



# Assessing the organic and inorganic fertilizers in a crop under agriculture sector using normal fuzzy TOPSIS method

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## Abstract

The farmers depend on agriculture, which has been developed in several states in India. organic and inorganic farming promote agriculture in various ways. Organic farming enhances agriculture in providing healthy food to human being and reflects relationship between its productivity and better environment. Farming are using their inorganic farming to push crop yield with rising healthy hazard and harms in earth. Organic and inorganic fertilizers in agriculture sector can be selected in the order and ranked by using normal fuzzy TOPSIS method[NFTM] in order to obtain the quantitative and qualitative manner.

## Keywords

Agriculture, Organic content, Inorganic content, Fuzzy TOPSIS, Normal TOPSIS.

## AMS Subject Classification

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## 1. Introduction

The chemical fertilizers are easiest available on cash payment to the farmers. They are using their Inorganic farming to push crop yield with rising healthy hazard and harms in earth. Farmers are facing many socio-economic problems. The harsh and harmful content of the chemical in the soil is depleted the procurement of the production.

Organic farming enhances agriculture in proving healthy food to the human being and reflects relationship between its productivity and better environment. So, with abundant use of chemical and anti-biotic in Inorganic farming in the Agricultural technology has compelled the healthier people to

explore and support Organic farming technology in Agricultural sectors.

Normal fuzzy TOPSIS Method is used to evaluate the preference ranking for the results of agricultural production and based on the farming. Triangular Fuzzy numbers are used to solve the decision making by arranging the order of using the Organic and Inorganic farming and these methods can be applied effectively with necessary support information and quantitative result which has objective and reasonable [17]. Rank of assessing organic waste and Inorganic fertilizers in the order of using normal fuzzy TOPSIS Methods in agricultural sectors.

The development of application of fuzzy set theory [1–5, 14, 15] has created great opportunities for decision of agricultural land suitability problem. In particularly, fuzzy indicators have been successfully applied for the assessment of particular field contaminated by harsh farming [12, 13], for the assessment of low area after flooding [6], for the assessment of contaminated agricultural field in the order of taking a strategy for prophylactic action [7], for the assessment of destructing area with aim of planning land restoration [8], for the assessment of land suitability process in agricultural sector [9], for the assessment of agricultural lands specifying effective management [10] and for the assessment of agricultural lands

with evaluation of land markets [11, 16].

## 2. Normal Fuzzy TOPSIS Method [NFTM]

The following steps are the procedure for NFTM.

**Step 1:** Given  $X_{ij}$ , decision table,  $i = 1, 2, \dots, m$ , and  $j = 1, 2, \dots, n$ , the performance of each alternative required to be expanded with equation

$$r_{ij} = \frac{X_{ij}}{\sum_{j=1}^m X_{ij}}, \quad (2.1)$$

**Step 2:** obtain the weight  $W_i$  from the given initial table.

$$\sum_{i=1}^n W_i \text{ given } i = 1, 2, 3, \dots, m$$

**Step 3:** The Positive ideal solution A + and negative ideal solution A- can be calculated with weighted normalized vector ( $v_{ij}$ ) as:

$$v_{ij} = w_i(r)_{ij}; \text{ given } i = 1, 2, 3, \dots, m; \text{ and } j = 1, 2, 3, \dots, n. \quad (2.2)$$

**Step 4:** The positive ideal solution matrix can be evaluated as,

$$A^+ = (y_1^+, y_2^+, \dots, y_n^+) \quad (2.3)$$

The negative ideal solution matrix can be evaluated as

$$A^- = (y_1^-, y_2^-, \dots, y_n^-) \quad (2.4)$$

**Step 5:** The difference of positive ideal solution can be formulated with equation;

$$S_i^+ = \sum_{j=1}^n |y_{ij} - y_i^+|; i = 1, 2, 3, \dots, m \quad (2.5)$$

The difference of negative ideal solution can be formulated with equation ;

$$S_i^- = \sum_{j=1}^n |y_{ij} - y_i^-|; i = 1, 2, 3, \dots, m \quad (2.6)$$

**Step 6:** Estimate the value of preference for each alternative ( $C_i$ ) is given as:

$$C_i = \frac{s_i^-}{s_i^+ + s_i^-}$$

## 3. Computational Procedure for Assessing the Fertilizers in Normal Agricultural Activity

The application of the agricultural sector in which Organic and Inorganic farming the order can be computed with above procedure can be summarized as follow.

Take 4 criteria used as a basis for decision making in Organic fertilizer.

- $X_1$ : Agricultural Waste;
- $X_2$ : Municipal sludge;

- $X_3$ : Livestock manure;
- $X_4$ : Industrial Waste;

On the other hand, take 10 criteria as a basis for decision making on Inorganic fertilizer.

- $X_1$ : Potassium fertilizer
- $X_2$ : Calcium nitrate
- $X_3$ : Calcium superphosphate
- $X_4$ : Sodium nitrate
- $X_5$ : Citrate-soluble phosphate fertilizer
- $X_6$ : Ammonium chloride
- $X_7$ : phosphorus fertilizer
- $X_8$ : Nitrate nitrogen
- $X_9$ : Ammonium bicarbonate
- $X_{10}$ : Nitrogen fertilizer

Next, The decision for the linguistic variable for the importance weight of each criterion for organic fertilizer is given in Table 3.1 below.

The decision for the linguistic variable for the importance weight of each criterion for Inorganic fertilizer is given in Table 3.2 below.

**Table 3.1.** Organic fertilizer

Alternative	Linguistic Variable	Fuzzy Number
$C_1$	Very High(H)	(0.4, 0.5, 0.6)
$C_2$	High(H)	(0.3, 0.4, 0.5)
$C_3$	Medium(M)	(0.2, 0.3, 0.4)
$C_4$	Low(L)	(0.1, 0.2, 0.3)

**Table 3.2.** Inorganic fertilizer

Alternative	Linguistic Variable	Fuzzy Number
$C_1$	Extremely Low (EL)	(0.00, 0.15, 0.30)
$C_2$	Very Low (VL)	(0.15, 0.30, 0.45)
$C_3$	Low (L)	(0.30, 0.45, 0.60)
$C_4$	Medium Low (ML)	(0.45, 0.60, 0.75)
$C_5$	Low Medium(LM)	(0.60, 0.75, 0.90)
$C_6$	Medium(M)	(0.75, 0.90, 1.05)
$C_7$	High Medium(HM)	(0.90, 1.05, 1.20)
$C_8$	Medium High(MH)	(1.05, 1.20, 1.35)
$C_9$	High(H)	(1.20, 1.35, 1.50)
$C_{10}$	Very High(VH)	(1.35, 1.50, 1.65)

### 3.1 Calculations

**Table 3.3**

Alternative Criteria	$A_1$	$A_2$	$A_3$	Total
$C_1$	0.4	0.5	0.6	1.5
$C_2$	0.3	0.4	0.5	1.2
$C_3$	0.2	0.3	0.4	0.9
$C_4$	0.1	0.2	0.3	0.6
Total	1.0	1.4	1.8	4.2

Weight  $\sum W_i = 1, W_1 = 0.2381,$

$W_2 = 0.3333, W_3 = 0.4286$



**Table 3.4.** Normalized Fuzzy Numbers

Alternative Criteria	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
C <sub>1</sub>	0.4	0.3571	0.3333
C <sub>2</sub>	0.3	0.2857	0.2778
C <sub>3</sub>	0.2	0.2143	0.2222
C <sub>4</sub>	0.1	0.1429	0.1667

$$v_{ij} = (r_{ij})W_i$$

**Table 3.5.** Normalized Fuzzy Numbers

Alternative Criteria	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
C <sub>1</sub>	0.0952	0.1190	0.1429
C <sub>2</sub>	0.0714	0.0952	0.1191
C <sub>3</sub>	0.0476	0.0714	0.0952
C <sub>4</sub>	0.0238	0.0476	0.0714

$$A^+ = \{0.0238, 0.1190, 0.0714\},$$

$$A^- = \{0.0952, 0.0476, 0.1429\}$$

**Table 3.6**

No.	Criteria	$S_i^+$ $=  V_{ij} - v_i^+ $	$S_i^-$ $=  V_{ij} - v_i^- $	$C_i$ $= \frac{S_i^-}{S_i^+ + S_i^-}$	Rank
1	C <sub>1</sub>	0.1428	0.0714	0.333	4
2	C <sub>2</sub>	0.1191	0.0952	0.444	3
3	C <sub>3</sub>	0.0952	0.1191	0.55576	2
4	C <sub>4</sub>	0.0714	0.1429	0.6696	1

**Table 3.7.** Inorganic fertilizers

Alternative Criteria	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Total
C <sub>1</sub>	0.00	0.15	0.30	0.45
C <sub>2</sub>	0.15	0.30	0.45	0.90
C <sub>3</sub>	0.30	0.45	0.60	1.35
C <sub>4</sub>	0.45	0.60	0.75	1.80
C <sub>5</sub>	0.60	0.75	0.90	2.25
C <sub>6</sub>	0.75	0.90	1.05	2.70
C <sub>7</sub>	0.90	1.05	1.20	3.15
C <sub>8</sub>	1.05	1.20	1.35	3.60
C <sub>9</sub>	1.20	1.35	1.50	4.05
C <sub>10</sub>	1.35	1.50	1.65	4.50
Total	6.75	8.25	9.75	24.75

$$\text{Weight } W_1 = 0.2727,$$

$$W_2 = 0.3333, W_3 = 0.3939$$

**Table 3.8.** Normalized Fuzzy Numbers

Alternative Criteria	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
C <sub>1</sub>	0.00	0.0182	0.0308
C <sub>2</sub>	0.0222	0.0364	0.0462
C <sub>3</sub>	0.0444	0.0545	0.0615
C <sub>4</sub>	0.0667	0.0727	0.0769
C <sub>5</sub>	0.0887	0.0909	0.0923
C <sub>6</sub>	0.1111	0.1091	0.1077
C <sub>7</sub>	0.1333	0.1273	0.1231
C <sub>8</sub>	0.1556	0.1455	0.1385
C <sub>9</sub>	0.1778	0.1636	0.1538
C <sub>10</sub>	0.2	0.1818	0.1692

$$v_{ij} = (r_{ij})W_i$$

**Table 3.9**

Alternative Criteria	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>
C <sub>1</sub>	0.0000	0.0061	0.0121
C <sub>2</sub>	0.0061	0.0121	0.0182
C <sub>3</sub>	0.0121	0.0182	0.0242
C <sub>4</sub>	0.0182	0.0242	0.0303
C <sub>5</sub>	0.0242	0.0303	0.0364
C <sub>6</sub>	0.0303	0.0364	0.0424
C <sub>7</sub>	0.0364	0.0424	0.0485
C <sub>8</sub>	0.0424	0.0485	0.0546
C <sub>9</sub>	0.0485	0.0545	0.0606
C <sub>10</sub>	0.0545	0.0606	0.0666

$$A^+ = \{0.0000, 0.0606, 0.0121\},$$

$$A^- = \{0.0545, 0.0061, 0.0666\}$$

**Table 3.10**

No.	Criteria	$S_i^+$ $=  V_{ij} - v_i^+ $	$S_i^-$ $=  V_{ij} - v_i^- $	$C_i$ $= \frac{S_i^-}{S_i^+ + S_i^-}$	Rank
1	C <sub>1</sub>	0.0545	0.109	0.6667	1
2	C <sub>2</sub>	0.0607	0.1028	0.6287	2
3	C <sub>3</sub>	0.0666	0.0969	0.5927	3
4	C <sub>4</sub>	0.0728	0.0907	0.5547	4
5	C <sub>5</sub>	0.0788	0.0847	0.5180	5
6	C <sub>6</sub>	0.0848	0.0787	0.4813	6
7	C <sub>7</sub>	0.091	0.0725	0.4434	7
8	C <sub>8</sub>	0.097	0.0665	0.4067	8
9	C <sub>9</sub>	0.1031	0.0604	0.3694	9
10	C <sub>10</sub>	0.109	0.0545	0.3333	10

## 4. Conclusion

It can be concluded that the analysis and requirement of fertilizers in agriculture sector have been taken in order in the normal fuzzy TOPSIS Method. The result indicated that the assessment of ordering the selection in the requirement using Organic and Inorganic fertilizers is same result in using

TOPSIS Method. Therefore, we can also formulate the order in this method used in this paper for indicating the rank and has an efficient evaluation rather than the TOPSIS Method. So we can highly recommend the same method to select the preferences in any fields.



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