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THE ROLE OF POSSIBILITY INTUITIONISTIC FUZZY SOFT SETS ON THE SELECTION OF APPROPRIATE MACHINE FOR PADDY HARVESTING

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ABSTRACT

P*ossibility Intuitionistic Fuzzy Soft Sets plays a vital role on decision making applications. In this paper, based on the survey on various machines for Paddy harvesting in agricultural research centre at Kaveripattinam, Paiyur, Krishnagiridistrict and by using the response of more than 100 farmers in Manjamedu, Arasampatti and Pochampalli villages in Krishnagiri district of Tamilnadu, the best machine suitable for Paddy harvesting by using some logical operations on Intuitionistic Fuzzy Soft Sets has been identified. This paper will be a boost for farmers on the basis of their income security.*

Keywords: *Waking type small rise harvester, Mini combine harvester, Three row reaper Binder, Two row reaper Binder, Mini reaper Binder(AMS-RB100), Possibility Intuitionistic fuzzy soft set.*

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1 INTRODUCTION

Agriculture has been transformed by technology to increase output and quality ofgoods. Most of the farmers do not know the advantages of Mechanical Power andMachinery in Agriculture and hence they incur prot only in small amounts. Tractorthat was once the epitome of technological genius in the agriculture sector is old news. The strength of modern equipment has transformed the agriculture industry for thebetter. The concept of fuzzy set and fuzzy set operations were rst introduced by L.A. Zadeh in 1965 [5]. Then Atanassov [2] deed the concept of intuitionistic fuzzy setwhich is more general than fuzzy set. Molodtsov [5] initiated the theory of soft sets asa new mathematical tool for dealing with uncertainties which traditional mathematical tools cannot handle. Alkhazaleh and Salleh [1] dened the concept of soft expert set and they gave an application of this concept to decision making. Also Maji *et al.* [3,4] studied the theory of soft sets and introduced the concepts of fuzzy soft set andintuitionistic fuzzy soft set. Intuitionistic Fuzzy Soft Sets plays a vital role on decision1making applications. In this paper, based on the survey on various machines for Paddyharvesting in agricultural research centre at Kaveripattinam, Paiyur, Krishnagiri district and by using the response of more than 100 farmers in Manjamedu, Arasampatti and Pochampalli villages in Krishnagiri district of Tamilnadu, it has been identified that the best machine suitable for Paddy harvesting by using some logical operationson Intuitionistic Fuzzy Soft Sets. This paper will be a boost for farmers on the basisof their income security.

2. PRELIMINARIES

In this section we recall some definitions regarding intuitionistic fuzzy soft set and apossibility fuzzy soft set required in this paper.

Definition 2.1: Let U be a non-empty set. A **Fuzzy set** in U is a function with domain U and values in the closed unit interval I = [0,1].

Definition 2.2: (2) An **Intuitionistic Fuzzy Set.**A in a nonempty set U (a universe of discourse) is an object having the form A = $\{x, \mu_A(x), \gamma_A(x)$: x ∈U$\}$. Where the functions $\mu_A(x)$: U →[0,1], $\gamma_A(x)$: U →[0,1], denotes the degree of membership and degree of non-membership of each element x ∈U to the set A respectively, and $0 \leq \mu_A(x) + \gamma_A(x) \leq 1$ for all x ∈U.

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Definition 2.3: (5) Let U be an initial universe set and E be the set of parameters and A be the subset of E. Let P(U) denotes the power set of U, then the pair (F,A) is called a **Soft set** over U where F is a mapping given by F:A →P(U).

Definition 2.4: (3) Let U be an initial universe set and E be the set of parameters. Let I^Udenotes the collection of all intuitionistic fuzzy subsets of U. Let A ⊆E, apair (F,E) is called a **Fuzzy Soft Set** over U, where F is a mapping givenby F : A → I^U.

Definition 2.5: (4) Let U be an initial universe set and E be the set of parameters. Let IF^Udenotes the collection of allintuitionistic fuzzy subsets of U. Let A ⊆E, a pair (F,A) is called**Intuitionistic Fuzzy Soft Set** over U, where F is a mapping given by F: A →IF^U.

Definition 2.6: (1) Let U = $\{x_1,x_2,x_3,\ldots x_n\}$ be the universal set of elements and E = $\{e_1,e_2,e_3,\ldots,e_m\}$ be the universal set of parameters. The pair (U, E) will be called a soft universe. Let F: E→$(I\times I)^U\times I^U$, where $(I\times I)^U$is the collection of all intuitionistic fuzzy subsets of U and $I^U$is the collection of all fuzzy subsets of U. Let P be a fuzzy subset of E, P: E →I^U. Let F_P: E →$(I\times I)^U\times I^U$be a function defined as follows:
$F_P(e_i)$=(F(e)(x),P(e)(x)), where F(e)(x)=(μ(x),$\gamma(x)$),P(e)(x)=$\gamma(x), x\in U$. Then $F_p$is called a Possibility Intuitionistic

Fuzzy Soft Set (PIFSSin short) over the soft universe (U, E). For each parameter e_i,$F_P(e_i)$,=(F$e_i(x), P(e_i)(x)$) indicates not only the degree of belongingness of the elements of U in F(e_i), but also the degree of possibility of belongingness of the elements of U in F(e_i), which is represented by P(e_i), so one can write $F_P(e_i)$ as follows:
$F_P(e_i)$ = {($\frac{x_1}{F(e_i)(x_1)}$,P(e_i)(x_1),($\frac{x_2}{F(e_i)(x_2)}$, $P(e_i)(x_2)$,…,($\frac{x_n}{F(e_i)(x_n)}$, $P(e_i)(x_n)$)}, ∀x ∈U.

3 APPLICATION OF POSSIBILITY INTUITIONISTIC FUZZY SOFT SET:

The aim of this paper is fulfilled by a survey at Kaveripattinam, Paiyur, Krishnagiridistrict and by using the response of more than 100 farmers from the same place.

Let U = $\{x_1, x_2, x_3, x_4, x_5\}$ be the universal set and E = $\{e_1, e_2, e_3, e_4, e_5, e_6, e_7\}$ be the set of parameters, where

Types of machine for Paddy Harvesting (Universal set of U**):**

x_1= Walking type small rise harvester
x_2= Mini combine harvester
x_3=Three row reaper Binder
x_4= Two row reaper Binder
x_5= Mini reaper Binder(AMS-RB100).

Criteria (Parameter set E):

e_1 = Power
e_2= Cutting width
e_3= Fuel Consumption
e_4= Capacity
e_5= Number of Operator
e_6= Total Loss
e_7= Working Productivity.

Construction of Possibility Intuitionistic Fuzzy Soft Set:
For the purpose of ascertaining membership function, non-membership function and degree of possibility of belongingness, the problems of the crop cultivators about the eight criteria for each mode of machine. The counts of membership function of each criterion for all the five modes were added and the proportion of count of each mode to the total was ascertained to fix degree of possibility of belongingness.
Therefore the Possibility Intuitionistic Fuzzy Soft Setfor this model are,

$F_P(e_1)$={($\frac{x_1}{0.71,0.25}$,0.85),($\frac{x_2}{0.82,0.13}$,0.93),($\frac{x_3}{0.63,0.35}$,0.62),($\frac{x_4}{0.50,0.56}$,0.43),($\frac{x_5}{0.63,0.35}$,0.62)}
$F_P(e_2)$= {($\frac{x_1}{0.75,0.21}$,0.73),($\frac{x_2}{0.93,0.03}$,0.92),($\frac{x_3}{0.61,0.31}$,0.71),($\frac{x_4}{0.52,0.41}$,0.43),($\frac{x_5}{0.71,0.23}$,0.71)}
$F_P(e_3)$={($\frac{x_1}{0.73,0.21}$,0.72),($\frac{x_2}{0.83,0.21}$,0.65),($\frac{x_3}{0.73,0.26}$,0.91),($\frac{x_4}{0.32,0.42}$,0.82),($\frac{x_5}{0.75,0.23}$,0.92)}
$F_P(e_4)$={($\frac{x_1}{0.51,0.23}$,0.5),($\frac{x_2}{0.83,0.21}$,0.8),($\frac{x_3}{0.76,0.21}$,0.7),($\frac{x_4}{0.92,0.04}$,1),($\frac{x_5}{0.72,0.21}$,0.7)}
$F_P(e_5)$= {($\frac{x_1}{0.8,0.13}$,1),($\frac{x_2}{0.72,0.21}$,0.82),($\frac{x_3}{0.85,0.13}$,1),($\frac{x_4}{0.81,0.12}$,1),($\frac{x_5}{0.85,0.01}$,1)}
$F_P(e_6)$={($\frac{x_1}{0.83,0.12}$,0.83),($\frac{x_2}{0.71,0.21}$,0.75),($\frac{x_3}{0.79,0.20}$,0.86),($\frac{x_4}{0.76,0.14}$,0.76),($\frac{x_5}{0.82,0.13}$,0.81)}
$F_P(e_7)$ = {($\frac{x_1}{0.83,0.11}$,0.6),($\frac{x_2}{0.93,0.02}$,0.92),($\frac{x_3}{0.75,0.12}$,0.81),($\frac{x_4}{0.53,0.42}$,0.73),($\frac{x_5}{0.73,0.15}$,0.83)}

Algorithm

1. Input the set A⊆E of choice of parameters of the farmer X
2. Consider the reduced Intuitionistic fuzzy soft set
3. Consider the tabular representation of membership function
4. Compute the comparison table membership function
5. Compute the membership score
6. Consider the tabular representation of non-membership function
7. Compute the comparison table non-membership function
8. Compute the membership non-membership score
9. Compute the final score by subtracting non-membership score from member ship score
10. Find the maximum score, if it occurs in ith row thenx_i will suits the farmer X willchoose the machine.

It is aimed to find the best machine suitable for paddy harvesting to the farmer X on the basis of his income security.

Step-1: Suppose the farmer X wishes to have the set of parameter as A = $\{e_2, e_3, e_4, e_6\}$ then the following operations are considered:

Step-2:

1 For membership function:

$\alpha(e_j)=\mu_i+\gamma_i-\mu_i\gamma_i$

2 For non-membership function:

$\beta(e_j) = \vartheta_i\gamma_i$, for i=1, 2, 3, 4, 5 & j=2, 4, 5, 7

These two operations are taken to ascend the membership value and descend the non-membership value of F(e_j) on the basis of the degree of preference of the farmer X. Then the PIFSS$F_P(e_j)$ reduced to an intuitionistic fuzzy soft set $\Psi(e_j)$ given as follows:

$\Psi(e_2) = \{\frac{x_1}{0.93,0.15}, \frac{x_2}{0.99,0.03}, \frac{x_3}{0.89,0.22}, \frac{x_4}{0.73,0.18}, \frac{x_5}{0.92,0.16}\}$

$\Psi(e_3) = \{\frac{x_1}{0.92,0.15}, \frac{x_2}{0.94,0.14}, \frac{x_3}{0.98,0.24}, \frac{x_4}{0.88,0.34}, \frac{x_5}{0.98,0.21}\}$

$\Psi(e_4) = \{\frac{x_1}{0.76,0.12}, \frac{x_2}{0.97,0.17}, \frac{x_3}{0.93,0.15}, \frac{x_4}{1,0.04}, \frac{x_5}{0.92,0.15}\}$

$\Psi(e_6) = \{\frac{x_1}{0.97,0.10}, \frac{x_2}{0.93,0.16}, \frac{x_3}{0.97,0.17}, \frac{x_4}{0.94,0.11}, \frac{x_5}{0.97,0.11}\}$

Step-3: Tabular representation of membership function:

U	e_2	e_3	e_4	e_6
x_1	0.93	0.92	0.76	0.97
x_2	0.99	0.94	0.97	0.93
x_3	0.89	0.98	0.93	0.97
x_4	0.73	0.88	1	0.94
x_5	0.92	0.98	0.92	0.97

Step-4: Comparison table of the above table:

A comparison table is a square table in which number of rows and number of columns are equal and both arelabelled by object name of the universe such as $x_1, x_2, x_3, \ldots, x_n$and the entries are $C_{ij}$where C_{ij}= the number ofparameters for which the value of $x_i$exceeds or equal to the value of x_j.

U	x_1	x_2	x_3	x_4	x_5
x_1	4	1	1	3	1
x_2	3	4	2	2	2
x_3	2	2	4	3	1
x_4	1	2	1	4	1
x_5	2	2	1	3	4

Step-5: Membership score table:

U	Row sum(a)	Column sum(b)	Membership score(a-b)
x_1	10	12	-2
x_2	13	11	2
x_3	12	9	3
x_4	9	15	-6
x_5	12	9	2

Step-6: Tabular representation of Non-Membership Function:

U	e_2	e_3	e_4	e_6
x_1	0.15	0.15	0.12	0.10
x_2	0.03	0.14	0.17	0.16
x_3	0.22	0.24	0.15	0.17
x_4	0.18	0.34	0.04	0.11
x_5	0.16	0.21	0.15	0.11

Step-7: Comparison table of the above table:

U	x_1	x_2	x_3	x_4	x_5
x_1	4	2	0	1	0
x_2	2	4	1	2	2
x_3	4	3	4	3	3
x_4	3	2	1	4	2
x_5	4	2	0	1	4

Step-8: Comparison table of the above table:

U	Row sum(c)	Column sum(d)	Non-Membership score(c-d)
x_1	7	17	-10
x_2	11	13	-2
x_3	17	6	11
x_4	12	11	1
x_5	11	11	0

Step-9: Final score table:

U	Membership score(m)	Non-Membership score(n)	Final score(m-n)
x_1	-2	-10	8
x_2	2	-2	4
x_3	3	11	-6
x_4	-6	1	-7
x_5	2	0	2

Step-10: In the above table, Parameter has the maximum final score 8. Hence, the Corresponding machine **Walking type small Rice Harvester** is the best machinesuitable for paddy harvesting to the farmer X.

In the same way we can choose the best machine suitable for paddy harvesting tothe farmers on the basis of their income security.

CONCLUSION

In this paper, based on the survey taken in agricultural research centre at Kaveripattinam, Paiyur, Krishnagiri district on various machines for paddy harvesting and byusing the response of more than 100 farmers in Manjamedu, Arasampatti and Pochampalli villages in Krishnagiri district of Tamilnadu, it has been identified that the bestmachine suitable for Paddy harvesting to a farmer X taking into account the features expected by him was found to be **Walking type small Rice Harvester**, by usingsome logical operations on Possibility Intuitionistic Fuzzy Soft Sets. This paper willbe a boost for farmers on the basis of their income security.

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