay.1976)

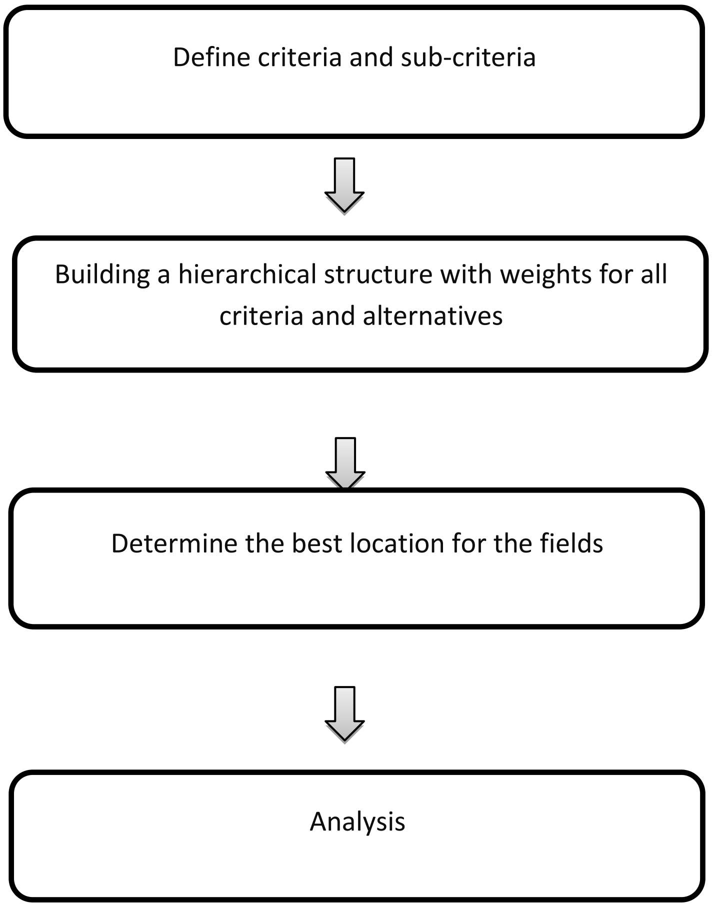


Figure 1 simplifies the structure of TOPSIS analysis (Parkhan, 2018(

3. Mathematical Formula

Each image (raster) has x,y coordinates, which means it is a two-dimensional function (Tow-Dimensional Funtion) f(x,y), and each sample in (raster) $f_i(x,y)$ can be expressed as a one-dimensional vector X_i of the vector Dimensions - N^2 and N^2 - Dimensional Vector as follows:

$$X_i = \begin{bmatrix} X_{i1} \\ X_{i2} \\ \vdots \\ X_{iN^2} \end{bmatrix} \quad \ldots (1)$$

Since x_{ij} denotes the j^{th} of the components of the i wave. One way to construct this vector is for the N to form the first component of xi from the first row of $fi\,(x, y)$, ie:

[x_{i1} = f(0,0) ,x_{i2} = f(0,1), x_{i3} = f(0,2) ,… x_{iN} =f(0,N-1)]

The second group of N is a compound of the second row, and so on. Another way is to use f(x,y) columns instead of rows. Therefore, it is possible to specify an average where:

$m_x = E(x)$ … (2)

It is possible to approximate the equations to preview images as follows:

$$m_x \cong \frac{1}{\mu}\sum_{i=1}^{\mu} x_i \quad \ldots (3)$$

$$C_x \cong \frac{1}{\mu}\sum_{i=1}^{\mu}(x - m_x)(x - m_x)^T \quad \ldots (4)$$

Which equal to:

$$C_x \cong \frac{1}{\mu}\left[\sum_{i=1}^{\mu}(x_i x_i)^T\right] - m_x m_x^{\ T} \quad \ldots (5)$$

Let a_i and λi , i = 1,2, ... N^2 represent distinct vectors and the distinct values of C_x . The transformation matrix has the rows of the characteristic vectors of C_x given as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1N^2} \\ a_{21} & a_{22} & \cdots & a_{2N^2} \\ \vdots & \vdots & \ddots & \vdots \\ a_{N^2 1} & a_{N^2 2} & \cdots & a_{N^2 N^2} \end{bmatrix} \quad \ldots (6)$$

Where a_{ij} is the j^{th} of the compounds for the i^{th} of the distinct vectors. A is N×N Unitary Matrix, meaning that ($A^{-1} = A^T$) the rows of A are N of the standard characteristic vectors.Normalized Eigen Vector for C_x . In order to perform the [KL] transformation, the covariance matrix must have the following diameter:

$$C_x = AC_xA^T = \begin{bmatrix} \lambda_1 & 0 & \cdots & 0 \\ 0 & \lambda_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \lambda_{N^2} \end{bmatrix} \quad \ldots (7)$$

Where $\lambda_1 \ldots \lambda_N^2$ (the variance of the principle compounds) are the characteristic values of C_x arranged in the form $\lambda 1 > \lambda 2 > \ldots \lambda i$ represents the variance of the image. Therefore, the smallest distinct value will contain only the private information in the image. [Gonzales & Woods,2008]

4. Consistency Verification

We note that the elements in the column are the reciprocal of the element in the row, so the sum of the elements in each column is calculated and each value is multiplied by the standard value of the corresponding row, then the results are summed for all columns. On the other hand, if the judgments are contradictory, this known value (λ max) will be greater than n the amount of the difference is a measure of the degree of discrepancy.

Assume we wish to compare a set of n components in setsagreeing to their extents and weights. Indicatescomponents by A1,A2……..An, and their weights by W1,W2………..Wn Comparisons can be spoken to by a twofoldframework as follows:

$$A=\begin{bmatrix} \frac{w1}{w1} & \frac{w2}{w1} \ldots\ldots & \frac{wn}{w1} \\ \frac{w1}{w2} & \frac{w2}{w2} \ldots\ldots & \frac{wn}{w2} \\ \frac{w1}{wn} & \frac{w2}{wn} \ldots\ldots & \frac{w}{wn} \end{bmatrix} \quad \ldots (8)$$

1. The eigenvalues or the characteristic roots of the matrix A of degree PXP are the set of solutions of the determinant of the following equation:

$$|A - \lambda I| = 0$$

The Laplace expression of the distinct determinant enables us to write the distinct polynomial as follows: (Morison: Page 64)

$$|A - \lambda I| = (-\lambda)^P + S_1(-\lambda)^{P-1} + S_2(-\lambda)^{P-2} + \ldots\ldots\ldots\ldots + S_{P-1}(-\lambda) + |A| \ldots (9)$$

where:

S_1 : the sum of all the minors of degree i*i of A

S_2 : the set of incliningcomponents of the matrix A or the follow of the tr(A)

The summation of the Eigen roots of A is equivalent to tr(A), that is:

$$tr(A) = \sum_{i=1}^{n} \lambda i$$

It incorporates a nonzero arrangementon the off chance that and only if n is an eigenvalue of A, that's , it speaks to the root The characteristic equation for A. But A has unit rank since each pushmay be asteady multiple

…(10) $$CI = \frac{\lambda_{max} - n}{n-1}$$

CI = stability index

λ = potential root for binary comperison matrix

n = the number of elements in the comparison

$$\sum_{i=1}^{n} \lambda i == tr(A) = sum\ of\ the\ diagonal\ elements\ =\ n$$

After obtaining the esteem of the Consistency criteria (CI), it must be accordingto the value of the Random criteria (RI)) in order to identify the stability ratio CR, we use the following equation:

$$CR = \frac{CI}{RI} \qquad \ldots\ldots(11)$$

CR = stability ratio or (consistency(

RI = random stability index

CI = stability index

The stability ratio CR, the closer it is to zero, the results are characterized by stability, and the upper acceptable limit for the stability ratio is (0.1), this indicates a contradiction, so the decision should be reviewed.

Table (1) units of the random stationarycriteriaCR

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49

5. The Classical TOPSIS Method

In numerous multiple-choice circumstances, an individualyearnsto create a “calculated” choice. From a logical point of see, there are explanatory and numerical strategies that take into consideration multiple options with numerous criteria. The TOPSIS strategymay be a multiple-choice inclinationmethod by similarity with the ideal solution, and it is one of the numerical strategies for multi-criteria decision-making, as the complexity emerges when there's more than one decision-maker One is since the favoredarrangement must be concurred upon by intriguedbunches that as a rule have distinctiveobjectives. The classic TOPSIS strategy is clarified to a single decision-maker and orderly collective decision-making. (Penjani HN, 2018)

The essentialrule is that the elective chosen ought to have the most limitedseparate from the positive idealarrangement and the longest remove from the negative ideal solution. We have m alternatives (options) Ai , each subordinate on n parameters (criteria) Xj whose values are positive genuine numbers Xij

i=1,2,…..,m

j=1,2,…..,n

And here must choose the alternative (option) perfect. (G. H. Tzeng, 2011)

6.Mathematical form of the method:

First, the values of the Xij parameters must be station as to the normalization approach . assume the aij is the parameters of calibrated parameter. Each alternative (option) Ai is expressed as a point

$$A_i\ (a_{i1},\ldots,a_{in}) \in R^n$$

Choosing the perfect value $a^*_j \in \{ a_{1j},\ldots, am_j \}$ then, each coefficient Xj will specified the non-negative perfect solution A+ = (a+1,….a+n) . In turn, the negative perfect solution will be (a-n,.....,1A-=(a- , the non-negative and negative perfect is also denoted by A^+, A^-). The rule is made about the rand the values in relation to the order of the numbers

$$D_i^* = \frac{d(A_i, A^-)}{d(A_i, A^+) + d(A_i, A^-)} \frac{1}{\frac{d(A_i, A^+)}{d(A_i, A^-)+1}} \quad \dots (12)$$

As, A^+ is the optimal solution if:

$$D_{A^+}^* = Max\ \{D_1^*, \dots \dots . . D_m^*\}$$

And option A^- is the bad solution if it is

$$D_{A^+}^* = Min\ \{D_1^*, \dots \dots . . D_m^*\}$$

And other alternatives amongthese two terminal values. Great way

$$D_{A^-}^* = Min\ \{D_1^*, \dots \dots . . D_m^*\}$$

It is always called a TOPSISunits(J. Xu,2012)

Figure 2 appears the beginningcourse of action of the optionswithin the TOPSIS strategy for n=2, the parameter X1=X*1 includes a monotonic expandinginclination, the positive and negative optimal solutions A- and A+ are found at the diagonally inverse positions, the most excellentarrangement is the elective A7 that's near to the idealarrangements Positive. (KA Yoon, 1987: pp. 277-286)

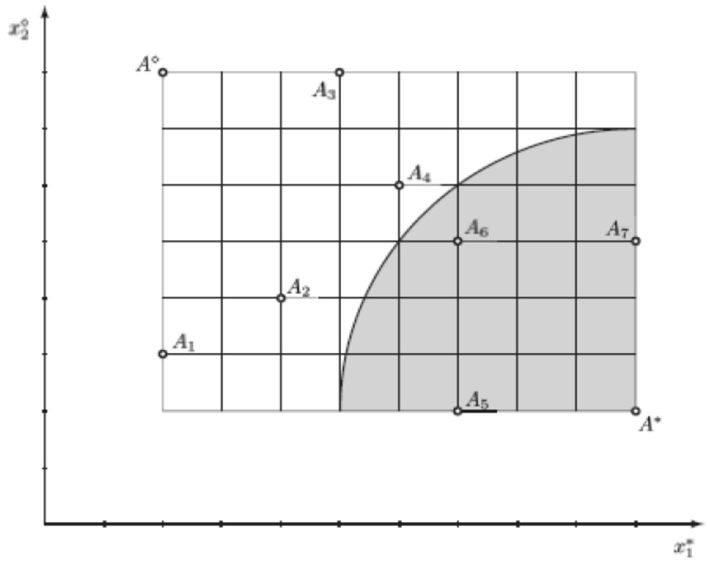


Figure (2) Geometric representation of TOPSIS method(Penjani HN, 2018)

These sorts of strategiespermit for compromise between diverse criteria, where a awful result in one model can be compensated for by a great score in another. An suspicion of the TOPSIS strategy is that each model has either an expanding or diminishinginclination. Due to the plausibility of criteria modeling, compensatory strategies, certainly counting TOPSIS, are broadlyutilized in differentdivisions of multi-criteria decision-making. I. B. (Huang, 2011: PP.3578-3594)

7. TOPSIS Calculation Procedures

We will test m of another's $A_1,\ldots,A_m$ each alternative Ai, relative to n of the parameters $x_1,x_2,\ldots,x_n$ which are expressed by the positive numbers x_{ij} . Criterion $x_1,\ldots,x_k$ is useful (monotonic preference) and criterion $x_{k+1},\ldots,x_n$ is unhelpful (monotonic decreasing preference) and weights w_j for criterion x_j are given such that$\sum_{j=1}^{n} wj = 1$. It is necessary to choose the best alternative.

For a better view, the selected alternatives, criteria and weights were set in Table (2) of the TOPSIS method's primary distribution. (G. R. Jahanshahloo, 2006: pp. 1544-1551)

Table (2) Distribution of criteria and weights for the TOPSIS method

CRIT ERIA	x_1 cr. 1	x_2 cr. 2	$\ldots$	x_n cr. n
weights	w_1	w_2	$\ldots$	w_n
A_1	x_{11}	x_{12}	$\ldots$	x_{1n}
A_2	x_{21}	x_{22}	$\ldots$	x_{2n}
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
A_m	x_{m1}	x_{m2}	$\ldots$	x_{mn}

The given numbers x_{ij} are represented by the following matrix:

$$X = \begin{bmatrix} x_{11} & x_{12} & \ldots . x_{1n} \\ x_{21} & x_{22} & \ldots . x_{2n} \\ \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \ldots . x_{mn} \end{bmatrix} \qquad \ldots(13)$$

It must be adjusted, as long as the xij numbers speak to values of distinctive parameters with distinctive units of degree. To start with, we must too take under consideration the weights wj of the standard xj, and to begin with of all, the xij numbers of the standard xj are supplanted by the relative or ordinary numbers. (K. A. Yoon, 1987: pp. 277-286)

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \; for\ i \in I = (1,2, \dots m) and\ j \in J = (1,2, \dots n)$$

which belongs to the open perid (0,1) and according to the $w_j x_j$ share of the xj criterion, r_{ij} is replaced by the weighted standard as,

$$a_{ij} = w_j r_{ij} = w_j \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \qquad \dots (14)$$

It is created for the period (0,1), and the extrainformationhandlingemployments the standard weighted choiceframework

$$C=\begin{bmatrix} c11 & c12 & \dots. & c1n \\ c21 & c22 & \dots. & c2n \\ \vdots & \vdots & & \vdots \\ cm1 & cm2 & \dots. & cmn \end{bmatrix} \qquad \dots \dots (15)$$

On the off chance that all the weights are precisely the same, within the case of wj=1/n and the numbers rij can be connected to the lattice A as the numbers aij.

Table (3) appears the extraction of the standard weighted choicenetwork A and all the information that we are going calculate and we are goingattempt to compose in one table. I. B. Huang, 2011: PP.3578-3594))

Table (3) working table for TOPSIS method

CRIT ERIA	x_1^* cr. 1	x_2^* cr. 2	… …	x_k^* cr. k	$x_{k+1}^\diamond$ cr. $k+1$	… …	$x_n^\diamond$ cr. n	d^* dips	$d^\diamond$ dins	D^* topm
A_1	a_{11}	a_{12}	…	a_{1k}	$a_{1\,k+1}$	…	a_{1n}	d_1^*	$d_1^\diamond$	D_1^*
A_2	a_{21}	a_{22}	…	a_{2k}	$a_{2\,k+1}$	…	a_{2n}	d_2^*	$d_2^\diamond$	D_2^*
⋮	⋮	⋮	⋱	⋮	⋮	⋱	⋮	⋮	⋮	⋮
A_m	a_{m1}	a_{m2}	…	a_{mk}	$a_{m\,k+1}$	…	a_{mn}	d_m^*	$d_m^\diamond$	D_m^*
A^*	a_1^*	a_2^*	…	a_k^*	a_{k+1}^*	…	a_n^*	A^*	$A^\diamond$	$d^* \sim d^\diamond$
$A^\diamond$	$a_1^\diamond$	$a_2^\diamond$	…	$a_k^\diamond$	$a_{k+1}^\diamond$	…	$a_n^\diamond$			

he arranges a*j for the positive idealarrangement A*=(a*1,…..a*n) will be chosen concurring to the taking afterequation:

Calculating the normal weighted value a_{ij}

$$a_{ij} = w_j r_{ij},\ \forall i \in I, \forall j \in J.$$

Where w_j is the weight value of the j^{th} criterion, and $\sum_{j=1}^{n} w_j = 1$.

Determine the positive perfect solution A^+ and the negative perfect solution A^-.

$$A^+ = \{(a_1^+, a_2^+, \cdots, a_n^+)\} = \{(\max_i a_{ij} \mid j \in S_B), (\min_i a_{ij} \mid j \in S_C)\}$$

$$A^- = \{(a_1^-, a_2^-, \cdots, a_n^-)\} = \{(\min_i a_{ij} \mid j \in S_B), (\max_i a_{ij} \mid j \in S_C)\}$$

The numbers d+i for column d+=(d+1,…..d+m)T are the remove from focuses Ai to point A*, which is calculated concurring to the taking afterequation:

$$d_i^* = d(A_i, A^*) = \sqrt{\sum_{j=1}^{n} \left(a_{ij} - a_j^+\right)^2}, \forall_i \in I \qquad \text{... (16)}$$

The numbers d^-i of column $d^-=(d-_1,\ldots\ldots\ldots, d^-_m)T$ is the distance from points Ai to point A^-, which is calculated according to the following formula:

$$d_i^- = d(A_i, A^-) = \sqrt{\sum_{j=1}^{n} \left(a_{ij} - a_j^-\right)^2}, \forall_i \in I \qquad \text{... (17)}$$

The numbers D*i for column $D^* = (D^*_1,\ldots,D^*_M)T$ is the distance from points A to points A^+ and A^- , which is expressed in the following form:

$$D^*_i = \frac{d_i^-}{d_i^+ + d_i^-} = \frac{d\left(A_i, A^-\right)}{d\left(A_i, A^*\right) + d\left(A_i, A^-\right)} \text{...(18)} \qquad \text{for } i \in I.$$

If Max{D*1,…..D*m}= D^*_{i1}

We accept the alternative A_{i1} as an optimal solution, but if it is

= min{$D^*_1,\ldots\ldots,D^*_M$}D^*_{i2}

We accept A_{i2} as a bad solution. To classify the alternatives using this indicator, we can choose the best alternative with the maximum relative convergence value. (Parkhan,2018)

8. Applied side:

For the purpose of selecting the locations of poultry fields use the classification of criteria and weights for comparison between the areas that were presented in the theoretical side, which is The Classical TOPSIS Method, using (GIS) language, where the results are presented and applied to data affecting the positioning of poultry fields.

The research data included the information available in the records of the General Directorate of Agriculture in Babylon, as well as the Office of the Governorate of Babylon / Department of Geographical Parameters Systems to obtain aerial maps. The study area and the criteria used were determined as follows:

A_1: Population

A_2: Output ratio

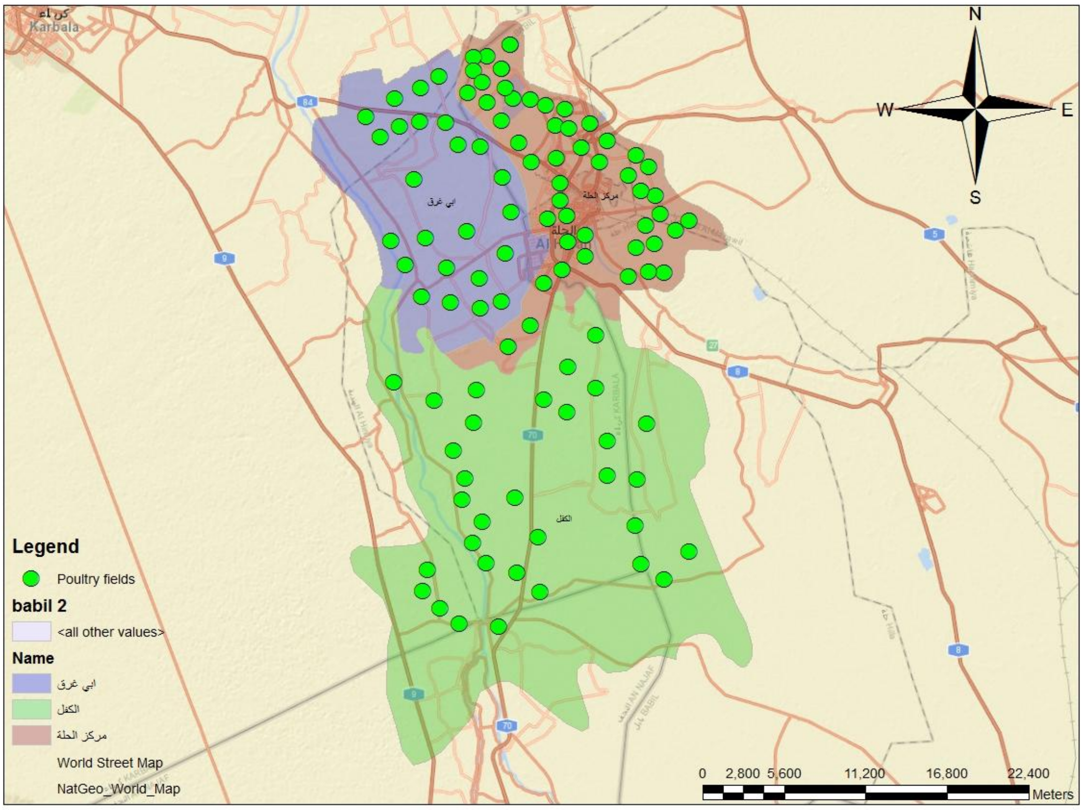
A_3: Fields area

A_4: Away from the rivers

A_5: Away from the street

C: Fields locations in Babylon Province N=1,2……,105

Five criteria were defined and the opinion of experts in geographic information systems and statistics was taken, according to the system in force in the Babylon Agriculture Directorate.And the appropriate sites will be determined according to the population density and the criteria affecting the production to determine the locations of the poultry fields in the center of Hilla, Al Kifl and Abi Gharq, as shown on the map below:



Map (1) of the study area for poultry fields of utmost importance using TOPSIS (researcher's work)

A pairwise comparison matrix based on the weights resulting from the main vectors of the decision matrix has been prepared. The main diameter of the decision matrix is units.

Table (4) Pairwise Comparison Matrix for Norms

A5	A4	A3	A2	A1	Criteria
7	2	5	2	1	A1
5	2	3	1	0.5	A2
2	0.33	1	0.33	0.2	A3
3	1	3	0.5	0.5	A4
1	0.33	0.5	0.2	0.14	A5
18	5.66	12.5	4.03	2.34	Column totals

A table (4) has been arranged for a pairwise comparison network for the criteria, based on the suppositions of the specialists in this field, to decide the significance between each criterion by utilizing the relative significance measures between the criteria, and after that building a pairwise comparison framework for the criteria. Relying on the choicelattice, it was found that the likelihood weights coming about from the criteria based on pairwise comparisons are as follows:

Table (5) (relative) priorities for the probability weights resulting from the criteria

(-)	(+)	Rank	Priority	Criteria	Category
6.7%	6.7%	1	41.4%	A1	population
5.8%	5.8%	2	26.7%	A2	production ratio
1.6%	1.6%	4	8.3%	A3	Fields area
4.4%	4.4%	3	18.4%	A4	Beyond the rivers
0.8%	0.8%	5	5.3%	A5	Fields distance from the street

From Table (5), the criteria were determined according to the importance and ranking of each criterion, and the population was the most influential for determining the locations of poultry fields, and the product of the probability weight was (41.40) and then the production ratio was the best standard by (26.70)

To appraise the consistency, the consistency file (CI) was calculated: Compute the consistency list (C

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

where n is the number of items being compared

To calculate the consistency ratio (CR):

$$CR = \frac{CI}{RI}$$

where RI could be aarbitraryrecord, which is the consistency record of the haphazardlyproduced pairwise comparison lattice. It can be appeared that RI depends on the number of things being compared. Multiply each esteemwithin theto begin with column of the pairwise comparison framework by the relative need of the primary element considered. The strategies are the same for other things. entirety values overlinesto induce a vector of values called “weighted sum”

To calculate the computed values (λ_{max})

$$\lambda_{max} = 5.075$$

$$CI = \frac{\lambda_{max} - n}{n-1} = \frac{5.075 - 5}{5-1} = 0.01875$$

$$CR = \frac{CI}{RI} = \frac{0.01875}{1.11} = 0.017 \leq 0.01875$$

We note that the degree of consistency resulting from the pairwise comparison matrix is acceptable.

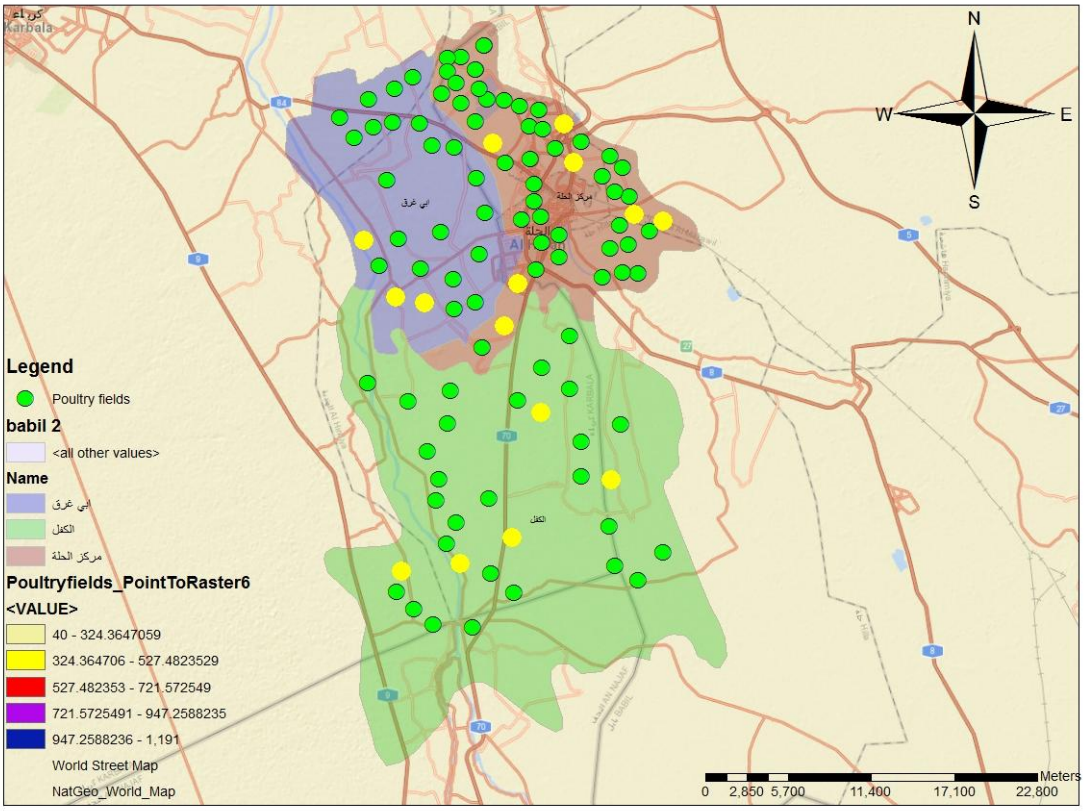
After extracting the binary decision matrix and determining the criteria according to the importance and giving a weight to each criterion, the population was the most influential for determining the locations of the poultry fields and the product of the probability weight was (41.40) and then the production ratio was secondly by (26.70) and then the othercriteria was applied TOPSIS technology based on the concept that the definition of the most excellentelective must be, at the same time, closer to (has the most limited Euclidean separate than) the positive idealarrangement (PIS) and most remote from the negative arrangementideal (NIS). The final ranking is obtained by means of the convergence index and the classification of centers according to the proximity coefficient and then a standard application and extraction of the convergence coefficient for each poultry field according to the tables listed below. Fields with a coefficient of convergence less than (0.5) have been excluded as unimportant and in order to obtain importance and choose areas It is an optimal site for creating fields and has been divided into two parts in terms of importance:

Table (6) theoptimal location for establishing poultry fields

FID	Shape *	boycott1	x	y	profits_Ne	earth_eari	Na_populat	after_stre	after_Rive	Approach coefficient
4	Point	alkifl	440058.936	3569641.148	11600	2500	153829	54	691	0.921
6	Point	alkifl	445615.1971	3580039.294	11230	2500	153829	88	640	0.9118
9	Point	alkifl	443630.8181	3571466.777	7800	3750	153829	135	1007	0.8684
15	Point	alkifl	450457.0818	3575435.535	16160	7500	153829	144	905	0.8735
25	Point	alkifl	436010.8029	3569164.897	9800	2500	153829	376	411	0.8505

41	Point	Abe drowned	433470.7978	3591866.193	19600	2500	119175	84	761	0.8301
43	Point	Abe drowned	435613.9271	3587976.81	8150	2500	119175	25	94	0.8175
44	Point	Abe drowned	437598.3061	3587579.934	8850	2500	119175	420	137	0.81
60	Point	Hillah	454028.9639	3593215.571	21320	2500	612976	303	40	0.8203
66	Point	Hillah	452044.5849	3593691.822	7600	5000	612976	190	148	0.7973
70	Point	Hillah	447837.7015	3597263.704	7160	2500	612976	363	220	0.7836
87	Point	Hillah	443075.192	3585992.431	6800	2500	612976	316	804	0.7598
88	Point	Hillah	444035.0955	3588895.42	5600	2500	612976	310	1191	0.7577
94	Point	Hillah	442281.4404	3598613.081	15440	2500	612976	118	933	0.7574
103	Point	Hillah	447202.7003	3599883.084	16600	2500	612976	317	449	0.74

Table No. 6 shows that the fields that have the greatest importance were (15) schools, where the coefficient of proximity was confined between (0.921-0.74), as it divided 7 fields in the center of Hilla, 5 fields in the Al-Kifl district, and three fields in Abi Gharq, according to the importance of each field and The map below shows the locations in order of importance



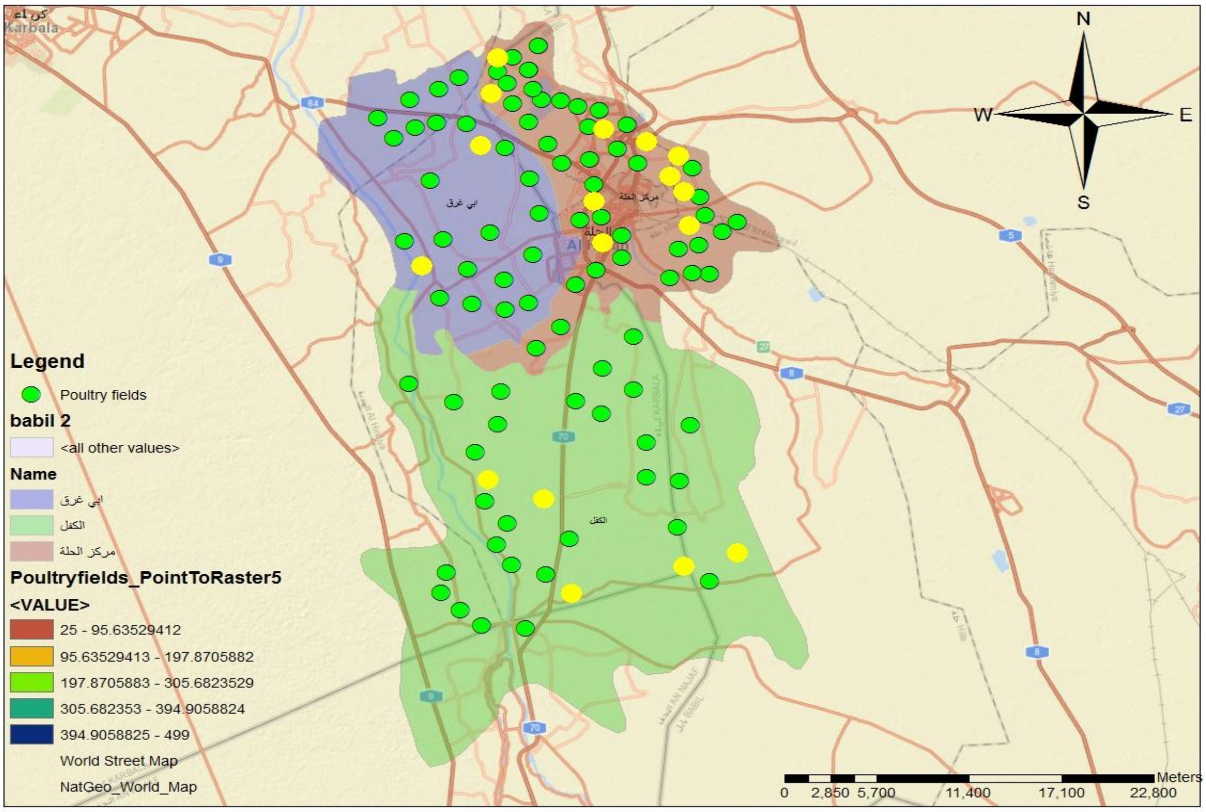
Map (2) class and classification of poultry fields of paramount importance to the TOPSIS method

It was also from table (6) and map (4) that these values are arranged according to the importance of the impact of each criterion and that the explanatory power of these criteria resulted in the approach coefficients for the fields of utmost importance of yellow color, and the number of poultry fields was 15 out of 105 fields according to the explanatory power of each criterion. And the important fields and the proximity coefficient was (0.7411-0.5699) and the number of fields was (17) fields and a percentage (0.16) of the total fields as shown in Table (7) through below and the selection of areas that would be an optimal location to create the fields, where 10 fields are divided in the center of Hilla, 5 fields in the Al-Kifl district, and 2 fields in Abi Gharq, according to the importance of each field. The map below shows the locations according to the importance.

Table (7) The optimal location for establishing poultry fields

FID	Shape *	boycott1	x	y	profits_Ne	earth_eari	Na_populat	after_stre	after_Rive	Approach coefficient
5	Point	alkifl	450695.2072	3569561.773	11280	2500	153829	429	725	0.7411
7	Point	alkifl	454028.9639	3570434.9	9200	2500	153829	199	375	0.7299
10	Point	alkifl	442043.3149	3574165.532	7300	2500	153829	199	1010	0.7248
17	Point	alkifl	438630.1831	3575514.91	34900	5000	153829	183	1190	0.7189
24	Point	alkifl	443789.5684	3567656.769	5600	2500	153829	436	567	0.7075
42	Point	Abe drowned	434502.6749	3590199.315	9600	3750	119175	155	794	0.6871
55	Point	Abe drowned	438153.9322	3598454.331	9600	3750	119175	29	801	0.677
56	Point	Hillah	448393.3276	3598692.457	18130	7500	612976	145	769	0.6471
57	Point	Hillah	450377.7066	3597739.955	9100	2500	612976	429	1097	0.6399
68	Point	Hillah	450695.2072	3595279.325	5800	2500	612976	498	876	0.6015
69	Point	Hillah	449822.0805	3596311.202	5600	2500	612976	266	979	0.6013
82	Point	Hillah	445138.9461	3594644.323	8900	2500	612976	283	1019	0.5998
84	Point	Hillah	445694.5722	3591786.818	24550	2500	612976	356	841	0.5975
85	Point	Hillah	451022.5254	3592925.813	8670	5000	612976	179	222	0.0594
99	Point	Hillah	439185.8092	3604486.843	8670	2500	612976	418	569	0.5784
102	Point	Hillah	438788.9334	3602026.213	5600	2500	612976	156	1113	0.5771
104	Point	Hillah	445773.9474	3599565.583	5700	5000	612976	117	1120	0.5699

It was also shown from table (7) that these values are arranged according to the importance of the impact of each criterion and that the explanatory power of these criteria resulted in the approach coefficients for the fields of utmost importance of yellow color, and the number of poultry fields was 17 out of 105 fields according to the explanatory power of each criterion



(3)class map and classification of important poultry fields for the TOPSIS method

9. Conclusions

In light of the results of the practical side, the following conclusions were reached:

1. Relying on the decision matrix, it was found that the most important criterion with the highest probability weights resulting from the criteria based on pairwise comparisons, the population was the most influential for determining the locations of poultry fields, and the product of the probability weight was (41.40) and then the production ratio was the best criterion by (26.70).

2. There's a significant deficiencywithin the number of areaswithin therangesinside the ponderrange and the reason for the need of waterways and administrations, which influences the generation rate.

3. Concentration of most of the fields from the areas and neighborhoods close to the city center.

4- Poultry fields are classified into two categories: first, the highest importance was that there were 15 fields, representing 14% of the total number, as it divided 7 fields in the center of Hilla, 5 fields in the Al-Kifl district, and three fields in Abi Gharq, according to the importance of each field. And second theimportance was 17 fields and 16% of the total number, where 10 fields were divided in the center of Hilla, 5 fields in the Al-Kifl district, and 2 fields in Abi Gharq, according to the importance of each field.

10. Recommendations

Based on the findings and conclusions, we recommend the following:

1. The necessity of applying geographic information systems programs in determining the optimal sites for establishing poultry fields to increase livestock wealth in accordance with the standards and controls set by the competent authorities in the field of planning.

2. The necessity of coordination between all the agencies concerned with providing services to provide lands that meet the standards in order to establish fields on them and meet all the necessary production standards

3. The necessity of employing statistical methods to analyze the criteria for selecting sites.

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