# A Novel approach of Crop selection using Soft Set Theory

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**Abstract**

Soft sets have been used extensively for decision making problems. Research on soft sets based decision making has received much attention in recent years. Decision making is very sensitive in today's fast moving world. It takes significant role in the field of selection of best fit in different alternatives. Different parameters and their values help decision makers to take right decision at right time. This paper brings in awareness on decision making model in crop selection by using soft set theory that helps to identify the crop to be cultivated by a farmer which suits best of his expectations by the questionnaire and it can be optimized by Relative closeness Method. In this paper we propose the Weight Aggregation Analysis algorithm in decision making for selecting a suitable crop to be cultivated depending on the available features using Relative closeness Method.

**Keywords:** Soft Set, Quick reduct, K-Means, Weight Aggregation Analysis Algorithm, Relative Closeness Method .

## I. INTRODUCTION

Agriculture plays an major role directly or indirectly in improving economy of developing countries like India, China, Brazil etc. In fact, one side agriculture provides food security to the people and on the other hand it provides raw materials to agro based industries. The growth of human civilization over the ages was mainly impact by the advancement in agriculture sector. The rise and fall civilizations like Indus valley civilization, Harappan civilization were based on the progression and regression in agriculture. Even though human race has progressed from farming to industrialization and to an era of technology, agriculture is the one sector that will never lose its significance due to its impact. The product and outcome of agriculture is very much necessary for the sustainment of human race.

### 1.1 Soft Set Theory

Soft set theory has a rich potential for applications in several directions which include the smoothness of function, game theory, operations research, Riemann integration, Perron integration, probability theory, and measurement theory had been shown by Molodtsov in his pioneer work and their applications of soft set to stability and regularization. In this section, define the some basic notation of soft set theory introduced by Molodtsov and some useful definition from Maji et al.,[12]. Here, U to be an initial universal set and E to be a set of parameters and A, B subset of E.

**Definition 1(Soft Set)**

A pair (F, E) is called a soft set (over U) if and only if f is a mapping of E into the set of all subsets of the set U. In other words, the soft set is a parameterized family of subsets of the set U. Every set F (e), e ε E, from this family may be considered as the set of e-approximate elements of the soft set. Let us consider the following example.

**Ex:1** A soft set (F, E) describes the attractiveness of the bikes which Mr. x is going to buy. U is the set of bikes under consideration. E is the set of parameters. E= (e1=stylish; e2=heavy duty; e3=light; e4=steel body; e5=cheap; e6=good mileage; e7=easily started; e8=long driven; e9=costly; e10=fiber body)

In this case, to define a soft set means to point out stylish bikes, heavy duty bikes, and so on.

**Definition 2 (Operation with Soft Sets)**

Suppose a binary operation denoted by *, is defined for all subsets of the set U. Let (F, A) and (G, B) be two soft sets over U. Then the operation * for the soft set is defined in the following way: (F, A) *(G, B) = (H, AXB) Where H (α , β)=F(α)*G(β), α ε A, β ε B and A×B is the Cartesian product of the sets A and B.

**Definition 3 (Union of Soft Set or OR function)**

Let E = {e1,e2,e3…en} be a set of parameters. The union of softest is defined by $\mu_{AUB}(x)=\max(\mu_A(x),\mu_B(x))$ for all i.

**Definition 4 (Intersection of Soft Set or AND function)**

Let E = {e1,e2,e3…en} be a set of parameters. The Intersection of softest is defined by $\mu_{A\wedge B}(x)=\min(\mu_A(x),\mu_B(x))$ for all i.

This paper gives the overview of the crop cultivation based on the desired features of the farmers acceptance. It divides into Five sections, The First section gives Introduction. The Second section focuses Review of the related works. Third section describes the Algorithm and Proposed method. The fourth section presents Experimental work and Finally, in the last section the conclusion are presented.

## II . Review of Related Work

This section focuses Soft set and its applications.

**P.K. Maji et al.,** defined the concept of the core is twofold. First, it can be used as a basis for computation of all reducts, then the core is included in every reduct, and its computation is straightforward. Secondly. the core can be interpreted as the set of the most characteristic part of knowledge, which cannot be eliminated when reducing the knowledge[12].

**F.Feng et al.,** discussed the application of interval-valued fuzzy soft sets to solve decision making problems [5]. They contributed to this research direction by proposing flexible schemes for decision making based on (weighted) interval-valued fuzzy soft sets.

**K.V.Babitha and J.J. Sunil.,** extended the concepts of relations and functions in soft set theory context. They have also made an attempt to explain the equivalent version of some theories on relations and functions in the background of soft sets [3].

**Z.Kong et al.** described the problems of suboptimal choice and added parameter set are discussed in the reduction of soft sets. A new definition of normal parameter reduction was introduced[10].

**D.Chen et al.,** pointed out some incorrect and unreasonable statements. The idea of employing the attributes reduction in rough set theory to reduce the number of parameters to compute the optimal objects seems meaningless. [4] the basic difference between parameterization reduction of soft sets and attributes reduction in rough sets is also mentioned.

**M.I.Ali et al.,** introduced some new notions such as the restricted intersection, the restricted union, the restricted difference and the extended intersection of two soft sets. Moreover, They improved the notion of complement of a soft set, and prove that certain De Morgan's laws hold in soft set theory with respect to these new definitions [1].

**T.Herawan et al.,** proposed the several algorithms exist to address the issues concerning reduction of soft sets. The most recent concept of normal parameter reduction is introduced in [6], which overcomes the problem of suboptimal choice and added parameter set of soft sets.

**Z.Xiao et al.,** discussed an appropriate definition of soft information is put forward. In order to discover soft sets application in recognizing soft information patterns, firstly analyze the basic definition of soft sets, make use of table to describe soft sets and give the conception of soft sets reduction according to the characters of soft sets[17][18].

**Manav Singhal et al.,**[13] described a mobile based application, namely Krishi Ville, for farmers. This application takes care of the updates of various agricultural commodities, agricultural news updates, weather forecast updates etc.

**Pethalakshmi et al.,**[14] studied and reviewed the concept of the soft set theory, and their development in the various fields of its existing literature is carried out such as Medical, Agriculture and Business etc.,

## III. METHODOLOGY AND PROPOSED ALGORITHM

In this section, presents an algorithm for crop cultivation using Soft Set Theory and various optimization methods are discussed. Here a questionnaire is prepared which is focusing on common features in crop cultivation. Thus obtained data is to be used in the further data analysis and research process. The Model questionnaire of the crop cultivation includes the following features which is tabulated in Table1. This questionnaire helpful to take the information table from the different farmers suggestions for crop cultivation process.

Table 1: Sample Survey Features of the Various Crops

| Sl.No | Features | Sugarcane | Paddy | Maize | Turmeric | Tomato | Cotton | Groundnut | Plantain | Tapioca |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Minimum Capital | 6 | 4 | 7 | 5 | 7 | 7 | 6 | 2 | 7 |
| 2 | Short duration(yield) | 5 | 2 | 6 | 3 | 6 | 6 | 5 | 1 | 4 |
| 3 | Minimum irrigation | 4 | 1 | 4 | 3 | 3 | 2 | 2 | 2 | 2 |
| 4 | Low manpower | 5 | 3 | 2 | 4 | 3 | 4 | 4 | 3 | 3 |
| 5 | Easy cultivation | 4 | 2 | 4 | 3 | 4 | 2 | 3 | 1 | 2 |
| 6 | Minimum Fertilizer | 4 | 3 | 2 | 4 | 5 | 5 | 4 | 4 | 3 |
| 7 | Low risk | 5 | 2 | 4 | 2 | 4 | 3 | 3 | 3 | 2 |
| 8 | Easy harvesting | 6 | 3 | 3 | 4 | 5 | 2 | 2 | 5 | 3 |
| 9 | Marketing facilities | 7 | 5 | 6 | 6 | 7 | 4 | 7 | 7 | 6 |
| 10 | High profit | 8 | 6 | 6 | 7 | 7 | 6 | 7 | 8 | 7 |

**A)Problem description**

Regarding the decision making problem involving Ten features of each crop $F_i$(i=1,2,….10) and Nine Crops $C_j$ =(j=1,2,…9) all the crop feature values are the maximum number of acceptance of the Farmers in cultivation. The attribute weight value is calculated the Maximum value of the features. Try to calculate the Relative closeness($R_i$) value of the each crop and make the effective decision depending on the maximum value of $R_i$ for the selection of the crop.

**B)K-Means Algorithm**

Partitioning algorithms construct partitions of a database of N objects into a set of k clusters. The construction involves determining the optimal partition with respect to an objective function. K-Means algorithms, where each cluster is represented by the center of gravity of the cluster[22]. The basic algorithm is given below.1.Select k points as initial centroids.2.Repeat3.Form k clusters by assigning all points to the closest centroid.4.Recompute the centroid of each cluster5.until the centroids don't change.

**C)Relative Closeness Method**

This is the Optimization tool for effective decision making. For calculating the relative closeness, first determine the weight value, this value is multiplied by the features of the crop and also find the ideal score and Negative of each crop. Relative closeness($R_i$) not only indicates how good the solution is but also corresponds to how close the features to each crop. This can be evaluated by $R_i = NS_i'/(IS_i + NS_i')$

**D) Proposed WAA Algorithm:**

In this section, the proposed algorithm for crop selection is detailed below.

**STEP 1:** Select the group of crops depending on decision of Farmer by applying K-Means algorithm.

**STEP 2:** Construct the All Features Weight Analysis Aggregation Table by applying maximum weight for the decision parameters. Si= eijVfi*Wi. The Weights (Wi) are Max(f1)=0.7, Max(f2) = 0.7 and Max(f3) = 0.8.

**STEP 3:**Determine the All Features Relative closeness value of each crop.

**STEP 4:** Finally crop selection can be optimized by Maximum value of $R_i$ using AFRC Method. The decision is $S_k$ if $S_k$=Max $R_i$.

**STEP 5:** The decision is represented by Relative closeness Chart.

## IV. EXPERIMENTAL ANALYSIS

In this section analyzes which crop is to be cultivated by the farmer. Here we get the acceptance from 100 Farmers in Nallampatti village. The content or input of the Table 2 can be created by the choice of the farmers decision from the Table 1 with the maximum acceptance of the farmer.

Table 2: Selected Features Information Table

| Features/Crops | Minimum Capital (f1) | Flexible Marketing (f2) | High Yields (f3) |
|---|---|---|---|
| C1(Sugarcane) | 6 | 7 | 8 |
| C2(Paddy) | 4 | 5 | 6 |
| C3(Maize) | 7 | 6 | 6 |
| C4(Turmeric) | 5 | 6 | 7 |
| C5(Tomato) | 7 | 7 | 7 |
| C6(Cotton) | 7 | 4 | 6 |
| C7(Groundnut) | 6 | 7 | 7 |
| C8(Plantain) | 2 | 7 | 8 |
| C9(Tapioca) | 7 | 6 | 7 |

**STEP 1: Select the group of crops depending on all the features by applying K-Means algorithm with** k=3.

After applying the K –Means algorithm and the final Clusters are cluster1 = {C1,C4,C5,C7}; cluster2 = {C2,C8} and cluster3 = {C3,C6,C9}.The above cluster values are tabulated in Table 3. This Table 3 contains three input features with one " decision value" column which can be yielded from K-Means algorithm.

Table 3: Decision Table

| Features/ Crops | Minimum Capital (f1) | Flexible Marketing (f2) | High Yields (f3) | Decision Value |
|---|---|---|---|---|
| C1(Sugarcane) | 6 | 7 | 8 | c1 |
| C2(Paddy) | 4 | 5 | 6 | c2 |
| C3(Maize) | 7 | 6 | 6 | c3 |
| C4(Turmeric) | 5 | 6 | 7 | c1 |
| C5(Tomato) | 7 | 7 | 7 | c1 |
| C6(Cotton) | 7 | 4 | 6 | c3 |
| C7(Groundnut) | 6 | 7 | 7 | c1 |
| C8(Plantain) | 2 | 7 | 8 | c2 |
| C9(Tapioca) | 7 | 6 | 7 | c3 |

**STEP 2: Construct the AFWA Table** by applying the maximum weight of the decision parameters. Si= eijVfi*Wi. The Weights (Wi) are Max(f1)=0.7, Max(f2) = 0.7 and Max(f3) = 0.8

**STEP 3:Determine the Relative closeness value($R_i$)** of the parameters for each crop by using the Ideal score(ISi)= Max(C1) and Negative score(NSi') =Min(C1). $R_i = NS_i'/(IS_i + NS_i')$ and its tabulated in Table 4.

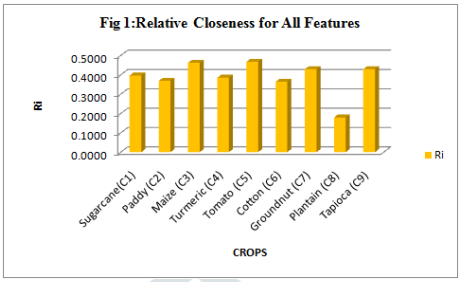
able 4: AF Weight Aggregation Analysis Table & Relaive Coseness Metho

| Crops | S1 | S2 | S3 | Isi | Nsi | Ri |
|---|---|---|---|---|---|---|
| ugarcane(C1) | 42 | 49 | 64 | 64 | 42 | 0.3962 |
| addy (C2) | 28 | 35 | 48 | 48 | 28 | 0.3684 |
| laize (C3) | 49 | 42 | 48 | 49 | 42 | 0.4615 |
| urmeric (C4) | 35 | 42 | 56 | 56 | 35 | 0.3846 |
| omato (C5) | 49 | 49 | 56 | 56 | 49 | **0.4667** |
| otton (C6) | 49 | 28 | 48 | 49 | 28 | 0.3636 |
| roundnut (C7) | 42 | 49 | 56 | 56 | 42 | 0.4286 |
| lantain (C8) | 14 | 49 | 64 | 64 | 14 | 0.1795 |
| apioca (C9) | 49 | 42 | 56 | 56 | 42 | 0.4286 |

**STEP 4: Finally crop selection can be optimized by Maximum value of $R_i$ using AFRC Method.**

The decision is $S_k$ if $S_k$=Max $R_i$ .From the above Table 5, Crop Tomato (C5) has First Maximum Value, Maize (C3) has second Maximum Value and Groundnut (C7) has Third Maximum Value. Thus proved, Tomato (C5) is suitable for cultivation depending on the farmers decision.

**STEP 5: The decision is represented by Relative closeness Chart and its represented in Fig1.**




## V. CONCLUSION

Integration of science and technology in agriculture is considered a judicious action. The proposed work of this paper, K-Means algorithm was applied to group the crops which is taken from the questionnaire depending on the motivating features of the Farmers. To make the effective decision for the particular crop selection done by the proposed Weight Aggregation analysis algorithm, depending on the features which can be optimized by Relative Closeness($R_i$) Method. In this crop data set among 9 crops Tomato crop was selected for cultivation and also observed Crop C5(Tomato) & C7(Groundnut) coming under the same group which are applying the K-means algorithm. Further research work limits to presenting the applicability of the above said technology to improve agricultural conditions.

## REFERENCES

[1]M.I.Ali,"Another view on reduction of parameters insoftsets", Appl.SoftComput. vol.12,no.6,pp.1814-1821,2011.
[2]S.Alkhazaleh., "Soft Multisets Theory", Applied Mathematical Sciences, Vol.5, No.72, Pp. 3561-3573.2011.
[3]K.V.Babitha & J.J. Sunil, "Soft Set Relations and Functions", Computers and Mathematics with Applications, Vol.60, No.7, Pp.1840- 1849,2010.
[4]D.Chen, E.C.C. Tsang, D.S.Yeung, and X.Wang, "The parameterization reduction of soft sets and its applications," Comput.Math.Appl.,vol.49, nos. 5-6, pp.757-763, 2005.
[5]F.Feng, C.Li, B.Davvaz, and M.I.Ali,"Soft sets combined with fuzzy sets and rough sets:A tentative approach," Soft Comput., vol.14,no.9,pp.899-911,2008.
[6]T.Herawan and M. M. Deris,"A soft set approach for association rules mining," Knowl-Based Syst., vol.24,no.1,pp.186-195,2009.
[7]Jhunjhunwala.Ashok; Umadikar, Jayalakshmi; Prashant, Suma "A New Personalized Agriculture Advisory System", Wireless Conference (EW), Proceedings of the 2013 19th European Year: 2013.
[8]Y.Jiang,Y.Tang,Q.Chen,H.Liu, and J.Tang,"Extending fuzzy soft sets with fuzzy description logics," Knowl.-Based Syst., vol.24,no.7,pp.1096-1107,2011.
[9]F.Karaaslan and S.Karatas, " OR and AND-products of if p- intuitionistic fuzzy soft sets and their application in decision-making," J. Intell, Fuzzy Syst., vol.31, no.3, pp.1427-1424, 2016.
[10]Z.Kong, L.Gao, andL.Wang, "Comment on 'A fuzzy soft set theoretic approach to decision making problems,"J.Comput.Appl.Math.,vol.223,no.2,pp.540-542,2009.
[11]Leila Naderloo et al., Application of ANFIS to predict crop yield based on different energy inputs" in ELSEVIER, vol.45, pp.1406-1413, march 2012.
[12]P.K. Maji, R.Biswas, and A.R.Roy, "Soft set theory",Comput.Math.Appl.,Vol.45,nos.4-5,pp.555-562,2003.
[13]Manav Singhal, Kshitij Verma, Anupam Shukala, "Krishi Ville-Android based Solution for Indian Agriculture", Advanced Networks and Communication Systems (ANTS) 2011,Bangalore, pp.134-139, 26th-27th November 2011.
[14]A.Pethalakshmi, " Soft Set Theory – A Review",National Conference on Mobile technologies & Big data Analytics, 2018.
[15]Miss.Sarika A.Hajare et al., "Fuzzy based approach for weather advisory system" in IOSR Journal of Computer engineering(IOSR- JCE),Vol.17,No.3,PP 90-95, 2015.
[16]K.Thangavel, P. Jaganathan, A. Pethalakshmi, M.Karnan,"Effective Classification with Improved Quick Reduct For Medical Database Using Rough System", BIME Journal, Volume (05), Issue (1), Dec., 2005.
[17]Z.Xiao, "Exclusive Disjunctive Soft Sets",Computers & Mathematics with Applications, Vol.59, Pp.2128-2137,2012.
[18]W.Xu,Z.Xiao, X.Dang, D.Yang, and X.Yang,"Financial ratio selection for business failure prediction using soft set theory,"Knowl-Based Syst., vol.63,pp.59 67,jun.2014.
[19]Yanbo Huang et al., "Development of Soft computing and applications in agricultural and biological engineering", in ELSEVIER, vol.71, pp.107-127, 2010.