http://infor.seaninstitute.org/index.php/infokum/index
JURNAL INFOKUM, Volume 9, No.1 Desember 2020 ISSN : 2302-9706

FUZZY TSUKAMOTO METHOD IN DETERMINING CORN QUALITY FOR ANIMAL FEED

Dinur Syahputra[1], M. Rhifky Wayahdi[2], Subhan Hafiz Nanda Ginting [3]
[1,2,3] Information System Study Program, Faculty of Technology, Battuta University
Email : [1]dinsyahui12@gmail.com , [2]muhammadrhifkywayahdi@gmail.com , [3]subhanhafiz16@gmail.com

Abstract

Animal feed is the largest cost component in the livestock industry. The existence of a solution to reduce the percentage of feed costs can have a tremendous positive impact for farmers. Animal feed is generally obtained by buying factory-produced animal feed that tends to be expensive or by making their own animal feed. However not all breeders can make their own animal feed because to make good feed the formulation process is. Fuzzy Tsukamoto is one of the fuzzy logic in which the methodology of the problem solving control system is suitable to be implemented on the system .
Keywords**:** Fuzzy Tsukamoto, Quality Corn.

1. Introduction

Today our country still imports livestock products in the form of meat, milk, and eggs to meet the animal protein needs of the community. The cause of the incapableness of our country to be able to meet the animal protein needs of the community is caused because the number of livestock that is still lacking is also caused by the low level of livestock productivity cultivated by our society. As for the cause of the low level of productivity of our livestock is influenced by many factors, including the availability of erratic feed, the quality and quantity of feed is relatively low and the price of feed that tends to rise at any time, where the increase in the price of feed is often can not be offset by the rising price of products from livestock itself, so this often makes people's livestock businesses go out of business. [1]–[4]

Animal feed is the largest cost component in the livestock industry. The existence of a solution to reduce the percentage of feed costs can have a tremendous positive impact for farmers. Animal feed is generally obtained by buying factory-produced animal feed that tends to be expensive or by making their own animal feed. But not all breeders can make their own fodder because to make good feed it is necessary to process the formulation . The Tsukamoto system is the least popular fuzzy system. Although its purpose is to combine the advantages of the Mamdani and the Sugeno system, it has found only limited application due to the constraint imposed by the special type monotonic fuzzy membership functions for the outputs [5]–[9].

Based on some of the above statements underlying the authors conducting the study, the authors decided to raise a title "Fuzzy Tsukamoto Method In Determining The Quality of Corn For Animal Feed" in the writing of this study. The benefit obtained after this research was successfully carried out is that it can provide convenience in determining the quality of corn for animal feed. [10]

2. Method

Method is a systematic way or technique to work on a case. Therefore, the author uses several ways to obtain it, including, Field research is a way to get data, which is done by doing research directly to the study site. The data collection techniques carried out by the author are:

1. Interview
   Interviews are data collection techniques by conducting direct Q&A with relevant sources.
2. Observation
   It is one of the most effective methods of collecting data to study a system.

3. Literature Studies (LibraryResearch)
   The author conducted a library study to obtain data related to research writing from various reading sources such as: books, internet, and others.

3. Result and Discusion

3.1 Fuzzy Logic

In his journal [3] said that fuzzy logic is a powerful concept for nonlinear handling, different timing, and adaptive systems. This allows the use of linguistic values of variables and improper relationships for system modeling behavior.

3.2. Tsukamoto Fuzzy Method

The Fuzzy Inference System is a computational framework based on fuzzy set theory, IF-THEN-shaped fuzzy rules, and fuzzy reasoning. So far several methods have been known in FIS, such as the Tsukamoto method, the Mamdani method and the Sugeno method. In the Tsukamoto method, each consequent to the IFTHEN-shaped rule must be represented by a fuzzy set with a monotonous membership function. As a result, the output of inference results from each rule is givenexpressly (crisp)based on α-predicate(firestrength). The final result uses a weighted mean [2].

In general, Tsukamoto's fuzzy model form is [2] :
If (X IS A) and (Y IS B) Then (Z IS C)
Where A, B, and C are fuzzy sets.
Suppose known the following 2 rules.
IF (x is A_1) AND (y is B_1) THEN (z is C_1)
IF (x is A_2) AND (y is B_2) THEN (z is C_2)
In its inference, the Tsukamoto method uses the following stages:

1. Fuzzyfikasi
2. Establishment of Fuzzy knowledge base (Rule in the form of IF.... THEN)
3. Inference Machine
   Use the MIN implication function to get α-predicate value of each rule (α_1, α_2 , α_3,... α_n). Then each of these α values is used to calculate the output of inference results expressly (crisp)each rule (z_1, z_2, z_3,.... z_n).
4. Defuzzyfikasi
   Using the Averagemethod

$$z^* = \frac{\sum \alpha_i z_1}{\sum \alpha_i} \dots\dots\dots\dots\dots\dots (1)$$

DeFuzzyfikasi Process
The final result of output (z) is obtained by using the weighting average:

$$z = \frac{\alpha_1 z_1 + \alpha_2 z_2}{\alpha_1 + \alpha_2} \dots\dots (2)$$

3.3 System Design

Thesystem design uses several forms of UML diagrams, namely: Use Case Diagram, Class Diagram, Activity Diagram, and Sequence Diagram.

1. **Use Case Diagram**

Use case is a series / description of a group that is interconnected and forms a system regularly carried out or supervised by an actor. Generally c use caseis described with an ellipse with a solid line,usually containing a name. Use case describes the system process (system needs from the user's point of view). Then drawn a form of Use Case diagram that can be seen in figure 1.

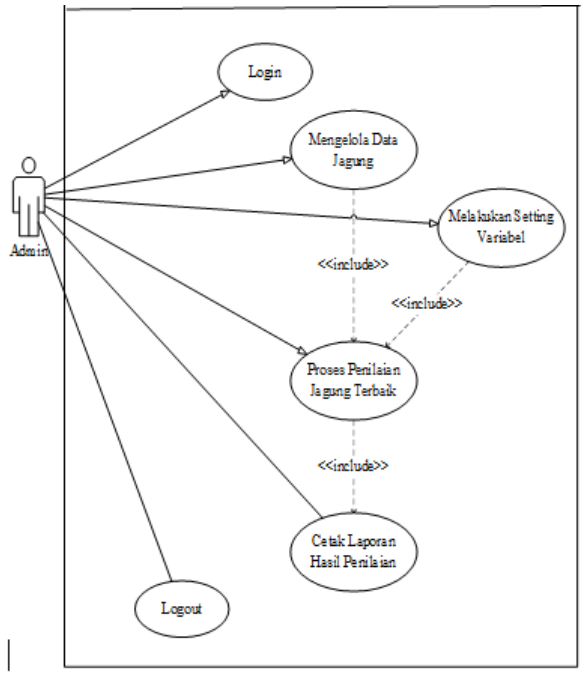

Figure 1. Use Case Diagram

2. **Method Implementation**

The process of applying Fuzzy Tsukamoto method in the supporting system of the best corn determination decision for animal feed at PT. Intraco Agro Industry as follows: Corn with code ID-0001 will be assessed to find out whether the quality of corn is good or not to be used as animal feed. The water content of corn is lacking, the quality is good, and the vitamin content is also good. The criteria used in the process of determining the best corn can be seen in table 1.

Table 1. Criteria and Sub Criteria

CRITERIA	SUB CRITERIA	VALUE
MOISTURE CONTENT	Good	100
	Less	50
QUALITY	Good	100
	Less	50
VITAMIN	Good	100
	Less	50

The highest and lowest values on each valuation variable can be seen in table 2.

Table 2. Variable Highs and Lows

№.	VARIABLE NAME	HIGHEST RATED	LOWEST VALUE
1.	Moisture Content	100	50
2.	Quality	100	50
3.	Vitamin	100	50
4.	Final Value	100	50

a. Stage 1: Establishment of Rule

Formation rules in the form of IF ... THEN which are invincible with the variables used. The rules that are formed are as follows:

R1] if high moisture content and high quality and high vitamins then high value
[R2] if water content is high and high quality and vitamin is low then value is high
[r3] if high water content and low quality and high vitamin then high value
[r4] if low water content and high quality and high vitamin then high value
[r5] if the water content is low and the quality is low and the vitamins are low then the value is low
[r6] if low water content and low quality and high vitamin then low value
[r7] if water content is low and high quality and vitamin is low then value is low
[r8] if water content is high and quality is low and vitamin is low then value is low

b. Stage 2: Inference Engine

In the inference engine, apply the MIN function to each rule to the implication function.

[R1] **IF** Water Content HIGH **AND** Quality HIGH **AND** Vitamin HIGH **THEN** Value HIGH

$\alpha\text{-predikat}_1 = \mu\text{HIGH} \cap \mu\text{HIGH} \cap \mu\text{HIGH}$
$= \min(0 ; 1 ; 1)$
$= 0$

Look at the HIGH set in the final Value variable membership graph:

$$\frac{d - 50}{50} = 0$$
$d - 50 = 0 * 50$
$d = 0 + 50$
$d_1 = 50$

[R2] **IF** Water Content HIGH **AND** Quality HIGH **AND** Vitamin LOW **THEN** Value HIGH

$\alpha\text{-predikat}_2 = \mu\text{HIGH} \cap \mu\text{HIGH} \cap \mu\text{LOW}$
$= \min(0 ; 1 ; 0)$
$= 0$

See the HIGH set on the final Value variable membership graph:

$$\frac{d - 50}{50} = 0$$
$d - 50 = 0 * 50$
$d = 0 + 50$
$d_2 = 50$

[R3] **IF** Water Content HIGH **AND** Quality LOW **AND** Vitamin HIGH **THEN** Value HIGH

$\alpha\text{-predikat}_3 = \mu\text{HIGH} \cap \mu\text{LOW} \cap \mu\text{HIGH}$
$= \min(0 ; 0 ; 1)$
$= 0$

Look at the HIGH set in the final Value variable membership graph:

$$\frac{d - 50}{50} = 0$$
$d - 50 = 0 * 50$
$d = 0 + 50$
$d_3 = 50$

[R4] **IF** Water Content LOW **AND** Quality HIGH **AND** Vitamin HIGH **THEN** Value HIGH

$\alpha\text{-predikat}_4 = \mu\text{LOW} \cap \mu\text{HIGH} \cap \mu\text{HIGH}$
$= \min(1 ; 1 ; 1)$
$= 1$

Look at the HIGH set in the final Value variable membership graph:

$$\frac{d - 50}{50} = 1$$
$d - 50 = 1 * 50$
$d = 50 + 50$

d_4 = 100

[R5] **IF** Water Content LOW **AND** Quality LOW **AND** Vitamin LOW **THEN** Value LOW
α-predikat$_5$ =μLOW∩ μLOW ∩ μLOW
= min(1 ; 0 ; 0)
= 0
Look at the LOW set in the final Value variable membership graph :

$$\frac{100 - d}{50} = 0$$

100 – d = 0 * 50
-d = 0 – 100
-d = -100
d_5 = 100

[R6] **IF** Water Content LOW **AND** Quality LOW **AND** Vitamin HIGH **THEN** Value LOW
α-predikat$_6$ =μLOW∩ μLOW ∩ μHIGH
= min(1 ; 0 ; 1)
= 0
Look at the LOW set in the final Value variable membership graph :

$$\frac{100 - d}{50} = 0$$

100 – d = 0 * 50
-d = 0 – 100
-d = -100
d_6 = 100

[R7] **IF** Water Content LOW **AND** Quality HIGH **AND** Vitamin LOW **THEN** Value LOW
α-predikat$_7$ = μLOW ∩ μHIGH ∩ μLOW
= min(1 ; 1 ; 0)
= 0
Look at the low set in the final Value variable membership graph:

$$\frac{100 - d}{50} = 0$$

100 – d = 0 * 50
-d = 0 – 100
-d = -100
d_7 = 100

[R8] **IF** Water Content HIGH **AND** Quality LOW **AND** Vitamin LOW **THEN** Value LOW
α-predikat$_8$ = μHIGH ∩ μLOW ∩ μLOW
= min(0 ; 0 ; 0)
= 0
Look at the low set in the final Value variable membership graph:

$$\frac{100 - d}{50} = 0$$

100 – d = 0 * 50
-d = 0 – 100
-d = -100
d_8 = 100

c. Phase 3: Defuzzyfication

Value tegas d dapat dicari menggunakan rata-rata terbobot, yaitu :

$$d = \frac{\begin{array}{c}\alpha pred_1 * d_1 + \alpha pred_2 * d + \alpha pred_3 * d_3 + \\ \alpha pred_4 * d_4 + \alpha pred_5 * d_5 + \alpha pred_6 * d_6 \\ + \alpha pred_7 * d_7 + \alpha pred_8 * d_8\end{array}}{\begin{array}{c}\alpha pred_1 + \alpha pred_2 + \alpha pred_3 + \alpha pred_4 + \\ \alpha pred_5 + \alpha pred_6 + \alpha pred_7 + \alpha pred_8\end{array}}$$

$$d = \frac{\begin{array}{c}0*50 + 0*50 + 0*50 + \\ 1*100 + 0*100 + 0*100 \\ + 0*100 + 0*100\end{array}}{0 + 0 + 0 + 1 + 0 + 0 + 0 + 0}$$

$$d = \frac{100}{1} = 100$$

Table 3. Table Decision

VALUE	DECISION
100	Quality Good
50	Quality Not Good

The final value of corn with code ID-0001 is 100. Based on the decision table (table 3), the corn has good quality. Means that corn with code ID-0001 can be used for animal feed.

4.Conclusions

As for the conclusion of the Fuzzy Tsukamoto Method in Determining the Quality of Corn For Animal Feed that the author built as follows, Decision support system built can help and provide convenience in the process of determining the quality of corn for animal feed. Setting variable assessment is done through the system. So, if there is a change in the maximum value and minimum variables, the admin just update through the system without having to change the program. Fuzzzy Tsukamoto method used is quite effective in providing the final result of determining the quality of corn for animal feed in accordance with the value owned by the corn. The accuracy of testing using fuzzzy Tsukamoto method is 100%.

References

[1] N. Novita, "Metode Fuzzy Tsukamoto Untuk Menentukan Beasiswa," *J. Penelit. Tek. Inform. Vol. 1 Nomor 1, Oktober 2016*, 2016.

[2] M. Ula, "IMPLEMENTASI LOGIKA FUZZY DALAM OPTIMASI JUMLAH PENGADAAN BARANG MENGGUNAKAN METODE TSUKAMOTO (STUDI KASUS : TOKO KAIN MY TEXT)," *J. Ecotipe (Electronic, Control. Telecommun. Information, Power Eng.*, 2014.

[3] W. E. Sari, O. Wahyunggoro, and S. Fauziati, "A comparative study on fuzzy Mamdani-Sugeno-Tsukamoto for the childhood tuberculosis diagnosis," in *AIP Conference Proceedings*, 2016.

[4] I. Wahyuni, W. F. Mahmudy, and A. Iriany, "Rainfall prediction in Tengger region Indonesia using Tsukamoto fuzzy inference system," in *Proceedings - 2016 1st International Conference on Information Technology, Information Systems and Electrical Engineering, ICITISEE 2016*, 2016.

[5] J. S. R. Jang, "ANFIS: Adaptive-Network-Based Fuzzy Inference System," *IEEE Trans. Syst. Man Cybern.*, 1993.

[6] L. Terán and A. Meier, "A fuzzy recommender system for eElections," in *Lecture Notes in*

Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 2010.

[7] A. Abraham, "Adaptation of Fuzzy Inference System Using Neural Learning," 2005.

[8] B. Pandey and R. B. Mishra, "Knowledge and intelligent computing system in medicine," *Comput. Biol. Med.*, 2009.

[9] L. A. Zadeh, "Outline of a New Approach to the Analysis of Complex Systems and Decision Processes," *IEEE Trans. Syst. Man Cybern.*, 1973.

[10] P. S. Hasugian and S. Panjaitan, "THE DATA MINING OF CELL PHONE MOST INTERESTED USING," *J. INFOKUM, Vol. 7, No.1, Desember 2018*, 2018.