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S Fuzzy Assessment Methodology to Diagnosis the Yield of Rice using S weights

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Rice is an very important crop around the world. Fuzzy Expert System helps to diagnosis the yield of rice, it is very useful for scientist and farmers. This paper expresses the structure of fuzzy expert system by applying the algorithm Fuzzy Assessment Methodology. The elements of Fuzzy expert system are fuzzification interface, S Fuzzy Assessment Methodology and defuzzification interface. The proposed S Fuzzy Assessment Methodology facilitates different components including the K Ratio, T fuzzy similarity measure and S weights. To find the overlapping between the membership function K ratio is used. To measure the similarity between fuzzy set, fuzzy number and fuzzy rule T Fuzzy similarity is used. Computation of S weights helps to manage uncertainty in data by using fuzzy rules. The effectiveness of the proposed algorithm was implemented using MATLAB Fuzzy Logic tool box to construct fuzzy expert system to diagnosis the yield of rice.

Keywords : K Ratio, Rice Application, S Fuzzy Assessment Methodology (SFAM), S Weights, T Fuzzy Similarity Measure.

1. INTRODUCTION

Rice is very important crop of India and it is widely consumed food for large part of the world's human population. In many areas agriculture expert systems are used for decision making. Fuzzy Expert System has been developed to diagnosis the yield of rice using S Fuzzy Assessment Methodology. Agricultural scientist can diagnosis the grain yield of rice with the input parameters and can analysis the yield as low, medium or high.

Harvey J Gold *et al.*, [1] derived a methodology for uncertainty management, combining the information within the frame work of expert system for soyabeans. Kalpana *et al.*, [2] proposed a fuzzy expert system which is based on Correlation fuzzy logic, to find the relationship between two membership function. Kalpana *et al.*, [3] designed a Fuzzy Expert System using Fuzzy Assessment Methodology to diagnosis the diabetes for patients. Senthilkumar *et al.*, [4] designed intensified fuzzy verdict mechanism which consists of fuzzification,fuzzy inference, implication aggregation and defuzzification. Kalpana *et al.*, [5] designed fuzzy expert system using the algorithm Enhanced Fuzzy Assessment Methodology. Enhanced Fuzzy Assessment Methodology uses fact value to find the uncertainty between the rules. Fact Value is based on evidence and hypothesis. Clarke *et al.*, [6] used certainty factor to represent uncertainty in expert system.

The rule based expert system was used to test the uncertainty for tillage selection alternatives for corn and soyabean production. Maria Wenisch *et al.*, [7] fuzzy inference system was developed on soil. The inference rules are framed for soil with IF...THEN rules. Matlab FIS tool box is used to build mamdani

Table 3
Algorithm: S Fuzzy Assessment Methodology (SFAM)

begin
1. Input Variables (D_1, D_2, D_3, D_4, D_5)
2. Output Variables $O(O_1, O_2, O_3)$
3. Input Rice data with N cases and
4. Initialize $i \longleftarrow 1$
Step 1: Create input fuzzy set $D_1(d_{11}, d_{12}, d_{13})$, $D_2(d_{21}, d_{22}, d_{23})$, $D_3(d_{31}, d_{32}, d_{33})$, $D_4(d_{41}, d_{42}, d_{43})$ $D_5(d_{51}, d_{52}, d_{53})$ and output fuzzy set $O(O_1, O_2, O_3)$
Step 2: Calculate the value of *min*, *max*, *mean* and *standard deviation*
DO UNTIL (i > N)
Dilow [Min, Mean-SD, Mean], Dimedium [Mean-SD, Mean, Mean+SD] and Dihigh [Mean, Mean+SD, Max] using triangular membership function.
END DO UNTIL
Step 3: Calculate K ratio
Step 4: Call procedure (S weights)
Step 5:
DO UNTIL(i > N)
IF (D_{1i} is d_{11}) or(D_{2i} is d_{21}) or (D_{3i} is d_{31}) or(D_{4i} is d_{41}) or(D_{5i} is d_{51})then
O_i is O_3 (S Weights)
END IF
END DO UNTIL
Step 6: Call procedure for T Fuzzy Similarity measure for fuzzy set, fuzzy numbers and rules
Step 7: Antecedent part (D_{1i} is d_{11}) or (D_{2i} is d_{21}) or (D_{3i} is d_{31}) or (D_{4i} is d_{41}) or (D_{5i} is d_{51}) into consequent (O is O_3) by MIN operator
Step 8: Set rules output SUM operator $\{$output term $O\}$
end
Procedure S Weights (SW)
begin
Step 1: Calculate the number of antecedent and consequent for rules
Step 2: for all Rules
S Weights = $\frac{Total\ no.\ of\ consequent\ matches\ with\ antecendent}{Total\ no.\ of\ antecedent\ and\ consequent}$
end

5. CONCLUSION AND FUTURE RESEARCH

Application of fuzzy expert system is very much useful to diagnois the yield of rice using S Fuzzy Assessment Methodology. S Fuzzy Assessment Methodology uses K ratio to find the overlapping between the membership function, T similarity measure is used to find the similarity between fuzzy set, fuzzy numbers, fuzzy rules and S weights to manage uncertainty in fuzzy expert system. Accuracy achieved through this method is 84.43% which can also be improved through future works. Future works includes to modify rules and to add rules to fuzzy expert system to perform similar accuracy. Data Mining technique can be used to generate rules.

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Table 4
Algorithm: T Fuzzy Similarity Measure for Fuzzy Set, Fuzzy Numbers and Rule

Procedure for T Fuzzy Similarity measure for fuzzy set, fuzzy numbers and rules
begin
Step 1: Generate initial fuzzy set, fuzzy numbers and rules for rice data.
Step 2: In this step, we propose a new similarity measure between three sets.
We conclude that sets A, B and C are similar, if they have all the values equal,
Otherwise, the sets are dissimilar having non equal values.
If the two values in the above equation are equal then merge into two sets A_1 ad B_1.
Step 3: Apply the merged set in rules.
Step 4: Compute the degree of similarity between all rules in the order. Consider two rules
Rule 1:IF (x_1 is A_1) or (x_2 is B_1) or (x_3 is C_1) or (x_4 is D_1) or (x_5 is E_1) then Y is O_1
Rule 2:IF (x_1 is A_1) or (x_2 is B_1) or (x_3 is C_2) or (x_4 is D_2) or (x_5 is E_1) then Y is O_1
Degree of Similarity (DS) $= \frac{Total\ no.\ of\ similar\ parameter\ between\ the\ rule}{Total\ no.\ of\ input\ and\ output\ parameter}$
DS $= \frac{4}{6} = 66\%$
Step 5: Constant Degree of Similarity (CDS) is set to 50%
IF (DS > CDS) then
Goto Step 6
else
Stop the algorithm
endif
Step 6: Calculate cvalue for similar input and output parameters
cvalue for C_1 and C_2 are calculated by average of fuzzy numbers
Kcalvalue = cvalue(C_2) − cvalue(C_1)
Kbase = First triangular number of C_2 −First triangular number of C_1
IF (Kcalvalue > Kbase)
two fuzzy number *ie*., c_1 and c_2 are reduced.
Minimum value C_1 is deleted, Maximum value C_2 is considered in rule.
else
not reduced. Similarly cvalue, Kcalvalue, Kbase values of D_1 and D_2 are calculated and the Rule 1 and Rule 2 are merged into one rule.
endif

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