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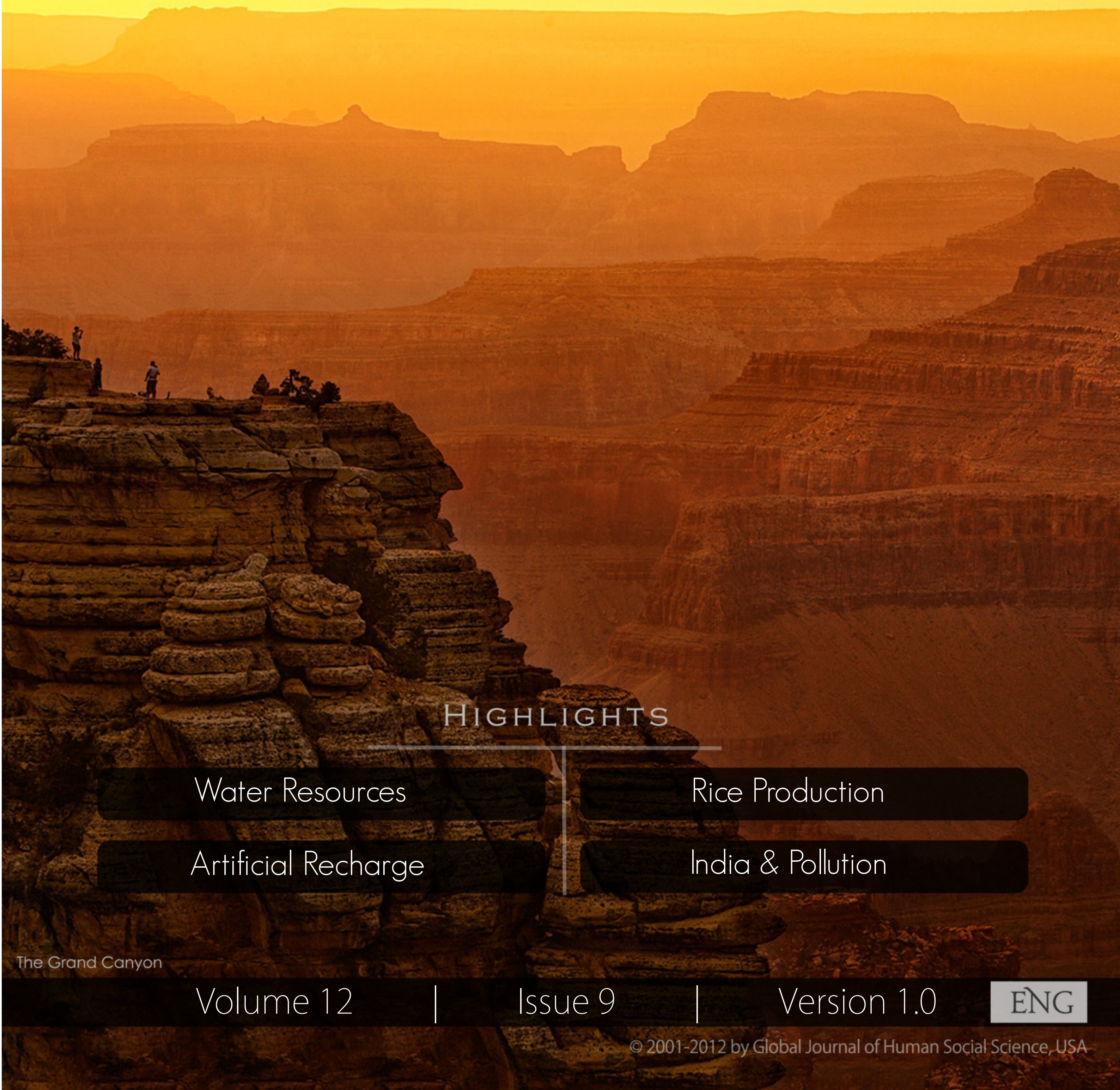

Highlights

- Water Resources
- Rice Production
- Artificial Recharge
- India & Pollution

The Grand Canyon

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Selection of Most Appropriate Area to Establish Soil Damp for the Purpose of Sustainable Development of Water Resources Using TOPSIS and ELECTRE Methods (A Case Study: Zarand-Saveh Watershed)

By Dr. M.H.Ramesht , Alireza Arab Ameri & Hamideh Beigi
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Abstract - Nowadays, shortage and decrease in fresh water is approximately under increased all over the world. Based on the statistics published by FAO (Food and Agriculture organization), need for fresh water has almost become double per 21 years, while useful water resources have been reduced by half in relation to 30 years ago. It seems that useful water resources will become one fourth up to 2025 than useful water resources in 1960. Meanwhile, danger of various pollutions for water resources frequently increased the value and importance of them. Due to mentioned cases, if water resources aren't managed in better way, the life of human being will be threatened by the shortage of water. Thus, it is necessary to acquire the exact and up to date information about the condition of water resources and prediction of their situation in future in order to achieve optimum management for water resources.

Keywords : *Watershed, Zarand-Saveh, ELECTRE method, TOPSIS, GIS technique, zoning.*
GJHSS-C Classification : *FOR Code: 090509, 300903 JEL Code: Q01, Q56, Q25*

SELECTION OF MOST APPROPRIATE AREA TO ESTABLISH SOIL DAMP FOR THE PURPOSE OF SUSTAINABLE DEVELOPMENT OF WATER RESOURCES USING TOPSIS AND ELECTRE METHODS A CASE STUDY ZARAND-SAVEH WATERSHED

Strictly as per the compliance and regulations of:

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(A Case Study: Zarand-Saveh Watershed)

Dr. M.H.Ramesht[α], Alireza Arab Ameri[σ] & Hamideh Beigi[ρ]

Abstract - Nowadays, shortage and decrease in fresh water is approximately under increased all over the world. Based on the statistics published by FAO (Food and Agriculture organization), need for fresh water has almost become double per 21 years, while useful water resources have been reduced by half in relation to 30 years ago. It seems that useful water resources will become one fourth up to 2025 than useful water resources in 1960. Meanwhile, danger of various pollutions for water resources frequently increased the value and importance of them. Due to mentioned cases, if water resources aren't managed in better way, the life of human being will be threatened by the shortage of water. Thus, it is necessary to acquire the exact and up to date information about the condition of water resources and prediction of their situation in future in order to achieve optimum management for water resources.

One of the management methods for water resources is Multi Criteria Decision Making. The result and findings of different studies show that in TOPSIS method, zone 3 with (0/8) point promotes in first rank among 7 studied zones and thus it is the most appropriate zone to establish the proper soil damp, in contrast zone 1 with (0/15) point goes down to the last rank and so it isn`t suitable for establishing soil damp and zones (4,2,5,6,7) with (0/79, 0/73, 0/46, 0/32, 0/21) points are located in next ranks. In ELECTRE method, zone (4) dominated (5) times and defeated (1) time, so it is located in the first rank with (4) points and is the most suitable zone for artificial recharge. In contrast, zone (1) defeated (6) time and dominated no time, therefore it is located in the last rank with (-6) points and is not the most suitable zone for artificial recharge. And, zones (3, 5, 2, 6, 7) dominated (4, 4, 2, 2, 1) times and defeated (5, 4, 2, 2, 4) and located in other ranks with (-4, -2, -2, 2, 2, 2) points respectively. Also, zones (7, 6, 2, 1) should be omitted because their defeated times are more than dominated times.

Keywords : Watershed, Zarand-Saveh, ELECTRE method, TOPSIS, GIS technique, zoning.

I. Introduction

Due to continuous decline in per capita water and the importance of nutritious preparation for people it is necessary to control the surface water using damp building or artificial recharge methods. Researchers of water sciences have studied the damp building and artificial recharge projects all over the world, drawn logarithm curve for cost against the amount of savable running water and concluded that it is frugal economically to accomplish artificial recharge projects especially flood distribution instead of damp building for the volume less than 30 million cube meter (Bize, et al., 1972). Food and Agriculture Organization described sustainable development as below:

> "Sustainable development is the management and conservation of basic natural resources and direction of technical and organizational changes to achieve and prepare requirements for generations at the present and in future. Such a development in agriculture section leads to the conservation of water, soil and plants and it is nondestructive environmentally, proper technically, frugal economically and acceptable socially. Similar to under development countries, our country needs to compress and develop agriculture in order to carry out enormous requirements of under growth population."

However, the experiences of under developed countries show that compressing the agriculture caused quick output purposes but they destroy the basic resources for a long term. It can be noticed in pasture destruction, forest resources reduction, deserts increase, reduction and destruction of surface water resources and ground water and exponential compress to the basic resources.

In our country, planning in agricultural, rural and natural resources development has always been founded at the level of political development. This traditional attitude toward planning and development caused instability in using basic resources. During 2 previous decades, our country has taken activities to develop agriculture and natural resources comprehensively. Although these activities were slow and sluggish, they can develop a new attitude among experts, connoisseurs and decision makers in agriculture section. Based on this attitude, casual, one-direction and one-dimensional activities can solve part of short term problems and difficulties related to agriculture section and have pathetic effects on this section in long term. In recent years, water exploitation has become greater for many reasons such as

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population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine and assign the suitable position for this case.

Water resources management is a set of various management activities aimed at the optimum utilization of water resources and reduction of economical, social and environmental damages and losses. Decision making issue in water resources management is very complex and complicated because of several decision indicators and criteria. Achieving a determine purpose, there are a lot of solutions with different priorities for various issues such as environmental, social, organizational and political problems. These necessities leads to use of multiple criteria decision making aimed at selection of best solution among different solutions.

There are several studies on ground water and their artificial recharge all over the world. For example, Krishnamurthy et.al (1995, 1996) used RS and GIS techniques to find a suitable position for artificial recharge of ground water in India. Also, they investigated the effects of geomorphologic and geological factors on the behavior of ground water and stated that there is a special unevenness in each area for recharge of ground water.

Saraf and Choudhury (1998) used remote sensing capabilities in extracting different layers like land usage, geomorphology, vegetation, and their integration in GIS environment to determine the most suitable area for artificial recharge of ground water.

Mahdavi (1997, 16) investigated water management and artificial recharge of ground water in Jourm city and indicated that controlling usage and recharge of water tables by the watershed management is the main management technique.

Abdi and Ghayoumian (2001, 86) prioritized the suitable areas for storing surface water and reinforcing ground water based on geophysics data, land usage, topography, their integration and analysis in GIS environment.

Kia Heyrati (2004) studied the function of flood distribution system in recharge of ground water in Moughar plain in Isfahan.

Mahdavi et.al (2005) attempted to find the best position for artificial recharge of ground water by RS and GIS techniques in watershed Shahr Reza in Isfahan and introduced this tool for this case efficiently.

Also, Noori et al (2004, 635) tried to find the appropriate areas for artificial recharge of ground water by recharge pools (recharge pools) and GIS technique in watershed Gavbandi and introduced alluvial fans and plain head (Dashtsar) as the best area for artificial recharge.

Mousavi et al (2010) found the potential appropriate areas for artificial recharge of ground water in the vicinity of Kamestan anticline by integration of remote sensing and GIS techniques and introduced broken formations, alluviums and river canals as the best position for artificial recharge.

Mianabadi and Afshar (2008) investigated and ranked the project of water supply in Zahedan using three methods: Induced Ordered Weighted Averaging (IOWA), Linear Assignment and TOPSIS methods, and then they compared the findings of these methods with the results of adaptable planning method (Mianabadi, 2008: 34-45).

Limon and Martinez (2006) used Multi Attribute Utility theory for optimum allocation of agriculture water in north of Spain (Limon, 2006: 313-336).

Ahmadi et al (2002) used multiple criteria decision making to rank different projects of refining agriculture water to reuse them (Ahmadi, 2002: 339-352).

Also, Anand Raj and Kumar (1996) ranked management options of river basin by ELECTRE method (Anand, 1996: 326-335).

The purpose of this study is zoning the best area for artificial recharge of underground basins in Zarand-Saveh watershed using effective factors in recharging underground water table by ELECTER method, TOPSIS and GIS technique. In another way, this study aimed at the selection of most appropriate area to establish soil damps for the purpose of sustainable development of water resources using Multi Criteria Decision Making methods (ELECTRE and TOPSIS) and classify the best areas in considered watershed.

a) Methods and materials

i. *Mathematical situation of studied area*

Being situated in the north part of central province, Saveh province is bounded by 34º, 45' latitude to 35º, 34' north latitude and 49º, 15' to 50º and 56' longitude. It has access to Ghazvin province in north, to Tafresh and Qom provinces in south, to Tehran province in east and to Hamedan province in west. Globally, Saveh is located at 1250 meter height above sea level and its extent is 1027 square kilometers.

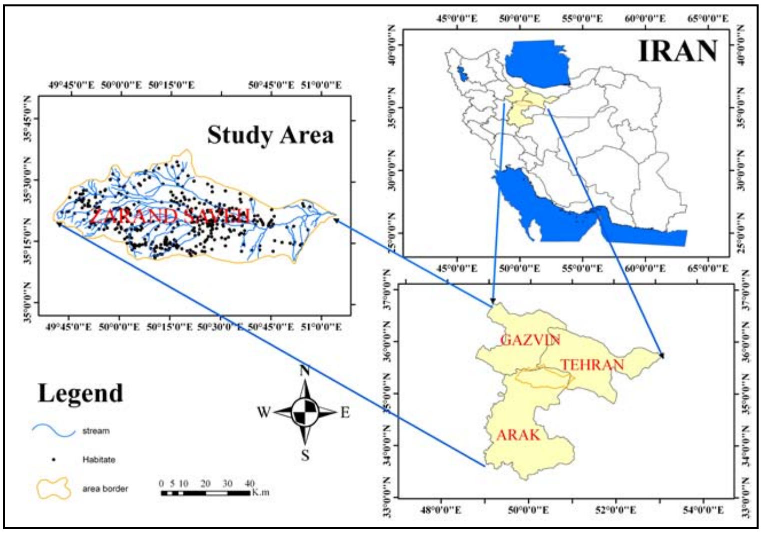


Figure 1 : Mathematical situation of studied area.

II. Methods

Firstly, studied area was investigated by the satellite images of Google Earth and its limitations were determined. Then digital elevation model of area was separated from its digital elevation model in Iran in the environment of soft ware GIOBAL MAPER and the output was received. Required data layers for zoning in the environment of software Arc GIS 9.3 was prepared as following:

First, digital elevation model classified in to 7 elevation classes based o natural breaks in the heights of the area. Mentioned classes represent the studied zones in the area and subsequent calculations were done in each of these classes. Slope layer prepared base on digital elevation model o the area by surface analyses tool in 3D analyses. There were different processes to prepare drainage density layer and habitual density such as digitizing main and minor waterways layers on the topographical map1:50000 of the area, digitizing main and minor fault on geological map 1:100000 of area and density tool in Spatial Analyses. Iso-Precipitation layer prepared by interpolating method like cringing technique and linear relationship between rain-height using Interpolate tools in 3D analyses (Figure 3 to 9).

Second, the investigated criteria for each height zones were calculated (Tables 2 , 10) and their layers prepared separately. After achieving a few numbers in each layer, the numbers were analyzed by ELECTRE and TOPSIS methods. Then considered watershed was ranked to select the best area for establishing soil damp.

a) *Theoretical principles of ELECTRE and TOPSIS method*

In recent decades, several researchers attempt to use Multi Criteria Decision Making (MCDM) in complex and complicated decisions. These decision methods divide into two parts;

1. MODM = Multi Objective Decision Making
2. MADM = Multi Attribute Decision Making

Multi Criteria Models use to select the best options. Evaluative Models for MADM classify into two models;

1. Compensatory Model
2. Non- Compensatory Model

Non-compensatory model includes methods which don`t need to achieve data from DM and lead to objective answer. Exchanging between indictors is permitted in Compensatory model. It means that for example, a weakness in an indicator may be compensated by option of other indicators.

TOPSIS algorithm is a Multi Criteria Decision Making, a type of compensatory model and an adaptable subgroup with strong ability to solve multi alternative problems because of having ability to overlap indicators in weak and power points (Kohansal and Rafiei, 2009-93). In this model, if quantitative criteria can change in to qualitative criteria, qualitative criteria can be used besides quantitative criteria. In aforementioned model, it is supposed that each indicator and criterion has steady increasing and decreasing utility in decision making matrix; it means if criteria gain more positive amount, they will be more appropriate, on the contrary the more negative amount, the less appropriate.

Electrical Method is a type of available methods in Compensatory Models. In this method whole options evaluate by non-ranked comparisons. All stages of this method are established based on coordinated and uncoordinated sets and thus this method is known as ''Coordination Analysis''. Banayoun established the Electrical Method and Delft, Nijkamp, Roy and their colleagues developed it. In Electrical method, the concept of domination uses implicitly. In this method, options are compared in pairs, then dominant and weak (dominant and defeated) options determined and weak or defeated options omitted (Roy, 1991. 49-73).

b) Problem solving process using ELECTRE and TOPSIS method

- Problem solving process using TOPSIS method

TOPSIS model includes 8 processes which are described in the following parts (Olson, 2003-2).

1. Establishing data matrix based on alternative n and indicator k:

Generally, in TOPSIS model, matrix **n**×**m** with **m** alternative and **n** criteria is evaluated. In this algorithm, it is supposed that each indicator and criterion in Decision Making matrix has steady increasing and decreasing utility.

$$A_{ij} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ . & . & & . \\ . & . & & . \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

2. Standardizing data and preparing normalized matrix (matrix R) by Equation (1):

Since it is possible that quantitative amount of criteria and indicators don`t have equal unit , the dimensions of their units should be omitted. Thus, all amounts of entries of Decision Making matrix should be changed into dimensionless amount with following formula:

$$R_{IJ} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^{2}}} \qquad (1)$$

$$\begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ . & . & & . \\ . & . & & . \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

3. Determining weights for whole indicators (w_j) by equation (2) and modifying calculated (w_j) by equation (3):

In this process, the weights of all indicators are calculated by expertise theories and approaches, Linmap method, AHP model, Antropi model and based on the importance of criteria. It is considerable that sum of criteria weights should be equal to 1. In this study, AHP model has been used to calculate the amount of ( ) 9Table 3).

$$\sum_{j=1}^{n} w_j = 1 \qquad (2)$$

$$= \frac{\lambda_j . w_j}{\sum_{j=1}^{n} \lambda_j . w_j} \qquad (3)$$

4. Creating dimensionless weighted matrix (V) to implement vector W as an input for algorithm:

In order that the amounts of entries in matrix R gain equal value, , sum of weights of parameter (w_j) are multiplied to the column of this matrix one by one. The acquired matrix is normalized and weighted matrix which is shown by sign (V) (Table 4).

$$V_{ij} = R_{ij} . W_{n\times n} = \begin{bmatrix} v_{11,\dots} & v_{1j,\dots} & v_{1n} \\ . & . & . \\ . & . & . \\ v_{m1,\dots} & v_{mj,\dots} & v_{mn} \end{bmatrix}$$

5. Determining positive ideal (A+) and negative ideal (A-) by equations (4) and (5) respectively:

$$\sqrt{\sum_{j=1}^{n} \left(V_{ij} - V^{+}_{j}\right)^2} \; ; i = 1,2,\dots,m \qquad (4)$$

$$\sqrt{\sum_{j=1}^{n} \left(V_{ij} - V^{-}_{j}\right)^2} \; ; i = 1,2,\dots,m \qquad (5)$$

6. Calculating distance size of i-alternaive with ideals and using Euclidean method, by equations (6) and (7):

$$d_{i+} = \text{dictance of i} - \text{alternative from positive ideal} = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V^{+}_{j}\right)^2} \; ; i = 1,2,\dots,m \qquad (6)$$

$$d_{i-} = \text{distance of i} - \text{alternative from negative ideal} = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V^{-}_{j}\right)^2} \; ; i = 1,2,\dots,m \qquad (7)$$

7. Calculating relative closeness for i-alternative (Ai) i to ideal solution using equation (8):

$$cl_{i+} = \frac{d_{i-}}{d_{i+} + d_{i-}} \; ; 0 \le cl_{i+} \le 1 \; ; i = 1,2,\dots,m \qquad (8)$$

As you can see, if Ai=A+ , then di+=1 and cli-=0, on the contrary if Ai=A¯, then di+=1 and cli-=0. In sum, the more alternative Ai is closer to ideal solution, the more value of cli+ is closer to unit.

8. Ranking alternatives based on descending order of cli+ :

This amount is fluctuating between 0 and 1. Thus, cli+ =1 represents the highest rank and cli+ =0 the lowest rank.

- Problem solving process using ELECTRE method

1. Establishing Decision Making Matrix:

According to the criteria and numbers of options and evaluation of whole options for the different criteria, Decision Making Matrix develops as follow;

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \cdots & \cdots\cdot \\ x_{1m} & \cdots & x_{mn} \end{bmatrix}$$

In which the Function of Xij (i = 1,2, ..., M) is in relation to the criteria I j (j = 1,2,3, ..., n).

2. Scale down the Decision Making Matrix:

In this stage, all criteria with different dimensions is changed into the dimensionless criteria and matrix R defined as follows. There are several methods to scale down, but generally the following equation used in electrical method (Tille: 2003, 19-21).

$$R = \begin{bmatrix} r_{11} & \cdots & r_{1n} \\ \vdots & \cdots\cdot & \cdots \\ r_{m1} & \cdots & r_{mn} \end{bmatrix} \qquad r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{=1}^{m} x_{ij}^2}} \tag{9}$$

3. Determining Weighted Matrix of criteria:

$$W = \begin{bmatrix} w_1 & \cdots & 0 \\ \vdots & w_2 & \cdots \\ 0 & \cdots & w_n \end{bmatrix}$$

As you can see, Weighted Matrix (W) is diagonal matrix in which the elements on main diameter are not zero and amount of these elements equal to importance coefficient of the related vector.

4. Determining Weighted Normalized Decision Matrix:

Weighted Normalized Decision Matrix is obtained by multiplying Scale down Decision Making Matrix into the Weighted Matrix of criteria.

$$V = R \times W = \begin{bmatrix} v_{11} & \cdots & v_{1n} \\ \vdots & \cdots & \cdots \\ v_{m1} & \cdots & v_{mn} \end{bmatrix}$$

5. Establishing agree and disagree criteria set

The criteria set J = (1, 2... m) divides into two subsets; agree and disagree for each pair of options e, k (k, e = 1,2, ..., M, k # e) . Agree Set (SKe) is a set of criteria in which option K is preferred to option e. and its complementary set is the opposite set (IKe) in mathematical language;

$$S_{ke} = \left\{ j \middle| v_{kj} \geq v_{ej} \right\} \tag{10}$$

$$I_{ke} = \left\{ j \middle| v_{kj} \prec v_{ej} \right\} \tag{11}$$

6. Establishing Agree Matrix:

To establish agree matrix, its elements, agree indicators, should be calculated. Agree indicator is sum of weight of criteria in agree set. Thus, indicator Cke is between option k and option e equals to (Roy, 1991, 49-73):

$$c_{ke} = \frac{\sum_{j \in s_{ke}} W_j}{\sum_{j=1} W_j} \tag{12}$$

For total normalized weights equals 1 so:

$$c_{ke} = \sum_{j \in s_{ke}} W_j \tag{13}$$

Agreement represents the superiority of options k on option e which its amount changes in the range of zero to one (0-1). After calculating agree indicator for all options, matrix which is a m×m matrix is defined as follows. Generally, this matrix is not symmetrical.

$$C = \begin{bmatrix} - & c_{12} & \cdots & c_{1m} \\ c_{21} & - & \cdots & c_{2m} \\ \vdots & \vdots & - & \vdots \\ c_{m1} & \cdots & c_{m(m-1)} & - \end{bmatrix}$$

7. Determining Opposite Matrix

Disagreement indicator (opposite) is described as follows (Roy: 1991, 49-73):

$$d_{ke} = \frac{\max_{j \in I_{ke}} \left| v_{kj} - v_{ej} \right|}{\max_{j \in J} \left| v_{kj} - v_{ej} \right|} \tag{14}$$

The amount of disagreement indicator changes from zero to one. After calculating disagree indicator for all options, matrix which is a m×m matrix is defined as follows. Generally, this matrix is not symmetrical.

$$D = \begin{bmatrix} - & d_{12} & \cdots & d_{1m} \\ d_{21} & - & \cdots & d_{2m} \\ \vdots & \vdots & - & \vdots \\ d_{m1} & \cdots & d_{m(m-1)} & - \end{bmatrix}$$

It noticed that the data including in agreement matrix, are different from data in opposite matrix and in fact these data are completed each other. The difference between the weights is developed through agreement matrixes, while the difference between determined values is obtained through opposition matrix.

8. Establishing agree dominant matrix:

In the sixth step, it indicated how to calculate agreement indicator Cke. Now there is a determined amount for agreement indicator in this step which is called agreement threshold . If Cke is larger , option k is preferred on option e, otherwise it is not. Agreed threshold is calculated by the following equation (Roy, 1991, 49-73):

$$\bar{c} = \sum_{\substack{k=1 \\ k \neq e}}^{m} \sum_{\substack{e=1 \\ e \neq k}}^{m} \frac{c_{ke}}{m(m-1)} \tag{15}$$

Agree Dominated Matrix (F) is developed based on the amount of agreement threshold and its elements determined in the equation bellow (Vami, 1992).

$$f_{ke} = \begin{cases} 0 & c_{ke} \geq \bar{c} \\ 1 & c_{ke} < \bar{c} \end{cases} \tag{16}$$

9. Establishing Opposed Dominance Matrix :

Opposed Dominance Matrix (G) is established the same as Agree Dominated Matrix. First, decision makers should express opposite threshold which is for example the mean of opposite indicators (disagreement) (Roy, 1991, 49) -73):

$$\bar{d} = \sum_{\substack{k=1\\k\neq e}}^{m}\sum_{\substack{e=1\\e\neq k}}^{m} \frac{d_{ke}}{m(m-1)} \tag{17}$$

Similar to seventh step, it is better that the amount of opposite indicator (dke) become less, because opposite amount (disagreement) expresses superiorities dimension of option k on option is acceptable. In contrast, if (dke) were larger than , opposite amount would be very great and it would not be ignored. Thus, Opposed Dominance Matrix is defined as follows (1991, 49-73):

$$g_{ke} = \begin{cases} 0 & d_{ke} \geq \bar{d} \\ 1 & d_{ke} < \bar{d} \end{cases} \tag{18}$$

Each element in the matrix (G) shows the dominant relationship between options.

10. Establishing Final Dominant Matrix:

Final Dominant Matrix (H) is developed after multiplying each element in Agree Dominated Matrix (F) into elements in Opposed Dominance Matrix (G) (Roy, 1991, 49-73).

$$h_{ke} = f_{ke}.g_{ke} \tag{19}$$

11. Removing less satisfaction options and selecting the best option:

Final Dominant Matrix (H) indicates detail preferences of options. For example, when amount of hke equals 1, it means that option k is preferred on option e in both agree and disagree situation (it means its preference is larger than the agree threshold and its opposite or weakness is less than disagree threshold), but option k may be dominated by other options yet. The options should be ranked in a way that the more dominated options are selected than the more defeated one.

Determining the importance coefficient of options than the other, criteria are compared in pair by time suggested method.

Table 1 : Weighting the factors based on preference in paired comparison (Ghodsi Poor, 2009, 14)

I9	Preferences (judging verbal)
9	Extremely preferred
7	Very strongly preferred
5	Strongly preferred
3	Moderately referred
1	Equally preferred
2‹4‹6‹8	Intervals between strong preferences

After the formation of paired comparison matrix, relative weights of criteria can be calculated. There are different methods to calculate the relative weight based on paired comparison matrix. The most important ones are the "least squares method, least squares logarithmic method, special vector method and approximate method. The special vector method is the most accurate one. In this method, Wi is determine in the equation12:

$$A \times W = \lambda maxW \tag{20}$$

In this equation, λ and W are special amount and special vector of paired matrix respectively. If dimensions of matrix were larger, calculation would be too time-consuming. So, to calculate λ, the amount of Dtrmynal λIA- matrix will be equaled to zero. Considering the greatest value of λ in equation (13), the amount of wi is calculated. (2001, 315: Saaty).

$$A – \lambda max.I = 0: \tag{21}$$

III. Research Findings

The results of ELECTRE and Linear Assignment methods to find the most suitable area for artificial recharge of groundwater aquifers of Zarand-Saveh watershed showed in figures (2) to (9) and tables (3) to (19). Therefore, a matrix is formed with rank (49) for data matrix, with 7 alternatives (height zones) and 7 related indicators (rainfall, stream density, habitual density, extent, land area facies, slope, height) (Tables 2 ,10).

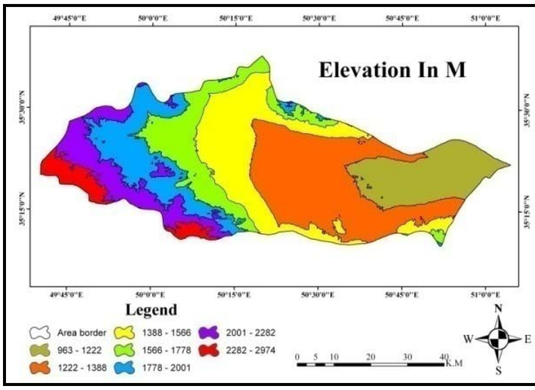
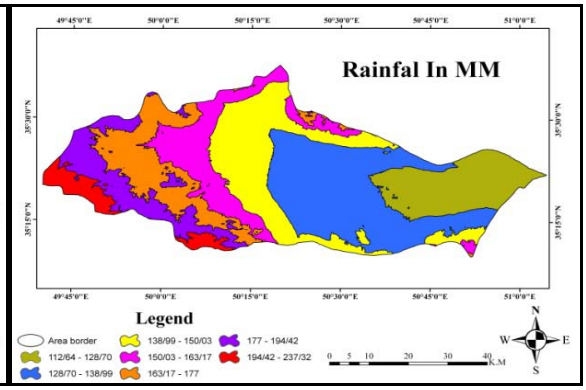


Figure 2 : Elevation Map of studied area.



Figur 3 : Rainfall Map of studied.

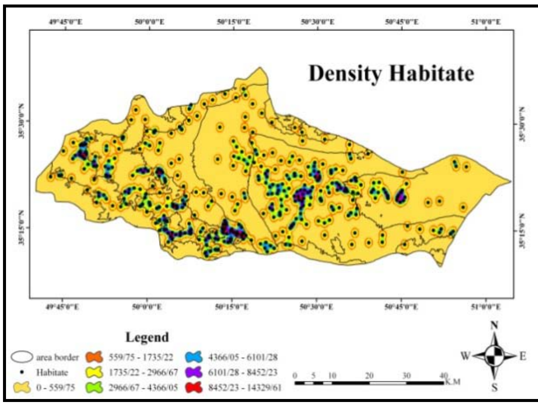


Figure 4 : Habitual Density Map of the studied area.

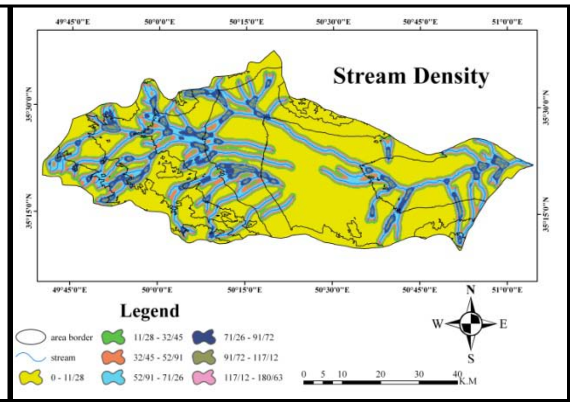


Figure 5 : Stream Density Map of studied area.

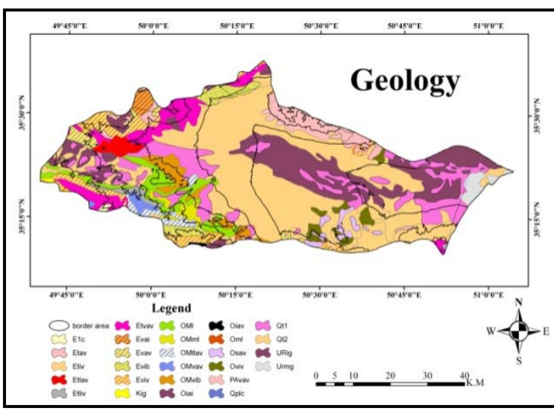


Figure 6 : Land Area Facies Map of the studied area.

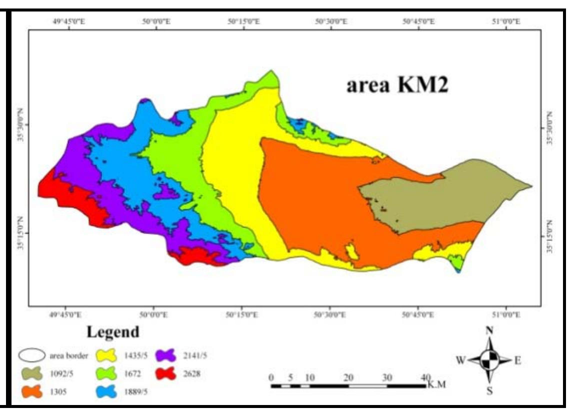


Figure 7: Area Map of study area.

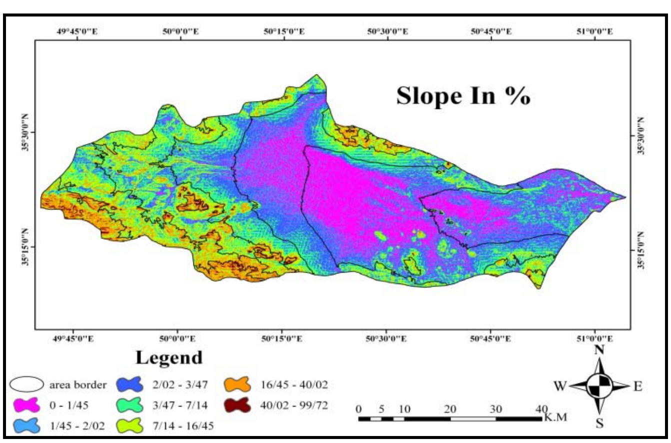


Figure 8 : Slope Map of the studied area.

IV. Problem Solving Matrixes in Topsis Method

Table 2 : Decision Matrix (X).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	2	121.29	90.31	13.28	4975.46	1092.5	484.85
2	5	134.22	63.91	22.09	5696.15	1300.5	958.1
3	9	144.66	76.99	26.71	3268	1435.5	695.27
4	8	157.28	79.115	31.68	7164.8	1672	461.46
5	7	169.62	85.42	49.86	5911.25	1889.5	478.64
6	3	185.58	62.23	48.73	4692.22	2141.5	363.41
7	1	214.41	61.19	36.61	3163.1	2628	149.57

Table 3 : Dimensionless Matrix (Matrix R).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.1310	0.2801	0.4553	0.1433	0.3646	0.2288	0.3245
2	0.3276	0.3099	0.3222	0.2384	0.4175	0.2723	0.6412
3	0.5896	0.3340	0.3882	0.2883	0.2395	0.3006	0.4653
4	0.5241	0.3632	0.3989	0.3420	0.5251	0.3501	0.3088
5	0.4586	0.3916	0.4307	0.5382	0.4332	0.3957	0.3203
6	0.1965	0.4285	0.3137	0.5260	0.3439	0.4485	0.2432
7	0.0655	0.4951	0.3085	0.3952	0.2318	0.5503	0.1001

Table 4 : Paired Comparison Matrix of different criteria (S).

Criteria	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area	Weight vector
Materials	1	3	5	5	7	7	9	0/3868
Precipitation	0.33	1	3	5	5	7	7	0/2349
Stream density	0.2	0.33	1	3	5	7	7	0/1585
Slope	0.2	0.2	0.33	1	3	5	7	0/1028
Cleft density	0.14	0.2	0.2	0.33	1	3	5	0/0603
Elevation	0.14	0.14	0.14	0.2	0.33	1	3	0/0353
Area	0.11	0.14	0.14	0.14	0.2	0.33	1	0/0214
Inconsistency rate: 0/0252 (due to being less than 0/1 compatibility matrix indices are acceptable)								

Table 5 : Weighted dimensionless Decision Matrix (V).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0506	0.0658	0.0721	0.0147	0.0221	0.0081	0.0070
2	0.1265	0.0728	0.0510	0.0245	0.0253	0.0097	0.0138
3	0.2277	0.0785	0.0615	0.0296	0.0145	0.0107	0.0100
4	0.2024	0.0853	0.0632	0.0352	0.0318	0.0125	0.0066
5	0.1771	0.0920	0.0682	0.0553	0.0262	0.0141	0.0069
6	0.0759	0.1007	0.0497	0.0541	0.0208	0.0160	0.0052
7	0.0253	0.1163	0.0489	0.0406	0.0140	0.0196	0.0022

Table 6 : Amounts of positive and negative ideals (highest and lowest function of indicator).

Ideals	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
A+	0.2277	0.1163	0.0721	0.0147	0.0318	0.0081	0.0138
A-	0.0253	0.0658	0.0489	0.0553	0.0140	0.0196	0.0022

Table 7 : Distance o i-alternative by ideals using Euclidean method.

regions / distance	1	2	3	4	5	6	7
D_i^+	0/189	0/116	0/050	0/046	0/057	0/154	0/205
D_i^-	0/035	0/103	0/203	0/180	0/161	0/073	0/057

Table 8 : Relative distance of i-alternative(A_i) to ideal solution.

Cl_i	C1	C2	C3	C4	C5	C6	C7
Amount	0/15	0/46	0/8	0/79	0/73	0/32	0/21

Table 9 : Points and Ranks of zones.

Region	1	2	3	4	5	6	7
Point (Fuzzy Logic)	0/15	0/46	0/8	0/79	0/73	0/32	0/21
Rank	Seventh	Fourth	First	Second	Third	Fifth	Sixth

Table 10 : Decision Making Matrix (X).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	1	121.29	90.31	13.28	4975.46	1092.5	484.85
2	5	134.22	63.91	22.09	5696.15	13.5	958.1
3	9	144.66	76.99	26.71	3268	1435.5	695.27
4	9	157.28	79.115	31.68	7164.8	1672	461.46
5	7	169.62	85.42	49.86	5911.25	1889.5	478.64
6	3	185.58	62.23	48.73	4692.22	2141.5	363.41
7	1	214.41	61.19	36.61	3163.1	2628	149.57

Table 11 : Scale down Decision Matrix (R).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0636	0.2801	0.4553	0.1433	0.3646	0.2378	0.3245
2	0.3181	0.3099	0.3222	0.2384	0.4175	0.0029	0.6412
3	0.5727	0.3340	0.3882	0.2883	0.2395	0.3124	0.4653
4	0.5727	0.3632	0.3989	0.3420	0.5251	0.3639	0.3088
5	0.4454	0.3916	0.4307	0.5382	0.4332	0.4112	0.3203
6	0.1909	0.4285	0.3137	0.5260	0.3439	0.4661	0.2432
7	0.0636	0.4951	0.3085	0.3952	0.2318	0.5719	0.1001

Table 12 : Paired Comparison Matrix of different criteria (S).

Criteria	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area	Weight vector
Materials	1	3	5	5	7	7	9	0/3868
Precipitation	0.33	1	3	5	5	7	7	0/2349
Stream density	0.2	0.33	1	3	5	7	7	0/1585
Slope	0.2	0.2	0.33	1	3	5	7	0/1028
Cleft density	0.14	0.2	0.2	0.33	1	3	5	0/0603
Elevation	0.14	0.14	0.14	0.2	0.33	1	3	0/0353
Area	0.11	0.14	0.14	0.14	0.2	0.33	1	0/0214
Inconsistency rate: 0/0252 (due to being less than 0/1 compatibility matrix indices are acceptable)								

Table 13 : Weighted Normalized Decision Matrix (V).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0246	0.0658	0.0721	0.0147	0.0221	0.0085	0.0070
2	0.1229	0.0728	0.0510	0.0245	0.0253	0.0001	0.0138
3	0.2212	0.0785	0.0615	0.0296	0.0145	0.0111	0.0100
4	0.2212	0.0853	0.0632	0.0352	0.0318	0.0130	0.0066
5	0.1720	0.0920	0.0682	0.0553	0.0262	0.0146	0.0069
6	0.0737	0.1007	0.0497	0.0541	0.0208	0.0166	0.0052
7	0.0246	0.1163	0.0489	0.0406	0.0140	0.0204	0.0022

Table 14 : Agreement Matrix (C).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0000	0.1940	0.2189	0.1799	0.1799	0.2404	0.6266
2	0.8059	0.0000	0.0820	0.0215	0.0215	0.6266	0.6266
3	0.7810	0.9179	0.0000	0.4077	0.4077	0.5661	0.6266
4	0.8200	0.9784	0.9784	0.0000	0.4467	0.6266	0.6266
5	0.8200	0.9784	0.5922	0.5532	0.0000	0.7294	0.7294
6	0.7595	0.3733	0.4338	0.3733	0.2705	0.0000	0.7294
7	0.7595	0.3733	0.3733	0.3733	0.2705	0.2705	0.0000

Table 15 : Opposite Matrix (D).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	1	1	1	1	1	1
2	0.214494	0	1	1	1	0.601495	0.442481
3	0.054111	0.109532	0	1	0.522695	0.165727	0.192437
4	0.045479	0.072698	0.194701	0	0.410479	0.128322	0.157619
5	0.026487	0.140366	1	1	0	0.088066	0.164765
6	0.456288	1	1	1	1	0	0.318163
7	0.460453	1	1	0.1028	1	1	0

Table 16 : Agree Dominated Matrix (F).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	0	0	0	0	0	1
2	1	0	0	0	0	1	1
3	1	1	0	0	0	1	1
4	1	1	1	0	0	1	1
5	1	1	1	1	0	1	1
6	1	0	0	0	0	0	1
7	1	0	0	0	0	0	0

Table 17 : Opposite Dominated Matrix (G).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	1
3	1	1	0	0	1	1	1
4	1	1	1	0	1	1	1
5	1	1	0	0	0	1	1
6	1	0	0	0	0	0	1
7	1	0	0	1	0	0	0

Table 18 : Final Dominated Matrix (H).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	1
3	1	1	0	0	0	1	1
4	1	1	1	0	0	1	1
5	1	1	0	0	0	1	1
6	1	0	0	0	0	0	1
7	1	0	0	0	0	0	0

Table 19 : Number of dominant and recessive of each selected areas.

Difference	Number being defeated	Rule number	Regions
-6	6	0	1
-2	4	2	2
2	2	4	3
4	1	5	4
2	2	4	5
-2	4	2	6
-4	5	1	7

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V. Discussion and Conclusion

Having Systematic attitudes toward geography as a science distribution indicates that geography is depending on Mathematical Sciences (Shakoeei, 1999, 43). Generally, model (1) is a schematic but accurate description about a system which is corresponded with its previous behavior and therefore, there is hope that it will be used to predict the future behavior of the system (Hekmat- Nia and Moosavi, 2007, 29).

In recent decades, researchers have used Multi Criteria Decision Making in complex and complicated decisions. In these models, several criteria are used to measure instead of a desirable criterion (Taherkhani, 2008, 62). Nowadays, prioritizing and selecting appropriate substitutions out of different elements and deciding about them is significant in environmental planning and management. In other words, it is necessary to use suitable methods which are combined different indicators in order to achieve better results and to do the best job for environmental planning and management.

In previous decades, decision making in water management problems and selection of better option among suggested options to solve a watershed problems was only done based on economical criteria - profit in relation to cost- and on changing social and environmental criteria in to the economical criterion. However, today using Multi criteria decision making, it is not necessary to use financial equivalent of social and environmental criteria to select the best option. In fact, various qualitative and quantitative criteria can be used to prioritize and select the best options for water resources management.

Nowadays, because of uncontrolled exploitation of ground water, water shortage is became doubled. Accurate control and management of these water resources can alleviate the problem of drought approximately. One of the management techniques of ground water resources is artificial recharge of basins and determination of the most appropriate place for it. The ground water resources are the largest and most importance reservoirs of fresh water on the earth for human being after glaciers and glacial zones (Freeze, 1979). Since these resources are 99% of whole available fresh water, it is necessary to determine and exploit the ground water (Kouthar, 1986- 19).

Furthermore, it includes 80% of being used resources in arid and semi-arid areas in most countries (Sedaghat, 1994). Due to Iran`s situation in desert and semi-desert area and its average annual rainfall about 250 mm, so there were many ways to prepare fresh water for agriculture, drinking and industry in different parts of country from a long time ago. Therefore, determination and zoning the most appropriate area for artificial recharge of underground aquifers should be considered in this plain.

In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine and assign the suitable position for this case.

Water resources management is a set of various management activities aimed at the optimum utilization of water resources and reduction of economical, social and environmental damages and losses. Decision making issue in water resources management is very complex and complicated because of several decision indicators and criteria. Achieving a determine purpose, there are a lot of solutions with different priorities for various issues such as environmental, social, organizational and political problems. These necessities leads to use of multiple criteria decision making aimed at selection of best solution among different solutions.

This study aimed at ranking the water resources potential in Zarand-Saveh watershed by two methods; ELECTRE and TOPSIS methods and compared the results and findings of them. TOPSIS algorithm is a Multi Criteria Decision Making which combines quantitative and qualitative indicators, weights each indicator in relation to its importance and helps decision makers to select the best alternative. And ELECTRE method is one of the available compensatory models. In this method, all options are analyzed and evaluated by non-ranked comparisons. Whole stages of this method are based on coordinated and uncoordinated sets and thus it is called ‘‘coordination analysis’’. The result and findings of different studies show that in TOPSIS method, zone 3 with (0/8) point promotes in first rank among 7 studied zones and thus it is the most appropriate zone to establish the proper soil damp, in contrast zone 1 with (0/15) point goes down to the last rank and so it isn`t suitable for establishing soil damp and zones (4,2,5,6,7) with (0/79, 0/73, 0/46, 0/32, 0/21) points are located in next ranks. In ELECTRE method, zone (4) dominated (5) times and defeated (1) time, so it is located in the first rank with (4) points and is the most suitable zone for artificial recharge. In contrast, zone (1) defeated (6) time and dominated no time, therefore it is located in the last rank with (-6) points and is not the most suitable zone for artificial recharge. And, zones (3, 5, 2, 6, 7) dominated (4, 4, 2, 2, 1) times and defeated (5, 4, 2, 2, 4) and located in other ranks with (-4, -2, -2, 2, 2, 2) points respectively. Also, zones (7, 6, 2, 1) should be omitted because their defeated times are more than dominated times.

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Impact of Environmental Factors on the Profit Efficiency of Rice Production: A Study in Vietnam's Red River Delta

By Long Van Hoang & Prof. Mitsuyasu Yabe

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GJHSS-C Classification : FOR Code: 070199

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Strictly as per the compliance and regulations of:

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Long Van Hoang [α] & Prof. Mitsuyasu Yabe [σ]

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I. Introduction

Viet Nam is the second highest rice exporting country in the world. Rice production is important to the Vietnamese economy in general and to its agricultural sector in particular. It occupies a high share of the country's Gross Domestic Product (GDP), approximately 20.4% in 2006 (WB, 2008). However, as a result of rapid economic expansion and industrialization, land for rice production has become smaller and less fertile.

In addition, industrial development and the development of handicraft production are the major contributors causing lower water quality that impacts rice production.

The were some studies related to efficiency measurements of rice production such as technical efficiency [1, 2] and productivity [3]. However, the research related to profit efficiency is limited in the literature. This research aims to estimate the three dimensions of profitability of rice production, namely profit elasticity, profit loss and profit inefficiency. In addition, the environmental attributes affecting the profitability of rice production were determined.

Environmental degradation is a consequence of economic and industrial development in developing countries, especially Viet Nam. Water pollution has also been a major concern as pollutants from industrial production activities contaminate the rice fields and affect the country's overall rice production. Omission of variables presenting environmental factors do not only affect technical efficiency but also the profitability of rice [4]. Therefore, environmental factors such as soil quality, irrigation management, plant disease, and water pollution were given special attention in this study.

Farmers may combat environmentally constraining factors by allocating more labor and adding more chemical fertilizers to the input bundle of their production [5]. These activities may lower the productivity and increase inefficiency. As a result, advanced technologies like using machinery, new seeds, and fertilizers are major factors toward improving productivity.

The objectives of this research include the following. First, to determine the effects of the environmental factors on the profit efficiency of rice production. Second, to estimate the profit loss of rice production due to environmental factors. Third, to provide recommendations to policy-makers on how to sustain rice production. Finally, contribute to the literature pertaining to the methodological development of estimating the impacts of environmental factors on rice production.

This paper is organized as following. The next section will review the literature related to the estimation of efficiency giving special consideration to profit functions. The third section will describe the research areas and will explain the results of the household survey. The framework for analysis and the econometric specification will be presented in the fourth section. The fifth section will be the main section of the paper with the results and discussions from model estimation included. The sixth section will be the conclusions of the study and policy implications.

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II. Analytical Framework for Measuring Profit Efficiency

a) Analytical Framework

Economic efficiency is classified into two categories: technical efficiency and allocative efficiency [6]. The profit function combines both technical and allocative concepts in profit relationships, and any errors in production decisions are translated into lower revenue [7] , hence low profit efficiency .

Measuring efficiency was started by Farrell [6], who explained the ability to produce a given level of output its lowest cost. Ali & Flinn [8] estimated the profit efficiency by comparing the OLS (Ordinary Least Squared) and MLE (Maximum Likelihood Estimation) approaches to show the profitability of rice production in Pakistan. Rahman [9]estimated rice profit efficiency by using a translog function and added the farmer's characteristics to reasons for inefficiency. Kolawole [10] computed the profit function by adding a constant to profit function in to obtain the positive values while using the Cobb-Douglass function to estimate profit frontier.

The standard profit function assumes that markets for outputs and inputs are perfectly competitive.

$$\ln(\prod + \theta) = \ln f(P, W) + (V - U) \qquad (1)$$

wθ is a constant added to the profit of each firm in order to obtain positive values [10].

The farm profit is measured in term of Gross Margin (GM) which equals the difference between the total Total Revenue (TR) and Total Variable Cost (TVC)

$$GM(\Pi) = \Sigma(TR\text{-}TVC) = \Sigma(QP\text{-}WXi) \qquad (2)$$

The profit frontier approach is defined as:

$$\pi_i = f(P_i, Z_i).\exp(\xi_i) \qquad (3)$$

where $\pi_i^{'}$ is the normalized profit of farm i*th*; $P_j^{'}$ is the normalized input prices measured by dividing profit and input prices for output prices; Z_k is fixed inputs such as land and capital.

This function can be estimated by OLS of MLE [8]

The OLS approach of profit function is written as:

$$\ln \pi_i^{'} = \alpha + \sum_i \alpha \ln P_i^{'} + \alpha_L \ln Z_j^{'} + \xi_i \qquad (4)$$

The translog profit function approach was used by Aigner et al. [11]; Meeusen & Broeck [12]; and Ali & Flinn [8]. The translog frontier form can be written as follows:

$$\ln \pi_i = \alpha + \sum_i \alpha \ln P_i^{'} + \tfrac{1}{2}\alpha(\ln P)^2 + \alpha_L \ln Z + \tfrac{1}{2}\alpha(\ln Z)^2$$
$$+ \sum\sum \alpha \ln Z \ln P + \xi \qquad (5)$$

The paper used both forms of profit frontier to compare the coefficients between the different approaches of estimation.

Production inefficiency is measured by three components: technical, allocative, and scale inefficiency.

Error terms are

$$\xi_i = v_i - u_i \qquad (6)$$

Production/Profit efficiency of individual farm is defined as:

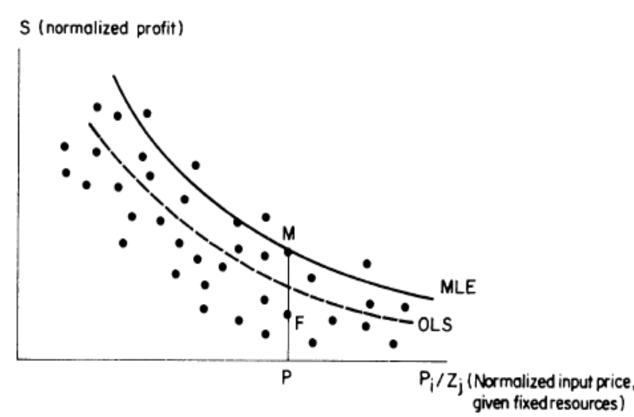
$$PE = E[\exp(-u_i) \mid \xi_i] = e[\exp(-\delta_0 - \sum_{d=1}^{D} \delta_d W_{di}) \mid \xi_i] \qquad (7)$$

Precluding farm and household characteristics, other environmental factors/constraints are used to estimate efficiency including irrigation, land suitability, insects and pests, weed infestation, weather variation (drought and storm), and poor soil fertility [4]. In this study, four environmental factor variables were selected: irrigation, plant disease, soil fertility, and water quality.

b) Frontier MLE and OLS stochastic profit frontier

Fig. 1 shows the differences in estimation of profit efficiency by MLE and OLS approaches. The OLS estimate the average of profit value while the MLE estimate the profit frontier [8]. From the results of the MLE, the profit loss can be derived by dividing the profit of individual farms by profit efficiency.

Figure 1 : Relation between MLE and OLS in frontier estimation.



Source : Ali & Flinn [8].

III. Research Area, Data and Econometric Specification

a) Research Area and Data

The Red River Delta is of two rice granaries in Viet Nam. Although rice productivity has been gradually increasing in recent years due to the adoption of advanced technologies, the production is still challenged by constraints including land fragmentation, soil degradation, and water pollution. One of the reasons for this situation is the development of industrial production and handicraft production. Many industrial parks and production zones have been established near the rice fields, and the handicraft production villages are also increasing rapidly in quantity. Recently, the total number of craft villages has increased to 2790 craft-villages located throughout the country, half of which are located in the Red River region. This development makes the surrounding environment more polluted [13]. The problem of water pollution is at an alarming stage with about 90 percent of the craft-villages violating environmental standards.

Rice production in the Bac Ninh province still plays an important role in the economic development of the province (because of) with some special rice varieties that are well-known for their flavor. The province has the highest number of craft villages (n=61) in the country. The water pollution from these craft villages cause some many hectares of land in regions uncultivable and made farm households become having no land for cultivation.

This research was conducted in Bac Ninh province and one part of the capital in Ha Noi where rice production is still dominated by the local economy. In addition, these areas were selected to study the effects of water pollution on rice production in parallel with other environmental factors. Four communes were chosen for the survey, namely: Phong Khe, Da Ton, Phu Dong, and Ninh Hiep. The Phong Khe commune is located in Bac Ninh Province, while the three remaining communes were located near Ha Noi. The Phong Khe and Da Ton communes are located in polluted areas, while the remaining two communes are located in non-polluted areas. First, Phong Khe commune is located in Bac Ninh province, which is famous for its handicraft production. Paper recycling is one of the major local industries in this commune. This industry uses a large amount of "cleaning and colorful chemicals". A significant amount of wastewater is discharged directly into river without treatment. Therefore, almost all paddy rice areas are contaminated. Next, Da Ton commune is located near an industrial production zone named Sai Dong where pollutants from electronic companies are discharged to the nearby river that flows to the irrigation canals of the farmers. Thirdly, Phu Dong commune is located at the end of the downstream of a branch in the Red River. Water Pollution in this commune is relatively low. The source of the pollution in the water is mainly from household wastes, which do not affect rice production significantly. Finally, Ninh Hiep commune is less polluted because it is not near any production areas and the irrigation is used from a larger river, namely the Red River.

Surveys with rice farmers were conducted in four communes of two provinces in the Red River Delta namely Ha Noi capital and Bac Ninh province. A total 369 rice farmers were interviewed using a questionnaire. The survey was given during in the month of August 2010 by a group of enumerators after receiving brief training on the questionnaire. A pre-test was made to revise the questionnaire before the formal survey. Which in 369 rice farming households in the sample, 20 households were deleted from the sample due to minus values of profit in production. Finally, the sample used for profit function estimation is 349 households.

The dataset uses of variables including rice output (kg), rice yield (kg/sao), land (sao), the price of fertilizer ('000VND/kg) , pesticide ('000VND/100ml), labor wage (000VND/working day per man), land input (sao per farm), and capital ('000VND/farm). All value of these varialbes were converted to annual value instead of the value for each crop. Only 5 production inputs were used for the model estimation.

The environmental factors measured were soil quality, irrigation, disease, and water pollution. Managerial variables are age, gender, education, and family labor ratio. Futhermore, rice plot, monocropping, and adopting of row seeding technology are considered. Finally, access to loans from the banks was included.

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Table 1 : Description of Variables.

Descriptions	Measure	Mean	Standard Deviation	Minimum	Maximum
Output and inputs					
Rice output	kg per year per farm	1552.829	1198.26	90	10400
Rice Yield	kg per sao per annum	178.0096	44.49657	62.5	700
Fertilizer price	'000VND per kg	5.806547	1.895004	1.528205	20
Pesticide price	'000VND per 100ml	10.1832	9.296003	.9782609	75
Labor wage	'000VND per working day	73.2728	11.94356	33.36355	110
Land cultivated	Sao (1Sao=360m^2)	8.472063	5.445733	0.5	40
Capital (Rental cost for land preparation, harvesting, and transportation services)	'000VND per farm per annum	713.3011	584.7483	0	4484
Environmental factors:					
Soil quality	Dummy (1= good; 0= bad)	0.5799458	0.4942374	0	1
Irrigation	Dummy (0= N; 1= Y)	0.9539295	0.2099224	0	1
Diseases	Dummy (0= N; 1= Y)	0.9945799	0.0735209	0	1
Water Pollution	Dummy (0= N; 1= Y)	0.5338753	0.4995285	0	1
Managerial variables					
Age	Years	48.12466	9.70016	26	75
Male household head	Dummy (1= Male; 0=otherwise)	0.495935	0.5006623	0	1
HH size	Number of HH members	4.791328	1.51526	2	10
Education	Completed years of schooling	6.336043	3.110436	0	12
Experience in rice farming	Years of rice growing	27.7561	12.00544	0	57
Family Labor Ratio	Rate of No. of Family Labor and HH Size	0.3946369	0.2967001	0	1
Rice plots	Number of plots of rice fields that HH cultivate	4.01626	2.317175	1	17
Mono-cropping	Dummy (0= N; 1= Y)	0.0813008	0.2736676	0	1
Row-Seeding	Dummy(1=Row-seeding; 0=Broadcasting and others)	0.1544715	0.3618909	0	1
Credit	Dummy (1=borrow loan for rice production; 0=not borrow)	0.0189702	0.1366049	0	1
Total number of observations		349			

1USD equivalent to 20,000 VND in 2010.

b) Econometric Specification

To estimate the impacts of environmental factors on profit efficiency, first the stochastic profit function must be defined as:

$$\pi_i = f(P_i, Z_i).\exp(\zeta_i) \qquad (8)$$

where π is normalized profit of the i *th* farmer is defined as gross revenue less variable cost, divided by farm output price; P is the vector of variable input prices faced by the ith farmer divided by output price; Z is the vector of the fixed factor of ith farmer. ζ_i is an error term; and I = 1,…,n is the number of farms in the sample.

The model was fist development by [14] and applied by [9] and [15].

$$\ln\pi' = \alpha_0 + \sum_{j=1}\ln P_j' + \tfrac{1}{2}\sum_{j=1}\sum_{k=1}\tau_{jk}\ln P_j'\ln_k' + \sum_{j=1}\sum_{k=1}\phi_{jl}\ln P_j'\ln Z_l$$
$$+\sum_{l=1}^{2}\beta_l\ln Z_l + \tfrac{1}{2}\sum_{l=1}^{2}\sum_{t=1}^{2}\varphi_{lt}\ln Z_l\ln Z_t + v - u \qquad (9)$$

where Ps, Pf, Po, Pp, Ph, Pw, Zli, Zti are price of seed, price of fertilizer, price of organic fertilizer, price of pesticide, price of herbicide, labor wage, land area, and capital of each farm, respectively.

$$u = \delta_0 + \sum_{d=1}^{n}\delta_d W_d + \omega \qquad (10)$$

where W is the variable representing socio-economic characteristics and environmental factors of the farm to explain inefficiency: (1) Age of household head; (2) Male household head; (3) Education (number of completed years of schooling); (4) Household size; (5) Family labor ratio; (6) Rice plots (the number of plots that households use to cultivate rice); (7) Mono-cropping (Dummy for household is to cultivate one crop per year; (8) Row seeding technique; (9) Household who take loans for rice production; (10) Dummy for soil quality; (11) Dummy for diseases; (12) Dummy for irrigation use (13) Dummy for water pollution.

IV. Results and Dicussions

a) Profit efficiency

Comparing the result of OLS and MLE demonstrates the small change in coefficients when using different methods to estimate profit frontier. In addition, the OLS estimation results shows that 69% of the dependent variable (profit) can be explained by the independent variable (production input). This indicates that production profit is close to the profit frontier.

Fertilizer price show a positive effect on profit. The reason is that the chemical fertilizers are mixed. Therefore the price is estimated by the average price of all fertilizers per kg. This shows that a higher price of fertilizer means that farmers use higher qualities of fertilizer. Therefore, it is rational to obtain a higher profit. The land area is positively related to the profit. This means that the margin profits increase when the area of land cultivated is increased. Also, this indicates economics of scale in rice production.

Land area dominates the profit share (share of profit?). Increasing the land area by 1%,will increase the profit by 1.2%. If the price of rice increases 1%, the profit will increase 0.7%. If the price of fertilizer increases 1%, the profit will increase 0.07%. If the price of pesticide increases 1%, the profit will decrease 0.08%. If the labor wage increases 1%, the profit will increase 0.9%. If capital increases 1%, the profit will decrease 0.09%. In this study, the increase in the price of fertilizer means that the farmers will use higher qualities of fertilizer and yield will be indirectly increased. An increase in cost of labor would mean the farmers use more hired labor than home labor which would increase the yield. The capital lowers the profit because capital is consider as input and it is better if farmers can rent capital.

Table 2 : Model Estimation for Profit Function.

Variables		OLS Estimation		MLE (Frontier Estimation)	
	Parameters	Coefficients	*t*-ratio	Coefficients	z-value
Profit function					
Constant	α_0	6.029***	6.85	6.324***	8.14
$\ln P'_F$	α_1	0.228	0.28	0.784	1.1
$\ln P'_P$	α_2	0.163	0.38	0.344	0.9
$\ln P'_W$	α_3	-0.615	-1.14	-0.509	-1.09
$½ \ln P'_F \times \ln P'_F$	α_4	-0.475**	-2.44	-0.451***	-2.88
$½ \ln P'_P \times \ln P'_P$	α_5	-0.042	-0.7	-0.064	-1.19
$½ \ln P'_W \times \ln P'_W$	α_6	0.523**	2.28	0.466***	2.44
$\ln P'_F \times \ln P'_P$	α_7	-0.114	-1.23	-0.025	-0.31
$\ln P'_F \times \ln P'_W$	α_8	0.244	0.96	0.210	0.99
$\ln P'_P \times \ln P'_W$	α_9	-0.019	-0.12	-0.031	-0.24
$\ln C$	α_{10}	0.138	0.63	0.045	0.24
$½ \ln C \times \ln C$	α_{11}	-0.028*	-1.61	-0.003	-0.18
$\ln P'_F \times \ln C$	α_{12}	-0.128	-1.1	-0.236**	-2.3
$\ln P'_P \times \ln C$	α_{13}	-0.024	-0.44	-0.0349	-1.14
$\ln P'_W \times \ln C$	α_{14}	-0.028	-0.35	-0.027	-0.39
$\ln P'_F \times \ln L$	α_{15}	0.037	0.27	0.115	0.98
$\ln P'_P \times \ln L$	α_{16}	0.005	0.08	0.0511	0.53
$\ln P'_W \times \ln L$	α_{17}	0.025	0.16	0.036	0.27
$\ln L$	α_{18}	0.013**	0.03	-0.010	-0.03
$½ \ln L \times \ln L$	α_{19}	0.353***	7.34	0.341***	7.58
R-squared		0.690			
No. of Observations		349		349	
Variance para. $\ln \sigma v\ 2$				-4	-12.66
$\ln \sigma u\ 2$				-1.85	-12.42
$\sigma\ 2 = \sigma u\ 2 + \sigma v\ 2$	$\sigma 2$			0.170	
$\lambda = \sigma u / \sigma v$	λ			3.313	

**** significant at 1 percent level (p<0.01), ** significant at 5 percent level (p<0.05), * significant at 10 percent level (p<0.10).*

b) Profit Inefficiency and Profit-loss

Farm households can maximize profit efficiency by minimizing profit inefficiencies. The factors that contribute positively to inefficiencies are household size, land plots and water pollution. On the other hand, factors that contribute negatively to inefficiencies are male household head, plant diseases, and irrigation. The disease and irrigation variables are not well defined in the data. The reason is the percentage of sample that was attacked by disease is 95% and irrigation apply is 99% (Table 1) . The reason for including these variables is to give evidence that almost all the farmers had disease attacks and irrigation service use in rice production.

Age of household head increases profit inefficiency. A young farm household head can work more effectively than an older one.

Household size increases profit inefficiency because the households with more members cannot use the home labor as well households with fewer members. Large households are composed mainly of dependents such as elders and children. They do not contribute substantially to the labor force for farming activities.

Table 3 : Estimation for Profit Inefficiency.

Variables	Para.	Coefficients	Standard Errors	t-ratio
Constant	β_0	0.351***	0.1727	2.04
Age	β_1	0.001	0.0012	1.19
Male HH head	β_2	-0.061**	0.0231	-2.67
Education	β_3	-0.003	0.0038	-0.94
HH size	β_4	0.060**	0.0264	2.29
Family labor ratio	β_5	-0.042**	0.0240	-1.75
Rice plots	β_5	0.052**	0.0238	2.22
Mono-cropping	β_7	0.053	0.0457	1.16
Row-seeding technique	β_8	-0.060**	0.0348	-1.74
Credit	β_9	-0.071	0.0861	-0.83
Env. Factors				
Soil quality	δ_1	0.074	0.1468	0.51
Diseases	δ_2	-0.047**	0.0235	-2.01
Irrigation	δ_3	-0.139**	0.0577	-2.41
Water Pollution	δ_4	0.043**	0.0259	1.67
Total number of observations		349		

**** significant at 1 percent level (p<0.01), ** significant at 5 percent level (p<0.05), * significant at 10 percent level (p<0.10).*

With the family labor ratio varialbe. Households with more members of working age will decrease the profit efficiency because they use more of their home labor in rice production rather than rental labor force.

The fragmentation of land is measured by the quantity of farm plots. The higher number of land plots may increase the production cost of rice [16] or reduce the production profit as a result. This is a critical issue in the Northern region of Vietnam as discussed in the previously stated literature

[17]. In this study, the number of plots show an increase in profit inefficiency or decrease in the profit of rice production. This indicates that the number of plots can increase production cost for rice producer households.

Table 4 : Estimation of Profit Elasticities.

Prices and fixed inputs	Profit elasticity
Rice price	0.690
Fertilizer price	0.072
Pesticide price	-0.086
Labor wage	0.956
Land area	1.257
Capital	-0.090

Source : Authors' estimation.

Mono production in rice farming means that a farm household cultivates only one type of crop per year. This strongly increases profit inefficiency. The reason for this is that rice production is not profitable or that one can find other opportunities to earn income than producing rice.

Appling the Row-seeding technique in rice production can decrease cost and increase productivity of rice production. This is the technique that farm households in the Red River's Delta should use when not using machinery for seeding.

The household with crop diseases will have decreased profit efficiency. The diseases in rice production are common now in Viet Nam in general and in the Red River's Delta in particular. However, if farmers use enough pesticide and they can combat the diseases. Farmers are very familiar about these diseases and they can prepare well to stop them.

Water pollution is a serious problem currently in rice production. The sources of pollution are industries and handicraft production where they discharge their waste water without any treatments. In this study, the rice producers in polluted regions have less profits because they have to spend more on labor and other input costs to abate pollution from chemical fertilizers, organic fertilizers, pesticides, etc.

Table 5 : Profit-loss by the Key Constraints.

Farm-specific Characteristics	N	Actual profit per ha	Estimated Profit-loss per ha[a]	Profit efficiency
Profit-loss by household size				
Small household size	255	11198.2	2758.276	.7648362
Large household size	94	10191.03	3169.689	.7140469
t-ratio		1.4460*	-2.2949**	2.9908***
Profit-loss by family labor ratio				
Low family labor ratio	171	9470.631	2679.177	.7301912
High family labor ratio	178	12325.95	3051.527	.7712975
t-ratio		-4.7532***	-2.3412**	-2.7218***
Profit-loss by farm plots				
Some farm plots	212	10803.16	2562.956	.7655034
Many farm plots	137	11118.45	3342.805	.7289557
t-ratio		-0.4970	-4.9150***	2.3577**
Profit-loss by mono cropping				
Not Mono cropping	325	11218.7	2885.818	.7443083
Mono cropping	24	6975.811	2642.512	.6857239
t-ratio		3.5260***	0.7690	1.8026**
Profit-loss by row seeding technique				
Not use row seeding technique	292	10501.35	2927.031	.7396094
Use row seeding technique	57	13107.07	2572.244	.8103105
t-ratio		-3.1522***	1.6431*	-3.4848***
Environmental factor effects				
Farm has plant disease	2	10225.69	918.6785	.900259
Farm has no plant disease	347	10930.97	2880.328	.7502972
t-ratio		-0.1718	-1.8570**	1.4883*
Profit-loss by soil quality				
Not Soil fertility	140	9560.321	2778.726	.7229509
Soil fertility	209	11842.36	2929.615	.7700504
t-ratio		-3.6787***	-0.9241	-3.0663***
Profit-loss by irrigation				
Farm without irrigation	15	7009.819	3597.521	.6195658
Farm with irrigation	334	11102.84	2836.372	.7570664
t-ratio		-2.7066***	1.9369**	-3.7273***
Profit-loss by water pollution				
Farm without water pollution	170	12439.08	2959.261	.7763847
Farm with water pollution	179	9490.8	2783.446	.7271969
t-ratio		4.9179***	1.0986	3.2716***
All farms	349	10926.93	2869.086	.7511566

[a] Profit loss is computed from the maximum profit (for?) given prices and fixed factor endowments.

Maximum profit per hectare is computed by dividing the actual profit per hectare of individual farms by its efficiency score.

**Significant at 10% (p<0.10); **Significant at 5% (p<0.05); ***Significant at 1% (p<0.01).*

V. Conclusions and Policy Implications

The estimation results show similar coefficients between OLS and MLE approaches. The inclusion of environmental factors show significant effects on profit efficiency. In specific, the environment changes the profit efficiency of rice production. Farmers receive approximately $150 of profit per hectare if they can control the production constraints. Therefore, in order to maximize profit, rice farm households need to overcome the obstacles such as labor and household size. However, there are some issues related to policy that the government should be involved in to support the farmers so that they can maximize their profits. These include land consolidation to minimize the number of farm plots, increasing farm size, technology, and water quality control. Advanced technology such as row seed tools and machine should be applied and promoted in rice farming. These are the policies that the government should consider to help sustain rice production in the Red River Delta and for the entire country as well.

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Zoning Zarand-Saveh Watershed for Artificial Recharge of Underground Aquifers Using Electre Method & Linear Assignment with GIS Technique

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Abstract - In previous decades, decision making in water management problems and selection of better option among suggested options to solve a watershed problems was only done based on economical criteria - profit in relation to cost- and on changing social and environmental criteria in to the economical criterion. However, today using Multi criteria decision making, it is not necessary to use financial equivalent of social and environmental criteria to select the best option. In fact, various qualitative and quantitative criteria can be used to prioritize and select the best options for water resources management. The purpose of this study is ranking the water resources potential in Zarand-Saveh watershed by two methods; ELECTRE method and Linear Assignment. ELECTRE method is one of the Multi criteria decision making which can compound the quantitative and qualitative criteria, weight each criterion based on its importance and help decision makers to select the best option at the same time. Electrical method is one of the available methods in compensatory methods. In this method, all options are analyzed and evaluated by non-ranked comparisons. Whole stages of this method are based on coordinated and uncoordinated sets and thus it is called ''coordination analysis''.

Keywords : Watershed, Zarand-Saveh, ELECTRE method, Linear Assignment, GIS technique, zoning.

GJHSS-C Classification : FOR Code: 770902,090509, 300903, 960910, JEL Code: Q56 , Q25

ZONING ZARAND-SAVEH WATERSHED FOR ARTIFICIAL RECHARGE OF UNDERGROUNDAQUIFERS USING ELECTRE METHOD LINEAR ASSIGNMENT WITH GIS TECHNIQUE

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M.H.Ramesht [α], Alireza Arab Ameri [σ] & Mahmood Soltanian [ρ]

Abstract - In previous decades, decision making in water management problems and selection of better option among suggested options to solve a watershed problems was only done based on economical criteria - profit in relation to cost- and on changing social and environmental criteria in to the economical criterion. However, today using Multi criteria decision making, it is not necessary to use financial equivalent of social and environmental criteria to select the best option. In fact, various qualitative and quantitative criteria can be used to prioritize and select the best options for water resources management. The purpose of this study is ranking the water resources potential in Zarand-Saveh watershed by two methods; ELECTRE method and Linear Assignment. ELECTRE method is one of the Multi criteria decision making which can compound the quantitative and qualitative criteria, weight each criterion based on its importance and help decision makers to select the best option at the same time. Electrical method is one of the available methods in compensatory methods. In this method, all options are analyzed and evaluated by non-ranked comparisons. Whole stages of this method are based on coordinated and uncoordinated sets and thus it is called ''coordination analysis''. The results and findings show that zone (4) dominated (5) times and defeated (1) time, so it is located in the first rank with (4) points and is the most suitable zone for artificial recharge. In contrast, zone (1) defeated (6) time and dominated no time, therefore it is located in the last rank with (-6) points and is not the most suitable zone for artificial recharge. And, zones (3, 5, 2, 6, 7) dominated (4, 4, 2, 2, 1) times and defeated (5, 4, 2, 2, 4) and located in other ranks with (-4, -2, -2, 2, 2, 2) points respectively. Also, zones (7, 6, 2, 1) should be omitted because their defeated times are more than dominated times. And in Linear assignment, zone (3) is located in the first rank, zone (8) in the last rank and zones (7, 2, 6, 5, 4) in other ranks respectively.

Keywords : watershed, Zarand-Saveh, ELECTRE method, Linear Assignment, GIS technique, zoning.

I. Introduction

Nowadays, because of uncontrolled exploitation of ground water, water shortage is became doubled. Accurate control and management of these water resources can alleviate the problem of drought approximately. One of the management techniques of ground water resources is artificial recharge of basins and determination of the most appropriate place for it. The ground water resources are the largest and most importance reservoirs of drinking water on the earth for human being after glaciers and glacial zones (Freeze, 1979). Since these resources are 99% of whole available drinking water, it is necessary to determine and exploit the ground water (Kouthar, 1986).

Furthermore, it includes 80% of being used resources in arid and semi-arid areas in most countries (Sedaghat, 1994). Due to Iran`s situation in desert and semi-desert area and its average annual rainfall about 250 mm, so there were many ways to prepare drinking water for agriculture, drinking and industry in different parts of country from a long time ago. Therefore, determination and zoning the most appropriate area for artificial recharge of underground aquifers should be considered in this plain.

In recent years, water exploitation has become greater for many reasons such as population growth, industrial development, urbanization growth and consequently increased demand for food products. Hence the rate of exploitation and consumption ground water become greater than recharge of them, in other words input of ground water system is less than its output and system with negative balance sheet has positive feedback and it is collapsing. Thus it is very significant to determine and assign the suitable position for this case.

Water resources management is a set of various management activities aimed at the optimum utilization of water resources and reduction of economical, social and environmental damages and losses. Decision making issue in water resources management is very complex and complicated because of several decision indicators and criteria. Achieving a determine purpose, there are a lot of solutions with different priorities for various issues such as environmental, social, organizational and political problems. These necessities leads to use of multiple criteria decision making aimed at selection of best solution among different solutions.

There are several studies on ground water and their artificial recharge all over the world. For example,

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Krishnamurthy et.al (1995, 1996) used RS and GIS techniques to find a suitable position for artificial recharge of ground water in India. Also, they investigated the effects of geomorphologic and geological factors on the behavior of ground water and stated that there is a special unevenness in each area for recharge of ground water.

Saraf and Choudhury (1998) used remote sensing capabilities in extracting different layers like land usage, geomorphology, vegetation, and their integration in GIS environment to determine the most suitable area for artificial recharge of ground water. Mahdavi (1997) investigated water management and artificial recharge of ground water in Jahrom city and indicated that controlling usage and recharge of water tables by the watershed management is the main management technique. Abdi and Ghayoumian (2001) prioritized the suitable areas for storing surface water and reinforcing ground water based on geophysics data, land usage, topography, their integration and analysis in GIS environment. KiaHeyrati (2004) studied the function of flood distribution system in recharge of ground water in Moughar plain in Isfahan. Mahdavi et.al (2005) attempted to find the best position for artificial recharge of ground water by RS and GIS techniques in watershed Shahrreza in Isfahan and introduced this tool for this case efficiently.

Also, Noori et al (2005) tried to find the appropriate areas for artificial recharge of ground water by recharge pools and GIS technique in watershed Gavbandi and introduced alluvial fans and pediplain as the best area for artificial recharge. Mousavi et al (2010) found the potential appropriate areas for artificial recharge of ground water in the vicinity of Kamestan anticline by integration of remote sensing and GIS techniques and introduced broken formations, alluviums and river canals as the best position for artificial recharge. Mianabadi and Afshar (2008) investigated and ranked the project of water supply in Zahedan using three methods: Induced Ordered Weighted Averaging (IOWA), Linear Assignment and TOPSIS methods, and then they compared the findings of these methods with the results of adaptable planning method (Mianabadi, 2008). Limon and Martinez (2006) used Multi Attribute Utility theory for optimum allocation of agriculture water in north of Spain (Limon, 2006). Ahmadi et al (2002) used multiple criteria decision making to rank different projects of refining agriculture water to reuse them (Ahmadi, 2002). Also, Anand Raj and Kumar (1996) ranked management options of river basin by ELECTRE method (Anand, 1996).

The purpose of this is zoning the best areas for artificial recharge of underground aquifers in Zarand-Saveh watershed using the effective factors in nurturing underground water tables by ELECTRE method, linear assignment and GIS techniques. In other words, this investigation attempts to find and zone the most suitable area for artificial recharge of underground aquifers using the analysis of effective parameters on soil penetrability and recharge of underground water tables by ELECTRE method, linear assignment and preparing its raster layers in the environment of soft ware Arc GIS 9.3.

II. Methods and Materials

a) *Mathematical situation of studied area*

Being situated in the north part of central province, Saveh province is bounded by 34^o, 45' latitude to 35^o, 34' north latitude and 49^o, 15' to 50^o and 56' longitude. It has access to Ghazvin province in north, to Tafresh and Qom provinces in south, to Tehran province in east and to Hamedan province in west. Globally, Saveh is located at 1250 meter height above sea level and its extent is 1027 square kilometers.

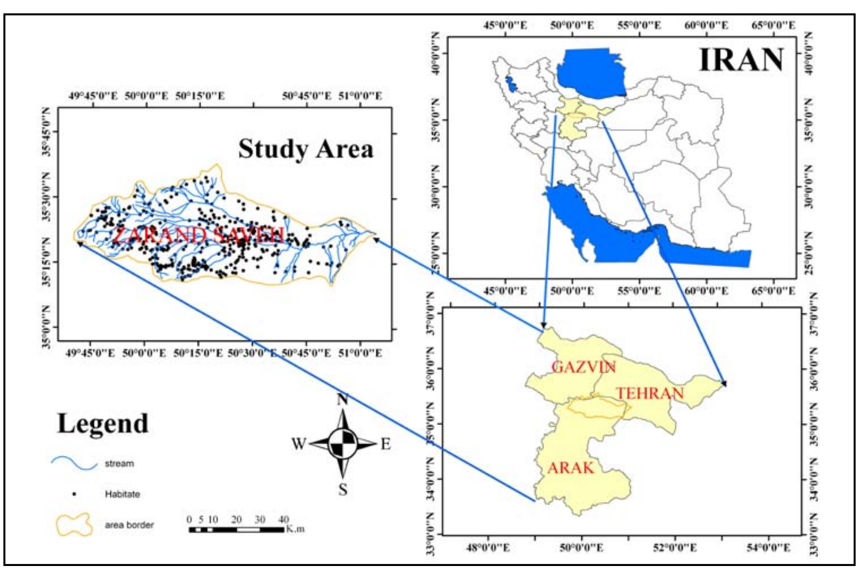

Figure 1 : Mathematical situation of studied area.

III. Methods

Firstly, studied area was investigated by the satellite images of Google Earth and its limitations were determined. Then digital elevation model of area was separated from its digital elevation model in Iran in the environment of soft ware GIOBAL MAPER and the output was received. Required data layers for zoning in the environment of software Arc GIS 9.3 was prepared as following:

First, digital elevation model classified in to 7 elevation classes based o natural breaks in the heights of the area (figure2). Mentioned classes represent the studied zones in the area and subsequent calculations were done in each of these classes. Slope layer prepared base on digital elevation model o the area by surface analyses tool in 3D analyses. There were different processes to prepare drainage density layer and habitual density such as digitizing main and minor waterways layers on the topographical map1:50000 of the area, digitizing main and minor fault on geological map 1:100000 of area and density tool in Spatial Analyses. Iso-Precipitation layer prepared by interpolating method like cringing technique and linear relationship between rain-height using Interpolate tools in 3D analyses (Figure 2 to 8).

Second, the investigated criteria for each height zones were calculated (Table1) and their layers prepared separately. After achieving a few numbers in each layer, the numbers were analyzed by ELECTRE and Linear Assignment methods and mentioned zones prioritized to select the most appropriate area for artificial recharge of underground watersheds in the studied area.

a) *Theoretical principles of ELECTRE method and Linear Assignment*

In recent decades, several researchers attempt to use Multi Criteria Decision Making (MCDM) in complex and complicated decisions. These decision methods divide into two parts;

1. MODM = Multi Objective Decision Making
2. MADM = Multi Attribute Decision Making

Multi Criteria Models use to select the best options. Evaluative Models for MADM classify into two models;

1. Compensatory Model
2. Non- Compensatory Model

Non-compensatory model includes methods which don`t need to achieve data from DM and lead to objective answer. Exchanging between indictors is permitted in Compensatory model. It means that for example, a weakness in a indicator may be compensated by option of other indicator. Electrical Method is a type of available methods in Compensatory Models. In this method whole options evaluate by non-ranked comparisons. All stages of this method are established based on coordinated and uncoordinated sets and thus this method is known as ''Coordination Analysis''. Banayoun established the Electrical Method and Delft, Nijkamp, Roy and their colleagues developed it. In Electrical method, the concept of domination uses implicitly. In this method, options are compared in pairs, then dominant and weak (dominant and defeated) options determined and weak or defeated options omitted (Roy, 1991; 49-73).

Linear Assignment is one of the Multi Criteria Decision Making combines qualitative and quantitative indicators, weights criteria based on their importance and helps decision makers to select the best options at the same time. In this method, supposed options are ranked based on their points in each available indicator and then the final rank of the options determined by the Linear Compensatory Process. The situation of these two models show among the other Multi Criteria Decision Making (Figure2).solution process doesn`t need to scale down the quantitative and qualitative indicators.

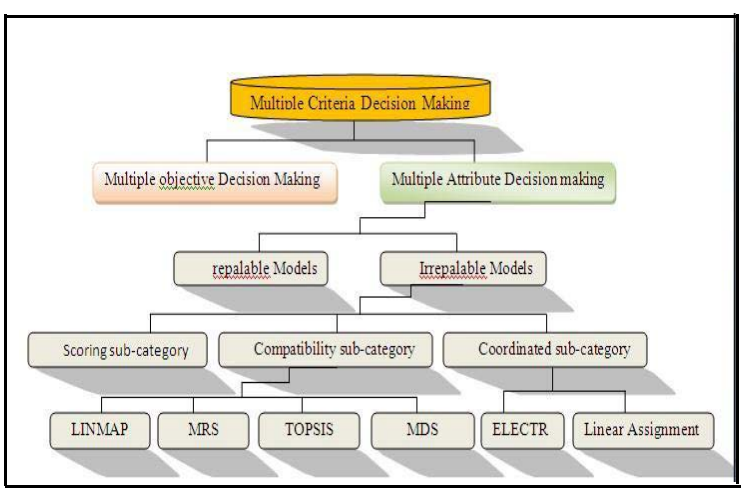

Figure 2 : Situation of ELECTRE and Linear Assignment methods among the other Multi Criteria Decision Making.

b) Problem solving process using ELECTRE and Linear Assignment methods

➢ Problem solving process in Linear Assignment method

1. Establishing Decision Making matrix

First, decision Making Matrix is established based on quantitative data related to the indicators in each area.

2. Ranking options according to available indicators.

Second, the areas are prioritized based on their ranks in each indicator.

3. Establishing QG Matrix

Third, having access to determined weights of indicators (W), QG Matrix is established. Each element in QG Matrix equals:

$$q/_{it} = \sum_{j=1}^{n} \pi itj \ . \ wj \quad (1)$$

If option i were in rank t in indicator j, then πitj= 1 otherwise it would be πitj.

4. The following assignment problem is solved with variables (0, 1 hit) in order to determine the final priority of options.

$$\max : \ \sum_{i=1}^{m} \sum_{k=1}^{m} \gamma_{ik} \ . h_{ik} \quad (2)$$

$$s.t \quad : \quad \sum_{k=1}^{m} h_{ik} = 1 \quad ; \quad i = 1,2, \dots , m$$

$$\sum_{i=1}^{m} h_{ik} = 1 \quad ; \quad k = 1,2, \dots , m \quad (3)$$

$$h_{ik} \quad \begin{cases} = 1 \\ = 0 \end{cases}$$

5. Ranking Options

In the final stage, the options are ranked.

c) Problem-Solving process in ELECTRE method

1. Establishing Decision Making Matrix:

According to the criteria and numbers of options and evaluation of whole options for the different criteria, Decision Making Matrix develops as follow;

$$X = \begin{bmatrix} x_{11} & \dots & x_{1n} \\ \vdots & \dots & \dots\dots \\ x_{1m} & \dots & x_{mn} \end{bmatrix}$$

In which the Function of Xij (i = 1,2, ..., M) is in relation to the criteria I j (j = 1,2,3, ..., n).

2. Scale down the Decision Making Matrix:

In this stage, all criteria with different dimensions is changed into the dimensionless criteria and matrix R defined as follows. There are several methods to scale down, but generally the following equation used in electrical method (Tille: 2003, 19-21).

$$R = \begin{bmatrix} r_{11} & \dots & r_{1n} \\ \vdots & \dots\dots & \dots \\ r_{m1} & \dots & r_{mn} \end{bmatrix} \qquad r_{ij} = \frac{x_{ij}}{\sum^{m} x_{ij}^2} \quad (4)$$

3. Determining Weighted Matrix of criteria:

$$W = \begin{bmatrix} w_1 & \dots & 0 \\ \vdots & w_2 & \dots \\ 0 & \dots & w_n \end{bmatrix}$$

As you can see, Weighted Matrix (W) is diagonal matrix in which the elements on main diameter are not zero and amount of these elements equal to importance coefficient of the related vector.

4. Determining Weighted Normalized Decision Matrix:

Weighted Normalized Decision Matrix is obtained by multiplying Scale down Decision Making Matrix into the Weighted Matrix of criteria.

$$V = R \times W = \begin{bmatrix} v_{11} & \dots & v_{1n} \\ \vdots & \dots & \dots \\ v_{m1} & \dots & v_{mn} \end{bmatrix}$$

5. Establishing agree and disagree criteria set

The criteria set J = (1, 2... m) divides into two subsets; agree and disagree for each pair of options e, k (k, e = 1,2, ..., M, k # e) . Agree Set (SKe) is a set of criteria in which option K is preferred to option e. and its complementary set is the opposite set (IKe) in mathematical language;

$$S_{ke} = \left\{ j \middle| v_{kj} \geq v_{ej} \right\} \quad (5)$$

$$I_{ke} = \left\{ j \middle| v_{kj} \prec v_{ej} \right\} \quad (6)$$

6. Establishing Agree Matrix:

To establish agree matrix, its elements, agree indicators, should be calculated. Agree indicator is sum of weight of criteria in agree set. Thus, indicator Cke is between option k and option e equals to (Roy, 1991, 49-73):

$$c_{ke} = \frac{\sum_{j \in s_{ke}} W_j}{\sum_{j=1} W_j} \quad (7)$$

For total normalized weights $\sum_{j \in 1} W_j$ equals 1 so:

$$c_{ke} = \sum_{j \in s_{ke}} W_j \quad (8)$$

Agreement represents the superiority of options k on option e which its amount changes in the range of zero to one (0-1). After calculating agree indicator for all options, matrix which is a m * m matrix is defined as follows. Generally, this matrix is not symmetrical.

$$C = \begin{bmatrix} - & c_{12} & \dots & c_{1m} \\ c_{21} & - & \dots & c_{2m} \\ \vdots & \vdots & - & \vdots \\ c_{m1} & \dots & c_{m(m-1)} & - \end{bmatrix}$$

7. Determining Opposite Matrix

Disagreement indicator (opposite) is described as follows (Roy: 1991, 49-73):

$$d_{ke} = \frac{\max_{j \in I_{ke}} |v_{kj} - v_{ej}|}{\max_{j \in J} |v_{kj} - v_{ej}|} \qquad (9)$$

The amount of disagreement indicator changes from zero to one. After calculating disagree indicator for all options, matrix which is a m * m matrix is defined as follows. Generally, this matrix is not symmetrical.

It noticed that the data including in agreement matrix, are different from data in opposite matrix and in fact these data are completed each other. The difference between the weight is developed through agreement matrixes, while the difference between determined values is obtained through opposition matrix.

8. Establishing agree dominant matrix:

In the sixth step, it indicated how to calculate agreement indicator Cke. Now there is a determined amount for agreement indicator in this step which is called agreement threshold . If Cke is larger , option k is preferred on option e, otherwise it is not. Agreed threshold is calculated by the following equation (Roy, 1991, 49-73):

$$\bar{c} = \sum_{\substack{k=1 \\ k \neq e}}^{m} \sum_{\substack{e=1 \\ e \neq k}}^{m} \frac{c_{ke}}{m(m-1)} \qquad (10)$$

Agree Dominated Matrix (F) is developed based on the amount of agreement threshold and its elements determined in the equation bellow (Vami, 1992).

$$f_{ke} = \begin{cases} 0 & c_{ke} \geq \bar{c} \\ 1 & c_{ke} < \bar{c} \end{cases} \qquad (11)$$

9. Establishing Opposed Dominance Matrix :

Opposed Dominance Matrix (G) is established the same as Agree Dominated Matrix. First, decision makers should express opposite threshold which is for example the mean of opposite indicators (disagreement) (Roy, 1991, 49) -73):

$$\bar{d} = \sum_{\substack{k=1 \\ k \neq e}}^{m} \sum_{\substack{e=1 \\ e \neq k}}^{m} \frac{d_{ke}}{m(m-1)} \qquad (12)$$

Similar to seventh step, it is better that the amount of opposite indicator (dke) become less, because opposite amount (disagreement) expresses superiorities dimension of option k on option is acceptable. In contrast, if (dke) were larger than , opposite amount would be very great and it would not be ignored. Thus, Opposed Dominance Matrix is defined as follows (1991, 49-73):

$$g_{ke} = \begin{cases} 0 & d_{ke} \geq \bar{d} \\ 1 & d_{ke} < \bar{d} \end{cases} \qquad (13)$$

Each element in the matrix (G) shows the dominant relationship between options.

10. Establishing Final Dominant Matrix:

Final Dominant Matrix (H) is developed after multiplying each element in Agree Dominated Matrix (F) into elements in Opposed Dominance Matrix (G) (Roy, 1991, 49-73).

$$h_{ke} = f_{ke}.g_{ke} \qquad (14)$$

11. Removing less satisfaction options and selecting the best option:

Final Dominant Matrix (H) indicates detail preferences of options. For example, when amount of hke equals 1, it means that option k is preferred on option e in both agree and disagree situation (it means its preference is larger than the agree threshold and its opposite or weakness is less than disagree threshold), but option k may be dominated by other options yet. The options should be ranked in a way that the more dominated options are selected than the more defeated one.

Determining the importance coefficient of options than the other, criteria are compared in pair by time suggested method.

Table 1 : Weighting the factors based on preference in paired comparison (Ghodsi Poor, 2009, 14).

Numerical values	Preferences (judging verbal)
9	Extremely preferred
7	Very strongly preferred
5	Strongly preferred
3	Moderately referred
1	Equally preferred
2،4،6،8	Intervals between strong preferences

After the formation of paired comparison matrix, relative weights of criteria can be calculated. There are different methods to calculate the relative weight based on paired comparison matrix. The most important ones are the "least squares method, least squares logarithmic method, special vector method and approximate method. The special vector method is the most accurate one. In this method, Wi is determine in the equation12:

$$A \times W = \lambda \max W \qquad (15)$$

In this equation, λ and W are special amount and special vector of paired matrix respectively. If dimensions of matrix were larger, calculation would be too time consuming. So, to calculate λ, the amount of Dtrmynal λIA-matrix will be equaled to zero. Considering the greatest value of λ in equation (13), the amount of wi is calculated. (2001, 315: Saaty).

$$A - \lambda_{max} . I = 0 \quad (16)$$

IV. Research Findings

The results of ELECTRE and Linear Assignment methods to find the most suitable area for artificial recharge of groundwater aquifers of Zarand-Saveh watershed showed in figures (2) to (8) and tables (3) to (12). Therefore, a matrix is formed with rank (49) for data matrix, with 7 alternatives (height zones) and 7 related indicators (rainfall, stream density, habitual density, extent, land area facies, slope, height) (Table 3).

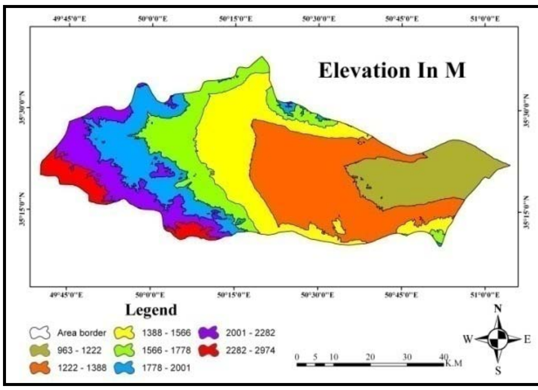

Figure 3 : Elevation Map of studied area.

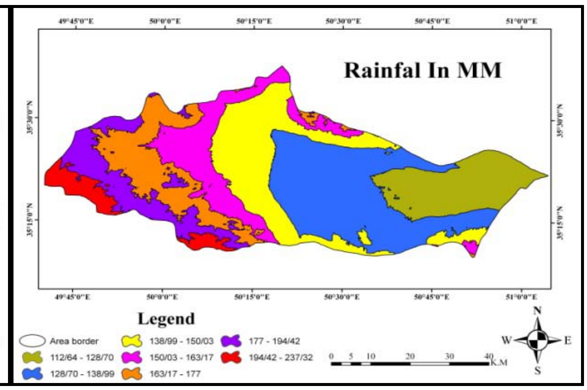

Figure 4 : Rainfall Map of studied area.

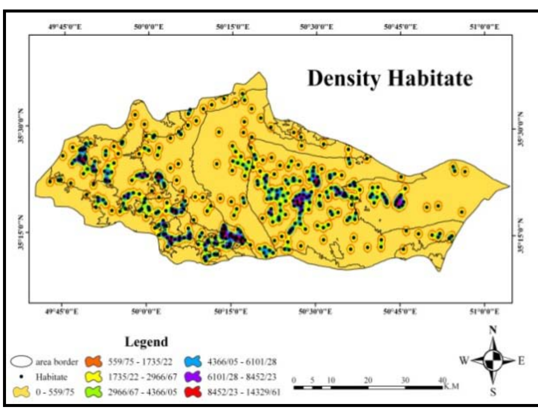

Figure 5 : Habitual Density Map of the studied area.

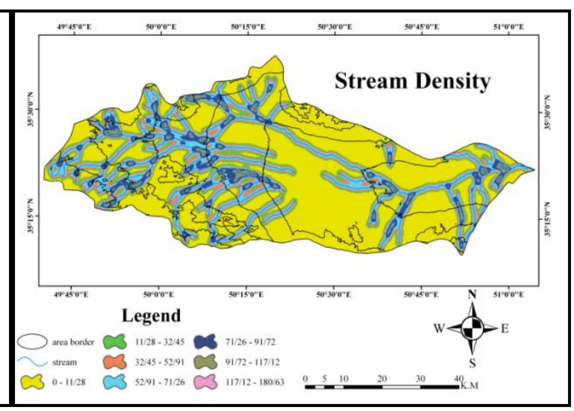

Figure 6 : Stream Density Map of studied area.

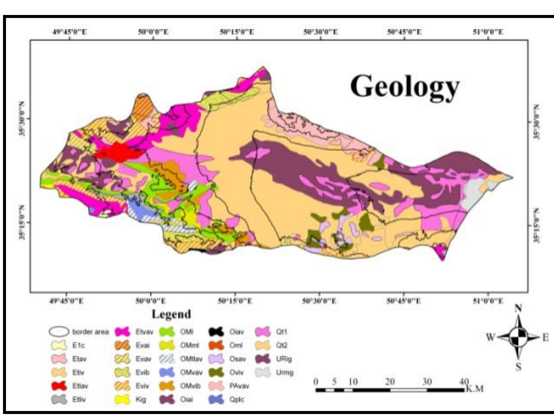

Figure 7 : Geological Map of the studied area.

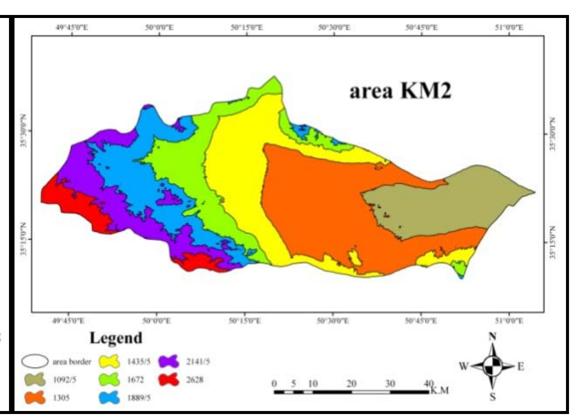

Figure 8 : Area Map of study area.

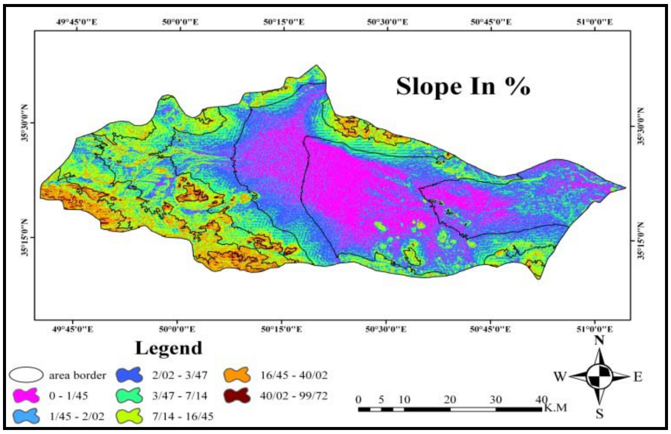

Figure 9 : Slope Map of the studied area.

a) *Problem Solving Matrixes in ELECTRE method*

Table 2 : Decision Matrix (X).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	1	121.29	90.31	13.28	4975.46	1092.5	484.85
2	5	134.22	63.91	22.09	5696.15	13.5	958.1
3	9	144.66	76.99	26.71	3268	1435.5	695.27
4	9	157.28	79.115	31.68	7164.8	1672	461.46
5	7	169.62	85.42	49.86	5911.25	1889.5	478.64
6	3	185.58	62.23	48.73	4692.22	2141.5	363.41
7	1	214.41	61.19	36.61	3163.1	2628	149.57

Table 3 : Scale down Decision Matrix (R).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0636	0.2801	0.4553	0.1433	0.3646	0.2378	0.3245
2	0.3181	0.3099	0.3222	0.2384	0.4175	0.0029	0.6412
3	0.5727	0.3340	0.3882	0.2883	0.2395	0.3124	0.4653
4	0.5727	0.3632	0.3989	0.3420	0.5251	0.3639	0.3088
5	0.4454	0.3916	0.4307	0.5382	0.4332	0.4112	0.3203
6	0.1909	0.4285	0.3137	0.5260	0.3439	0.4661	0.2432
7	0.0636	0.4951	0.3085	0.3952	0.2318	0.5719	0.1001

Table 4 : Paired Comparison Matrix of different criteria (S).

Criteria	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area	Wij
Materials	1	3	5	5	7	7	9	0/3868
Precipitation	0.33	1	3	5	5	7	7	0/2349
Stream density	0.2	0.33	1	3	5	7	7	0/1585
Slope	0.2	0.2	0.33	1	3	5	7	0/1028
Habitual density	0.14	0.2	0.2	0.33	1	3	5	0/0603
Elevation	0.14	0.14	0.14	0.2	0.33	1	3	0/0353
Area	0.11	0.14	0.14	0.14	0.2	0.33	1	0/0214
Inconsistency rate: 0/0252 (due to being less than 0/1 compatibility matrix indices are acceptable)								

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Table 5 : Weighted Normalized Decision Matrix (V).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0246	0.0658	0.0721	0.0147	0.0221	0.0085	0.0070
2	0.1229	0.0728	0.0510	0.0245	0.0253	0.0001	0.0138
3	0.2212	0.0785	0.0615	0.0296	0.0145	0.0111	0.0100
4	0.2212	0.0853	0.0632	0.0352	0.0318	0.0130	0.0066
5	0.1720	0.0920	0.0682	0.0553	0.0262	0.0146	0.0069
6	0.0737	0.1007	0.0497	0.0541	0.0208	0.0166	0.0052
7	0.0246	0.1163	0.0489	0.0406	0.0140	0.0204	0.0022

Table 6 : Agreement Matrix (C).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0.0000	0.1940	0.2189	0.1799	0.1799	0.2404	0.6266
2	0.8059	0.0000	0.0820	0.0215	0.0215	0.6266	0.6266
3	0.7810	0.9179	0.0000	0.4077	0.4077	0.5661	0.6266
4	0.8200	0.9784	0.9784	0.0000	0.4467	0.6266	0.6266
5	0.8200	0.9784	0.5922	0.5532	0.0000	0.7294	0.7294
6	0.7595	0.3733	0.4338	0.3733	0.2705	0.0000	0.7294
7	0.7595	0.3733	0.3733	0.3733	0.2705	0.2705	0.0000

Table 7 : Opposite Matrix (D).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	1	1	1	1	1	1
2	0.214494	0	1	1	1	0.601495	0.442481
3	0.054111	0.109532	0	1	0.522695	0.165727	0.192437
4	0.045479	0.072698	0.194701	0	0.410479	0.128322	0.157619
5	0.026487	0.140366	1	1	0	0.088066	0.164765
6	0.456288	1	1	1	1	0	0.318163
7	0.460453	1	1	0.1028	1	1	0

Table 8 : Agree Dominated Matrix (F).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	0	0	0	0	0	1
2	1	0	0	0	0	1	1
3	1	1	0	0	0	1	1
4	1	1	1	0	0	1	1
5	1	1	1	1	0	1	1
6	1	0	0	0	0	0	1
7	1	0	0	0	0	0	0

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Table 9 : Opposite Dominated Matrix (G).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	1
3	1	1	0	0	1	1	1
4	1	1	1	0	1	1	1
5	1	1	0	0	0	1	1
6	1	0	0	0	0	0	1
7	1	0	0	1	0	0	0

Table 10 : Final Dominated Matrix (H).

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	1
3	1	1	0	0	0	1	1
4	1	1	1	0	0	1	1
5	1	1	0	0	0	1	1
6	1	0	0	0	0	0	1
7	1	0	0	0	0	0	0

Table 11 : Number of dominant and recessive of each selected areas.

Difference	Number being defeated	Rule number	Regions
-6	6	0	1
-2	4	2	2
2	2	4	3
4	1	5	4
2	2	4	5
-2	4	2	6
-4	5	1	7

b) *Problem Solving Matrixes in Linear Assignment Method*

Table 12 : Data Collection Matrix.

Regions	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
1	2	121.29	90.31	13.28	4975.46	1092.5	484.85
2	5	134.22	63.91	22.09	5696.15	1300.5	958.1
3	9	144.66	76.99	26.71	3268	1435.5	695.27
4	8	157.28	79.115	31.68	7164.8	1672	461.46
5	7	169.62	85.42	49.86	5911.25	1889.5	478.64
6	3	185.58	62.23	48.73	4692.22	2141.5	363.41
7	1	214.41	61.19	36.61	3163.1	2628	149.57

Table 13 : Options Ranked Matrix based on indicators.

Rated	Materials	Precipitation	Stream density	Slope	Habitual density	Elevation	area
first	3	7	1	1	4	1	2
Second	4	6	5	2	5	2	3
third	5	5	4	3	2	3	1
Fourth	2	4	3	4	1	4	4
Fifth	6	3	2	7	6	5	5
Sixth	1	2	6	6	3	6	6
Seventh	7	1	7	5	7	7	7

Table 14 : Ranks Number Matrix of Options.

Regions	first	Second	third	Fourth	Fifth	Sixth	Seventh
1	3	1	1	1	0	0	1
2	0	2	1	1	2	1	0
3	1	1	2	1	2	0	0
4	1	1	1	4	0	0	0
5	0	1	1	0	2	2	1
6	1	1	1	0	0	4	0
7	1	0	0	0	1	0	5

Table 15 : Weight Matrix of rank number of options.

Regions	first	Second	third	Fourth	Fifth	Sixth	Seventh
1	0.2968	0	0.215	0.0605	0	0.3862	0.2349
2	0.215	0.1384	0.0605	0.3862	0.1584	0.2349	0
3	0.3862	0.0215	0.1384	0.1584	0.2349	0.0605	0
4	0.0605	0.3862	0.1584	0.3948	0	0	0
5	0	0.2189	0.6211	0	0.0571	0	0.1028
6	0	0.2349	0	0	0.4467	0.3183	0
7	0.2349	0	0	0	0.1028	0	0.6622

Table 16 : Options Rating Table.

Points / Regions							
1	0	0	0	0	0	0	1
2	0	0	0	1	0	0	0
3	1	0	0	0	0	0	0
4	0	1	0	0	0	0	0
5	0	0	1	0	0	0	0
6	0	0	0	0	1	0	0
7	0	0	0	0	0	1	0

Table 17 : Options Ranking.

Regions	1	2	3	4	5	6	7
Rated	Seventh	Second	first	Fourth	third	Fifth	Sixth

V. Discussion and Conclusion

Having Systematic attitudes toward geography as a science distribution indicates that geography is depending on Mathematical Sciences (Shakoeei, 1999, 43). Generally, model (1) is a shematic but accurate description about a system which is corresponded with its previous behavior and therefore, there is hope that it will be used to predict the future behavior of the system (Hekmat- Nia and Moosavi, 2007, 29).

In recent decades, researchers have used Multi Criteria Decision Making in complex and complicated decisions. In these models, several criteria are used to measure instead of desirable criteria (Taherkhani, 2008, 62). Nowadays, prioritizing and selecting appropriate substitutions out of different elements and deciding about them is important is significant in environmental planning and management. In other words, it is necessary to use suitable methos which are combined different indicators in order to achieve better results and to do the best job for environmental planning and management.

This study aimed at ranking the water resources potential in Zarand-Saveh watershed by two methods; ELECTRE method and Linear Assignment. ELECTRE method is one of the Multi criteria decision making which can compound the quantitative and qualitative criteria, weight each criterion based on its importance and help decision makers to select the best option at the same time.

Electrical method is one of the available methods in compensatory methods. In this method, all options are analyzed and evaluated by non-ranked comparisons. Whole stages of this method are based on coordinated and uncoordinated sets and thus it is called ''coordination analysis''. The results and findings show that zone (4) dominated (5) times and defeated (1) time,so it is located in the first rank with (4) points and is the most suitable zone for artificial recharge. In contrast, zone (1) defeated (6) time and dominated no time, therefore it is located in the last rank with (-6) points and is not the most suitable zone for artificial recharge. And, zones (3, 5, 2, 6, 7) dominated (4, 4, 2, 2, 1) times and defeated (5, 4, 2, 2, 4) and located in other ranks with (-4, -2, -2, 2, 2, 2) points respectively. Also, zones (7, 6, 2, 1) should be omitted because their defeated times are more than dominated times. And in Linear assignment, zone (3) is located in the first rank, zone (8) in the last rank and zones (7, 2, 6, 5, 4) in other ranks respectively.

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Changed Human Values in India & Pollution: Analysis of Some Contemporary Issues

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Abstract - Environmental Pollution (Pollution) is a global issue. Though responsibility of India in creating Pollution is less as compared to developed countries, however we cannot deny our role as we shall be largest population country and 4th largest economy soon. Pollution is the problem that is purely created by human beings and human behavior is the main cause of this act. Behavior is governed by values. This paper addresses a theoretical study of impact of human values on pollution in the context of Indian Society.

Keywords : *Human Values, Pollution, Indian Society.*

GJHSS-C Classification : *FOR Code: 700401 JEL Code: Q51,Q52,Q53*

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Strictly as per the compliance and regulations of:

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Dr. Jayshri Bansal [α] & Pratosh Bansal [σ]

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I. Introduction

Environmental Pollution (Pollution) is the word that we are hearing since our childhood but now we realized that Pollution must have started with the birth of life of anatomically modern humans on this planet. So, the problem of Pollution is not new and in fact it is 02 Lakhs years old [01]. So, question arises why this problem, which is not new, but now, getting so much of attention? The answer lies in following facts- all natural resources like water; air and soil are limited in quantity, population of all living objects is increasing (especially humans) and the most important fact is that our modern society is not obeying the natural laws. We believe that we have been polluting the earth since last 02 Lakhs years but as the quantum was not so big so the Mother Nature was kind enough to absorb and accommodate it, but now it seems that we have crossed the limits. Nature has capability to rebuild its own system but this needs time, and with the speed with which we are disturbing this system, it has become very difficult to restore the system. The simple pure natural cycle has been converted to a vicious cycle.

Studies [02] show that there is a strong correlation between population and pollution. Exponential growth of population leads to more consumption of natural resources, toxic wastes generation, depletion of trees and forest lands. Unfortunately, creator of the earth has not provided "User Manual" otherwise that must have indicated *total life bearing capacity of the earth* and so we could stop increasing population and civilization. When we discuss about relation of population and pollution then we must consider the fact that, it is the human behavior that actually contribute to the pollution. Only human beings have been blessed with the power to sense, think and then act wisdom fully. Our insensible behavior, due to degraded values, is the only cause of pollution. Problem of pollution is not a technical problem because it can be reduced only by reducing the causes that create pollution, and causes of creating pollution are just because of unwise behavior of human beings.

An effort has been made in this paper to throw some light on the contemporary issues of human values on the pollution. This paper is purely a theoretical work on the basis of observations, beliefs and understandings. Suggested outcomes have not been quantified and measured by any means.

In the next section i.e. section-2, we discuss about pollution in the context of this paper. In section-3, issues related to human values in Indian society have been discussed. In section-4, an effort has been made to indicate impact of changed human values on pollution. Section-5 contains conclusion and future work possible. In the last section we have cited references.

II. Environmental Pollution

Word Pollution came from Pollute and Pollute means making unclean [03]. So, it is very easy to understand that Environmental Pollution is to make environment unclean by some means. This also means disturbing natural proportion of the elements and also access consumption of natural resources like water and fuel. Wastage of energy and water also leads to environmental pollution.

Very common and easily quantifiable forms of pollution are Air, Water and Soil Pollution. Some other forms are Noise, Thermal and Visual etc. [04].

Continuous pollution causes damage to health and growth of human beings, animals and trees. All natural patterns of air flow, water flow, temperature and rain get disturbed. Pollution affects physically and physiologically to all living objects. Several studies have confirmed poor quality life because of pollution [05] [06] [07].

Various government agencies, national and international NGOs and educational institutions keep on informing and alerting the society, about impact of pollution on environment and hence impact on every living and non-living object on this planet. So, why we do worry when environmental pollution increases? The reason is very simple; our life comes in danger. Then

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why all of us does not do worry about pollution? This is simply because of degraded human values and insensitivity. Is pollution affects only some people? The answer is NO. So, when pollution affects every citizen equally then why only some reacts?

III. Human Values in Indian Society

What are human values? On the basis of our learning, understanding and belief, we can define human values as- *the eternal qualities that an individual must possess for quality life and which does not changes with the change in the society or situation.* However, quality life is a relative term and all of us can not be agree on the same point. Some examples of human values are *Generosity, Kindness (Compassion), Tolerance, Cooperation, Sensitivity, Belongingness and Gratefulness.*

Socialization involves nurturing of these human values [08] [09] [10]. Society grows as a cultured society with the development of human values in individuals. Development of human values in an individual since childhood is greatly affected by the society in which he/she lives.

India is the country with rich historical culture and strong social values. However, our strong values and culture has been polluted now due to several reasons:

- *Not Believing in Ourselves* - So most of us do not know, what is correct?
- *Westernization* - Not adopted but actually we have started copying culture and life style of western countries in the race of so called modernization.
- *Intense Use of Technology* - Telephone, Television and Internet has several advantages to the society; however they are harming the society more instead of providing benefits.
- *Long Period of Outside Rulers* - This period was enough to destroy the culture of whole society; however our deep rooted values could protect it partially. Unfortunately, technology is now harming society and destroying culture.

Changed behavior of the society greatly affects the human value. How human values get propagated in the society? Some of us are responsible for this [11]: Parents and the home environment, Teachers and the Schools, Religious Authorities, Peers, Government Agencies, the Work Environment, Mass Media, literature and Law. It is worth mentioning that each of us does not get identical values. This is because human values get cultivated in an individual due to his/her wisdom along with exposure, experience and social environment [11]. So when an individual behaves erratically (unsocial) ultimately it affects the society. The more intense the impact of an individual, society gets affected more. If we ponder over reasons of pollution, we can easily conclude that a harmony between human being and the ecological system has been disturbed due to human-made systems and society. The next section deals with impact of changed human values on pollution specifically.

IV. Human Values and Pollution

How human values affect the environment? The reason lies in the meaning of an environment. Environment is all about surrounding but it is not only surrounding, it contains all living and non living objects on the earth (Figure-1). So, to protecting the environment is about protecting all living and non-living objects on this planet. This is also very necessary for our survival. Treating environmental elements; Soil (earth), Water and Air as friend are the teaching of India's great culture.

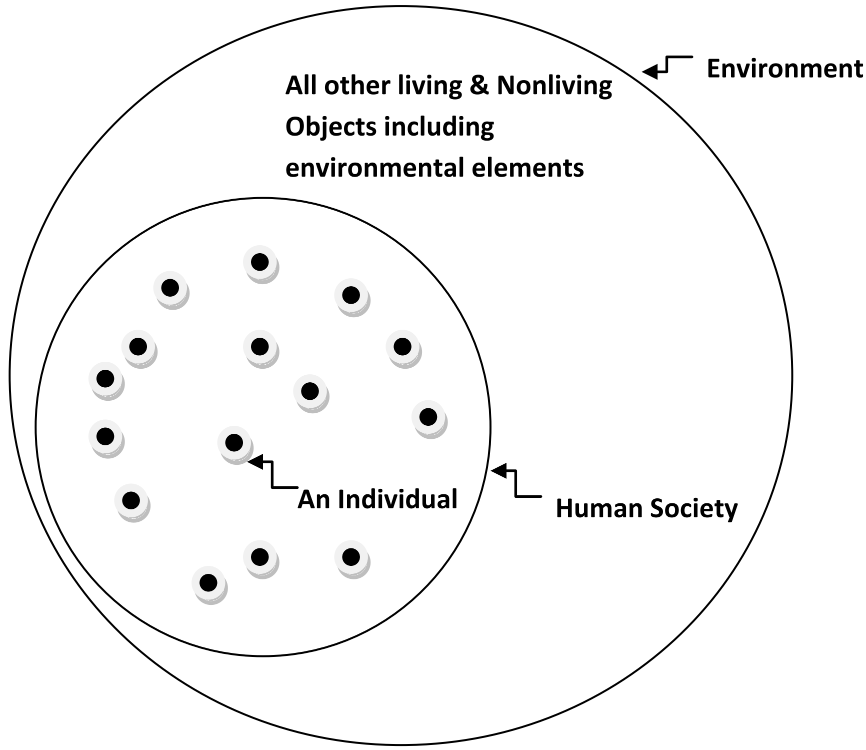

Figure 1 : Perception of Environment in the Context.

Some of the teachings of Rig-Veda [12] [13] clearly shows that we must respect environmental elements just as we treat our close relatives and friends. Some examples from Rig-Veda are [12] [13]- *"Heaven is my father, brother atmosphere is my navel, and the great earth is my mother", "The earth is my mother and I am Her son", "The person who pollutes waters of ponds, wells or lakes goes to hell", "O Air! You are our father, the protector".*

The problem of pollution created, when we as human being forgot considering environment as one of the friend of our family and society. We consider environment as the property of government or something which is free and comes in abundance. Our changed human values (some reasons we have discussed in previous section) towards our eternal and closest friend environment have created the problem of pollution. Pollution is now biggest threat to the society.

So now an analysis has been made here showing impact of changed human value on environmental pollution, by considering environment as one of the important element of a family.

a) Changed Human Values and Pollution

In this section an analysis has been done by considering environment as a friend (or close relative) and effect on environment due to changed human values.

Some important human values we have considered for the analysis are:

- *Generosity*
  - Great Indian values always insits on to show geneoristy, not only for our family members but for every single object on this planet.
  - When we becomes generous, we share.
  - Our selfishness stops us in sharing of natural resources and hence causes wastage/unutilization.
- *Tolerance*
  - Tolerance means acceptance.
  - When we accepts our surroundings and every living and non-living thing then we understand their advantages (strength, positive attributes) and disadvantages (weakness, negative attributes).
  - Technological innovations have made our life more comfortable and made us intolerable to the natural variations.
- *Sensitivity*
  - Sensitivity helps in understanding the current situation/condition.
  - Understanding- Why this has happen?
  - Helps in identifying the problem or sensing severity of the problem.
  - Sensing pain of others.
  - We are unable to sense severity of problem of pollution.

- *Belongingness*
  - o We do care of ourselves, our house and our properties with great involvement.
  - o When we do not feel belongingness then we don't take responsibility.
  - o Who owns this environment? Who is responsible to the problem of Pollution?
- *Gratefulness*
  - o When we get something from someone that is very precious to us, then we must be thankful and feel grateful to him.
  - o All natural elements are very precious to us and the most important fact is that, they can not be reproduced.
  - o We must express our gratefulness to the Mother Nature.

Table 1 : Summarizes the analysis made here in the context of this paper.

Human Value	Changed Human Value	Impact on Environment
Generosity	Selfishness	• Selfishness causes improper and wasted utilization of natural resources. • In selfishness we just think about our progress, growth and comfort by compromising of our friend environment. • Our insatiable appetite for growth, civilization and comfort is causing great harm to our environment and showing our selfishness. • Selfishness inhibits us for sharing and optimizing resources that could have saved lot amount of fuel and other natural resources.
Tolerance	Intolerance	• All natural elements (including us) are governed by principle of nature. • When we do not accept it, then nature reacts. • Modern life style has made us, intolerable to natural seasonal variations. • We cannot imagine our life without AC, Heater and Refrigerator, which are the major source of environmental pollution.
Sensitivity	Insensitivity	• We do not feel pain in wasting & polluting water, polluting air, cutting tree, poisoning soil, littering and creating noise. • We don't bother about severity of problem pollution. • Our insensitivity for other living–non living objects of the planet has disturbed equilibrium of the nature.
Belongingness	Irresponsibility	• We care our belongings but *who owns the environment*? Does not environment belong to us? • Who will take care the problem of pollution, is this problem is of only government? Who is responsible?
		• We have to own the environment also, and have to feel that this belongs to us.
Gratefulness	Thankless	• We have become thankless to the nature. • A fresh air, pure water and fertile soil are the gift of nature to us, but our thankless behavior has destroyed its purity. • We are thankless to the Mother Nature and don't hesitate in cutting trees, making soil; water and air impure.

We can now establish very easily to the fact that our values decides our action. Our actions with degraded values are the reason to disturb natural equilibrium. This can be seen with some examples below:

- Cutting of trees (shows our insensitivity and thankless behavior).
- Unwise utilization of Plastics (shows our insensitivity).
- Inefficient use of fuel of any form (shows our selfishness).
- Pollution of natural sources of water through several means at domestic and commercial level (shows our insensitivity, Irresponsibility and thankless behavior).

V. Conclusion

A theoretical study carried by us clearly shows that problem of pollution is not the technological problem. This problem is purely behavioral problem. Changed (degraded) human values have affected our actions and hence it has disturbed equilibrium of the nature. No technology can stop it. Only human behavior and actions, which are the outcome of values, can reduce pollution. This can be achieved only with restoring great Indian values by considering environment as a member of the family. In future, a quantitative study can be carried out for identifying most important human value that contributes more for the protection of environment and also how these values can be maintained/ sustained in our society.

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31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

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- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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