ON T- CONORM OF FUZZY SOFT AGGREGATION AND ITS APPLICATION OF MULTI CRITERIA DECISION MAKING IN AGRICULTURE

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ABSTRACT:

Multi- Criteria Decision Making (MCDM) which that addresses the problem of making a suitable choice from a set of alternatives which are characterized in their attributes is a normal human activity. For this, use the Mathematical tool called Fuzzy Soft Matrix. In this paper to find the best agricultural place and applied the T- Conorm of FS-aggregation in Multi Criteria Decision Making .

KEYWORDS:

Fuzzy, Fuzzy Soft Matrix, Fuzzy Soft Aggregation (FS- Aggregation), T-Conorm, T- Conorm of Fuzzy Soft Aggregation.

1. INTRODUCTION:

Fuzzy set theory was formalized by Professor Lofti Zadhey at the university of California in 1965. Fuzzy Logic uses the whole interval between 0 (false) and 1 (true). Molodstov introduced the concept of soft sets can be seen as a new mathematical theory for dealing with uncertainty .Majet al presented the concept of the fuzzy soft sets by embedding the ideas of fuzzy sets. Roy and Maji gave some applications of fuzzy soft sets.The operations of the fuzzy soft sets defined by Majet et al. The purpose of this paper is use the fuzzy soft matrix in agriculture.On t-conorm of fuzzy soft aggregation is used in the field of agriculture and solve the decision making problems involving multiple decision makers.

2. PRELIMINARIES:

In this section, we recall the basic definition of soft matrix, fuzzy soft set, fuzzy soft aggregation, t-conorm, operators of t-conorms and associated with examples.

2.1 FUZZY SOFT SET:

An fuzzy soft set Γ_A over U is a set defined by a functions γ_A representing a mapping γ_A: E→ F(U) such that γ_A(x) = ∅ if xϵ A. Here γ_A is called fuzzy approximate function of the fuzzy soft set Γ_A , and the value $\gamma_A(x)$ is a set called x- element of the fuzzy soft set for all $x \epsilon E$. Thus, an fuzzy soft set Γ_A over U can be represented by the set of ordered pairs

$\Gamma_A = \{(X, \gamma_A(x)) : x \epsilon E , \gamma_A(x) \epsilon F(U) \}$.

The set of all fuzzy soft sets over U will be denoted by FS(U).

2.2 FUZZY MATRIX:

A fuzzy matrix (FM), A of order mxn is defined as

$A = [< a_{ij} , a_{ij\mu} >]_{mxn}$ where $a_{ij\mu}$ is the membership value of the element a_{ij} in A.

We write $A = [a_{ij\mu}]$.

2.3 FUZZY SOFT MATRIX:

Let U= $\{ c_1, c_2 , c_3, \ldots\ldots c_m \}$ be universal set and E be the set of parameters given by E = $\{ e_1, e_2 , e_3, \ldots\ldots e_n \}$.Let A$\subset$ E and (F, A) fuzzy soft set in the fuzzy soft class (U, E). Then represent the fuzzy soft set (F, A) in matrix form as

$A_{m\times n} =[a_{ij}]_{m\times n}$ or $A =[a_{ij}]$ where i=1,2,…m ; j=1,2,….n.

Where $a_{ij} = \mu_j (c_i)$ if $e_j \in A$; 0 if $e_j \notin A$.

Here $\mu_j (c_i)$ represents the membership of c_i in the fuzzy set F(e_j). The set of all $m\times n$ fuzzy soft matrices over U would be denoted by $FSM_{m\times n}$.

2.4 FUZZY SOFT AGGREGATION:

Let $\Gamma_A \in$ FS(U). Assume that U = $\{u_1,u_2\ldots.u_m\}$,E =$\{x_1, x_2 \ldots x_n\}$ and A$\subseteq$E, then the Γ_A can be presented by following table.

Γ_A	x_1	x_2	x_n
u_1	$\mu_{\gamma A(x_1)}(u_1)$	…………………………	$\mu_{\gamma A(x_n)}(u_1)$
u_2	$\mu_{\gamma A(x_1)}(u_2)$	…………………………	$\mu_{\gamma A(x_n)}(u_2)$
u_3	:		:
:	:		:
u_m	$\mu_{\gamma A(x_1)}(u_m)$	…………………………	$\mu_{\gamma A(x_n)}(u_m)$

Where μ_{γ_A} (x) is membership function of γ_A.

If $[a_{ij}] = \mu_{\gamma A(xj)}(u_i)$ for i = 1,2 ….. m & j = 1,2 … n the fuzzy soft set Γ_A is uniquely characterized by a matrix,

$$[a_{ij}]_{m\times n} = \begin{bmatrix} a_{11} & a_{12} & \ldots & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & \ldots & a_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ a_{m1} & a_{m2} & \ldots & \ldots & a_{mn} \end{bmatrix}$$

is called an mxn fuzzy soft matrix of the fuzzy soft set Γ_A over U.

2.5 CARDINAL SET:

Let $\Gamma_A \in$ FS(U). Then the cardinal set of Γ_A, denoted by c Γ_A and defined by,

c Γ_A = { $\mu c_{\Gamma_A}(x)$ / x: x ∈ E}

is a fuzzy set over over E. The membership function μc Γ_A of c Γ_A is defined by

$$\mu c_{\Gamma_A}(x) : E \rightarrow [0,1],\ \ \mu c_{\Gamma_A}(x) = \frac{|\gamma_A(x)|}{|U|}$$

Where $|U|$ is the cardinality of universe U and $|\gamma_A(x)|$ is scalar cardinality of fuzzy soft set $\gamma_A(x)$.

2.6 CARDINAL MATRIX:

Let $\Gamma_A \in$ FS(U) and c $\Gamma_A \in$ CFS(U). Assume that E= { x_1, x_2,….. x_n} and A⊂E, then $c_{\Gamma_A}(x)$ can be presented by the following ,

E	x_1	x_2		x_n
$\mu c_{\Gamma_A}(x)$	$\mu c_{\Gamma_A}(x_1)$	$\mu c_{\Gamma_A}(x_2)$	…	$\mu c_{\Gamma_A}(x_n)$

A_{1j}= μ $c_{\Gamma_A}(x_j)$ for j=1,2,…n, then the cardinal set c Γ_A is uniquely characterized by a matrix

$[a_{ij}]_{m\times n}$ = [a_{11} a_{12} ……a_{1n}]

Which is called the cardinal matrix of the cardinal set c Γ_A over E.

2.7 FUZZY SOFT AGGREGATION OPERATOR:

Let $\Gamma_A \in$ FS(U) and c $\Gamma_A \in$ FS(U). Then fuzzy soft aggregation operator denoted by FS_{agg} is defined by,

FS_{agg} : CFS(U) X FS(U) → F(U)

Where

$\Gamma_A^* = \{ \mu \Gamma_A^* (u) \mid u : u \in U\}$ is fuzzy set over U.

Γ_A^* is called the aggregate fuzzy set of the fuzzy soft set Γ_A.

The membership function $\mu\ \Gamma_A^*$ is defined as follows

$\mu\ \Gamma_A^* : U \to [0,1]$

$\mu\ \Gamma_A^*\ (U) = \frac{1}{|E|} \sum\ \mu\ c_{\Gamma_A}(x)\ \mu_{\gamma A(x)}(u)$

where $|E|$ is the cardinality of E.

2.8 T- CONORM:

Let S: [0,1] x [0,1] be function satisfying the following axioms

(1) S (a,0) = a, $\forall$ a $\in$ [0,1] (Identity)
(2) S (a,b) = s (b,a), $\forall$ a,b $\in$ [0,1] (commutativity)
(3) if $b_1 < b_2$, then s $(a,b_1) \leq$ s (a,b_2) $\forall$ a , b_1, b_2 $\in [0,1]$ (monotonicity)
(4) s (a ,s(b,c)) = s (s (a,b), c), $\forall$ a ,b,c $\in [0,1]$ (associativity

2.9 OPERATORS OF T-CONORM:

(1) Maximum operator : $S_M \{\mu_1 , \mu_2 , \ldots\ldots\ldots\ \mu_n \} = \max \{\mu_1 , \mu_2 , \ldots\ldots\ldots\ \mu_n \}$
(2) Product operator : $S_P \{\mu_1 , \mu_2 , \ldots\ldots\ldots\ \mu_n \} = 1 - \prod_{i=1}^{n} (1-\mu_i)$
(3) Operator Lukasiewicz t- conorm (bounded t- conorm) : $S_L \{\mu_1 , \mu_2 , \ldots\ldots\ldots\ \mu_n \} = \min \{ \sum_{i=1}^{n} \mu_i ,1 \}$.

3.ALGORITHM BASED ON T-CONORM OF FUZZY SOFT AGGREGATION:

STEP 1: Construct an fuzzy soft set Γ_A over U.

STEP 2: Find the cardinal set C Γ_A of Γ_A.

STEP 3: Find the aggregate fuzzy set Γ_A^* of Γ_A.

STEP 4: Compute S_M , S_p and S_L .

STEP 5: Find the alternative from this set that has the largest membership grade by max $\mu \Gamma_A^*(U)$.

3.1 APPLICATION OF DECISION MAKING PROBLEM IN AGRICULTURE:

Suppose U={D_1, D_2, D_3} be the set of three agricultural districts such as Thiruvannamalai, Cuddalore, Villupuram. Let P={p_1, p_2, p_3, p_4, p_5} be the five places in each districts. In each places, the farmers cultivated the same crops such as wheat, rice, sugarcane, oilseeds, and millets & pulses. By using the T-conorm of Fuzzy Soft Aggregation to find the best agricultural district.

Solution:

Let D_1 be the Thiruvannamalai district and let P={p_1, p_2, p_3, p_4, p_5} be the five places such as Polur, Cheyar, Arani, Chengam, Vandavasi. Let E={e_1, e_2, e_3, e_4} be the set of parameters of crops such as water facility, labours, electricity, nutrients & fertilizers.

STEP 1:

To find the Fuzzy Soft Aggregation Matrix, Cardinal set as follows:

Then [a_{ij}] is called mxn fuzzy soft matrix of the fuzzy soft set Γ_A over U as given below,

$$P_1 = \begin{bmatrix} 0 & 0 & 0 & 0.2 \\ 0.1 & 0.1 & 0.3 & 0.2 \\ 0.2 & 0.3 & 0.3 & 0 \\ 0.3 & 0 & 0.1 & 0.1 \end{bmatrix}, P_2 = \begin{bmatrix} 0.2 & 0 & 0.2 & 0.2 \\ 0.3 & 0.1 & 0.2 & 0.2 \\ 0.3 & 0.2 & 0.3 & 0 \\ 0.3 & 0.3 & 0.1 & 0.3 \end{bmatrix}, P_3 = \begin{bmatrix} 0 & 0.2 & 0.1 & 0.2 \\ 0.2 & 0.3 & 0.3 & 0 \\ 0.2 & 0 & 0.2 & 0.2 \\ 0.3 & 0.3 & 0.3 & 0 \end{bmatrix}$$

$$P_4 = \begin{bmatrix} 0.1 & 0.1 & 0.3 & 0.1 \\ 0.3 & 0 & 0.1 & 0.3 \\ 0.3 & 0.3 & 0 & 0.2 \\ 0.2 & 0 & 0.2 & 0.2 \end{bmatrix}, P_5 = \begin{bmatrix} 0.2 & 0.1 & 0.2 & 0.1 \\ 0.3 & 0 & 0.3 & 0.2 \\ 0.3 & 0.3 & 0.1 & 0.3 \\ 0.2 & 0 & 0.1 & 0 \end{bmatrix}$$

The cardinal set $c\Gamma_A$ of Γ_A of D_1 is computed as follows,

$c\Gamma_A(p_1)$ ={ $0.150/l_1$, $0.100/l_2$, $0.175/l_3$, $0.125/l_4$ }

$c\Gamma_A(p_2)$ ={ $0.275/l_1$, $0.150/l_2$, $0.200/l_3$, $0.175/l_4$ }

$c\Gamma_A(p_3)$ ={ $0.175/l_1$, $0.200/l_2$, $0.225/l_3$, $0.100/l_4$ }

$c\Gamma_A(p_4)$ ={ $0.225/l_1$, $0.100/l_2$, $0.150/l_3$, $0.200/l_4$ }

$c\Gamma_A(p_5)$ ={ $0.250/l_1$, $0.100/l_2$, $0.175/l_3$, $0.150/l_4$ }

The aggregate fuzzy set $M\Gamma_A$ of D_1 computed as follows,

$$M\Gamma_A^*(p_1) = \frac{1}{4}\begin{bmatrix} 0 & 0 & 0 & 0.2 \\ 0.1 & 0.1 & 0.3 & 0.2 \\ 0.2 & 0.3 & 0.3 & 0 \\ 0.3 & 0 & 0.1 & 0.1 \end{bmatrix} \times \begin{bmatrix} 0.150 \\ 0.100 \\ 0.175 \\ 0.125 \end{bmatrix} = \begin{bmatrix} 0.006 \\ 0.026 \\ 0.029 \\ 0.019 \end{bmatrix}$$

$$M\Gamma_A^*(p_2) = \frac{1}{4}\begin{bmatrix} 0.2 & 0 & 0.2 & 0.2 \\ 0.3 & 0.1 & 0.2 & 0.2 \\ 0.3 & 0.2 & 0.3 & 0 \\ 0.3 & 0.3 & 0.1 & 0.3 \end{bmatrix} \times \begin{bmatrix} 0.275 \\ 0.150 \\ 0.200 \\ 0.175 \end{bmatrix} = \begin{bmatrix} 0.033 \\ 0.043 \\ 0.043 \\ 0.050 \end{bmatrix}$$

$$M\Gamma_A^*(p_3) = \frac{1}{4}\begin{bmatrix} 0 & 0.2 & 0.1 & 0.2 \\ 0.2 & 0.3 & 0.3 & 0 \\ 0.2 & 0 & 0.2 & 0.2 \\ 0.3 & 0.3 & 0.3 & 0 \end{bmatrix} \times \begin{bmatrix} 0.175 \\ 0.200 \\ 0.225 \\ 0.100 \end{bmatrix} = \begin{bmatrix} 0.021 \\ 0.041 \\ 0.025 \\ 0.045 \end{bmatrix}$$

$$M\Gamma_A^*(p_4) = \frac{1}{4}\begin{bmatrix} 0.1 & 0.1 & 0.3 & 0.1 \\ 0.3 & 0 & 0.1 & 0.3 \\ 0.3 & 0.3 & 0 & 0.2 \\ 0.2 & 0 & 0.2 & 0.2 \end{bmatrix} \times \begin{bmatrix} 0.225 \\ 0.100 \\ 0.150 \\ 0.200 \end{bmatrix} = \begin{bmatrix} 0.025 \\ 0.036 \\ 0.035 \\ 0.029 \end{bmatrix}$$

$$M\Gamma_A^*(p_5) = \frac{1}{4}\begin{bmatrix} 0.2 & 0.1 & 0.2 & 0.1 \\ 0.3 & 0 & 0.3 & 0.2 \\ 0.3 & 0.3 & 0.1 & 0.3 \\ 0.2 & 0 & 0.1 & 0 \end{bmatrix} \times \begin{bmatrix} 0.250 \\ 0.100 \\ 0.175 \\ 0.150 \end{bmatrix} = \begin{bmatrix} 0.028 \\ 0.040 \\ 0.042 \\ 0.017 \end{bmatrix}$$

We have obtained,

$$\mu\, c\Gamma_A(P_1) = \begin{bmatrix} 0.006 \\ 0.026 \\ 0.029 \\ 0.019 \end{bmatrix}, \mu\, c\Gamma_A(P_2) = \begin{bmatrix} 0.033 \\ 0.043 \\ 0.043 \\ 0.050 \end{bmatrix}, \mu\, c\Gamma_A(P_3) = \begin{bmatrix} 0.021 \\ 0.041 \\ 0.025 \\ 0.045 \end{bmatrix}, \mu\, c\Gamma_A(P_4) = \begin{bmatrix} 0.025 \\ 0.036 \\ 0.035 \\ 0.029 \end{bmatrix}$$

$$\mu\, c\Gamma_A(P_4) = \begin{bmatrix} 0.028 \\ 0.040 \\ 0.042 \\ 0.017 \end{bmatrix}$$

STEP 2:

Let D_2 be the Cuddalore district and let P={p_1, p_2, p_3, p_4, p_5} be the five places such as Panruti, Neiveli, Nelikuppam, Vadalur, Chidambaram. Let E={e_1, e_2, e_3, e_4} be the set of parameters of crops such as water facility, labours, electricity, nutrients & fertilizers.

To find the Fuzzy Soft Aggregation Matrix, Cardinal set as follows:

Then [a_{ij}] is called mxn fuzzy soft matrix of the fuzzy soft set Γ_A over U as given below,

$$P_1 = \begin{bmatrix} 0.3 & 0.3 & 0.3 & 0.5 \\ 0.4 & 0.4 & 0.6 & 0.5 \\ 0.5 & 0.6 & 0.6 & 0.3 \\ 0.6 & 0.3 & 0.4 & 0.4 \end{bmatrix}, P_2 = \begin{bmatrix} 0.5 & 0.3 & 0.5 & 0.5 \\ 0.6 & 0.4 & 0.5 & 0.5 \\ 0.6 & 0.5 & 0.6 & 0.3 \\ 0.6 & 0.6 & 0.4 & 0.6 \end{bmatrix}, P_3 = \begin{bmatrix} 0.3 & 0.5 & 0.4 & 0.5 \\ 0.5 & 0.6 & 0.6 & 0.3 \\ 0.5 & 0.3 & 0.5 & 0.5 \\ 0.6 & 0.6 & 0.6 & 0.3 \end{bmatrix}$$

$$P_4 = \begin{bmatrix} 0.4 & 0.4 & 0.6 & 0.4 \\ 0.6 & 0.3 & 0.4 & 0.6 \\ 0.6 & 0.6 & 0.3 & 0.5 \\ 0.5 & 0.3 & 0.5 & 0.5 \end{bmatrix}, \; P_5 = \begin{bmatrix} 0.5 & 0.4 & 0.5 & 0.4 \\ 0.6 & 0.3 & 0.6 & 0.5 \\ 0.6 & 0.6 & 0.4 & 0.6 \\ 0.5 & 0.3 & 0.4 & 0.3 \end{bmatrix}$$

The cardinal set $c\Gamma_A$ of D_2 is computed as follows,

$c\Gamma_A$={ 0.450/l_1 , 0.400/l_2 , 0.475/l_3 , 0.425/l_4 }

$c\Gamma_A$={ 0.575/l_1 , 0.450/l_2 , 0.500/l_3 , 0.475/l_4 }

$c\Gamma_A$={ 0.475/l_1 , 0.500/l_2 , 0.525/l_3 , 0.400/l_4 }

$c\Gamma_A$={ 0.525/l_1 , 0.400/l_2 , 0.450/l_3 , 0.500/l_4 }

$c\Gamma_A$={ 0.550/l_1 , 0.400/l_2 , 0.475/l_3 , 0.450/l_4 }

The aggregate fuzzy set $M\Gamma_A^*$ of D_2 computed as follows

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.3 & 0.3 & 0.3 & 0.5 \\ 0.4 & 0.4 & 0.6 & 0.5 \\ 0.5 & 0.6 & 0.6 & 0.3 \\ 0.6 & 0.3 & 0.4 & 0.4 \end{bmatrix} \times \begin{bmatrix} 0.450 \\ 0.400 \\ 0.475 \\ 0.425 \end{bmatrix} = \begin{bmatrix} 0.153 \\ 0.210 \\ 0.220 \\ 0.188 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.5 & 0.3 & 0.5 & 0.5 \\ 0.6 & 0.4 & 0.5 & 0.5 \\ 0.6 & 0.5 & 0.6 & 0.3 \\ 0.6 & 0.6 & 0.4 & 0.6 \end{bmatrix} \times \begin{bmatrix} 0.575 \\ 0.450 \\ 0.500 \\ 0.475 \end{bmatrix} = \begin{bmatrix} 0.228 \\ 0.253 \\ 0.253 \\ 0.275 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.3 & 0.5 & 0.4 & 0.5 \\ 0.5 & 0.6 & 0.6 & 0.3 \\ 0.5 & 0.3 & 0.5 & 0.5 \\ 0.6 & 0.6 & 0.6 & 0.3 \end{bmatrix} \times \begin{bmatrix} 0.475 \\ 0.500 \\ 0.525 \\ 0.400 \end{bmatrix} = \begin{bmatrix} 0.201 \\ 0.243 \\ 0.213 \\ 0.255 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.4 & 0.4 & 0.6 & 0.4 \\ 0.6 & 0.3 & 0.4 & 0.6 \\ 0.6 & 0.6 & 0.3 & 0.5 \\ 0.5 & 0.3 & 0.5 & 0.5 \end{bmatrix} \times \begin{bmatrix} 0.525 \\ 0.400 \\ 0.450 \\ 0.500 \end{bmatrix} = \begin{bmatrix} 0.210 \\ 0.229 \\ 0.235 \\ 0.214 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.5 & 0.4 & 0.5 & 0.4 \\ 0.6 & 0.3 & 0.6 & 0.5 \\ 0.6 & 0.6 & 0.4 & 0.6 \\ 0.5 & 0.3 & 0.4 & 0.3 \end{bmatrix} \times \begin{bmatrix} 0.550 \\ 0.400 \\ 0.475 \\ 0.450 \end{bmatrix} = \begin{bmatrix} 0.213 \\ 0.240 \\ 0.258 \\ 0.180 \end{bmatrix}$$

We have obtained,

$$\mu\, c\Gamma_A(P_1) = \begin{bmatrix} 0.153 \\ 0.210 \\ 0.220 \\ 0.188 \end{bmatrix}, \mu\, c\Gamma_A(P_2) = \begin{bmatrix} 0.228 \\ 0.253 \\ 0.253 \\ 0.275 \end{bmatrix}, \mu\, c\Gamma_A(P_3) = \begin{bmatrix} 0.201 \\ 0.243 \\ 0.213 \\ 0.255 \end{bmatrix}, \mu\, c\Gamma_A(P_4) = \begin{bmatrix} 0.210 \\ 0.229 \\ 0.235 \\ 0.214 \end{bmatrix}$$

$$\mu\, c\Gamma_A(P_5) = \begin{bmatrix} 0.218 \\ 0.240 \\ 0.258 \\ 0.180 \end{bmatrix}$$

STEP 3:

Let D_3 be the Villupuram district and let P={p_1, p_2, p_3, p_4, p_5} be the five places such as Thirukovilur, Thindivanam, Vikravandi, Ulundurpettai, Gingee. Let E={e_1, e_2, e_3, e_4} be the set of parameters of crops such as water facility, labours, electricity, nutrients & fertilizers.

To find the Fuzzy Soft Aggregation Matrix, Cardinal set as follows:

Then [a_{ij}] is called mxn fuzzy soft matrix of the fuzzy soft set Γ_A over U as given below,

$$P_1 = \begin{bmatrix} 0.7 & 0.7 & 0.7 & 0.9 \\ 0.8 & 0.8 & 1 & 0.9 \\ 0.9 & 1 & 1 & 0.7 \\ 0.1 & 0.7 & 0.8 & 0.8 \end{bmatrix}, P_2 = \begin{bmatrix} 0.9 & 0.7 & 0.9 & 0.9 \\ 1 & 0.8 & 0.9 & 0.9 \\ 1 & 0.9 & 1 & 0.7 \\ 1 & 1 & 0.8 & 1 \end{bmatrix}, P_3 = \begin{bmatrix} 0.7 & 0.9 & 0.8 & 0.9 \\ 0.9 & 1 & 1 & 0.7 \\ 0.9 & 0.7 & 0.9 & 0.9 \\ 1 & 1 & 1 & 0.7 \end{bmatrix}$$

$$P_4 = \begin{bmatrix} 0.8 & 0.8 & 1 & 0.8 \\ 1 & 0.7 & 0.8 & 1 \\ 1 & 1 & 0.7 & 0.9 \\ 0.9 & 0.7 & 0.9 & 0.9 \end{bmatrix}, P_5 = \begin{bmatrix} 0.9 & 0.8 & 0.9 & 0.8 \\ 1 & 0.7 & 1 & 0.9 \\ 1 & 1 & 0.8 & 1 \\ 0.9 & 0.7 & 0.8 & 0.7 \end{bmatrix}$$

The cardinal set $c\Gamma_A$ of D_3 is computed as follows,

$c\Gamma_A$={ $0.850/l_1$, $0.800/l_2$, $0.875/l_3$, $0.825/l_4$ }

$c\Gamma_A$={ $0.975/l_1$, $0.850/l_2$, $0.900/l_3$, $0.875/l_4$ }

$c\Gamma_A$={ $0.875/l_1$, $0.900/l_2$, $0.925/l_3$, $0.800/l_4$ }

$c\Gamma_A$={ $0.925/l_1$, $0.800/l_2$, $0.850/l_3$, $0.900/l_4$ }

$c\Gamma_A$={ $0.950/l_1$, $0.800/l_2$, $0.875/l_3$, $0.850/l_4$ }

The aggregate fuzzy set $M\Gamma_A$ of D_3 computed as follows,

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.7 & 0.7 & 0.7 & 0.9 \\ 0.8 & 0.8 & 1 & 0.9 \\ 0.9 & 1 & 1 & 0.7 \\ 1 & 0.7 & 0.8 & 0.8 \end{bmatrix} \times \begin{bmatrix} 0.850 \\ 0.800 \\ 0.875 \\ 0.825 \end{bmatrix} = \begin{bmatrix} 0.628 \\ 0.734 \\ 0.754 \\ 0.693 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.9 & 0.7 & 0.9 & 0.9 \\ 1 & 0.8 & 0.9 & 0.9 \\ 1 & 0.9 & 1 & 0.7 \\ 1 & 1 & 0.8 & 0.1 \end{bmatrix} \times \begin{bmatrix} 0.975 \\ 0.850 \\ 0.900 \\ 0.875 \end{bmatrix} = \begin{bmatrix} 0.768 \\ 0.813 \\ 0.813 \\ 0.855 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.7 & 0.9 & 0.8 & 0.9 \\ 0.9 & 1 & 1 & 0.7 \\ 0.9 & 0.7 & 0.9 & 0.9 \\ 1 & 1 & 1 & 0.7 \end{bmatrix} \times \begin{bmatrix} 0.875 \\ 0.900 \\ 0.925 \\ 0.800 \end{bmatrix} = \begin{bmatrix} 0.721 \\ 0.793 \\ 0.743 \\ 0.815 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.8 & 0.8 & 1 & 0.8 \\ 1 & 0.7 & 0.8 & 1 \\ 1 & 1 & 0.7 & 0.9 \\ 0.9 & 0.7 & 0.9 & 0.9 \end{bmatrix} \times \begin{bmatrix} 0.925 \\ 0.800 \\ 0.850 \\ 0.900 \end{bmatrix} = \begin{bmatrix} 0.738 \\ 0.766 \\ 0.783 \\ 0.742 \end{bmatrix}$$

$$M\Gamma_A^* = \frac{1}{4}\begin{bmatrix} 0.9 & 0.8 & 0.9 & 0.8 \\ 1 & 0.7 & 1 & 0.9 \\ 1 & 1 & 0.8 & 1 \\ 0.9 & 0.7 & 0.8 & 0.7 \end{bmatrix} \times \begin{bmatrix} 0.950 \\ 0.800 \\ 0.875 \\ 0.850 \end{bmatrix} = \begin{bmatrix} 0.741 \\ 0.788 \\ 0.825 \\ 0.678 \end{bmatrix}$$

We have obtained

$$\mu\, c\Gamma_A(P_1) = \begin{bmatrix} 0.628 \\ 0.734 \\ 0.754 \\ 0.693 \end{bmatrix}, \mu\, c\Gamma_A(P_2) = \begin{bmatrix} 0.768 \\ 0.813 \\ 0.813 \\ 0.855 \end{bmatrix}, \mu\, c\Gamma_A(P_3) = \begin{bmatrix} 0.721 \\ 0.793 \\ 0.743 \\ 0.815 \end{bmatrix}, \mu\, c\Gamma_A(P_4) = \begin{bmatrix} 0.738 \\ 0.766 \\ 0.783 \\ 0.742 \end{bmatrix}$$

$$\mu\, c\Gamma_A(P_5) = \begin{bmatrix} 0.741 \\ 0.788 \\ 0.825 \\ 0.678 \end{bmatrix}$$

STEP 4:

By using the T-Conorm operator, obtained the values of S_M ,S_P ,S_L.

$$D_1(S_M) = \begin{bmatrix} 0.033 \\ 0.043 \\ 0.043 \\ 0.050 \end{bmatrix}, D_1(S_P) = \begin{bmatrix} 0.108 \\ 0.173 \\ 0.162 \\ 0.150 \end{bmatrix}, D_1(S_L) = \begin{bmatrix} 0.113 \\ 0.186 \\ 0.174 \\ 0.160 \end{bmatrix}$$

$$D_2(S_M) = \begin{bmatrix} 0.228 \\ 0.253 \\ 0.258 \\ 0.275 \end{bmatrix}, D_2(S_P) = \begin{bmatrix} 0.675 \\ 0.738 \\ 0.740 \\ 0.718 \end{bmatrix}, D_2(S_L) = \begin{bmatrix} 1 \\ 0.935 \\ 1 \\ 1 \end{bmatrix}$$

$$D_3(S_M) = \begin{bmatrix} 0.768 \\ 0.813 \\ 0.825 \\ 0.855 \end{bmatrix}, D_3(S_P) = \begin{bmatrix} 0.998 \\ 0.999 \\ 0.997 \\ 0.999 \end{bmatrix}, D_3(S_L) = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

STEP 5:

Find the best alternative from this set that has the largest membership grade.

i.e.,D_3 is the best agricultural district .

$D_3 > D_2 > D_1$

CONCLUSION:

Agricultural plays a vital role in our country.In this paper, examines the definitions of Fuzzy Soft Aggregation and T-Conorm of Fuzzy Soft Aggregation in Multi- Criteria Decision Making. Finally, an illustrated example was presented to show the applicability of the T-Conorm of Fuzzy Soft Aggregation in the field of agriculture to find the best agricultural district.

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