A PREDICTION SYSTEM DESIGN FOR THE AMOUNT OF CORN PRODUCTION USING *TSUKAMOTO FUZZY INFERENCE SYSTEM*

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ABSTRACT

Fuzzy inference system is a computing framework based on fuzzy set theory, fuzzy rules in the form of IF-THEN, and fuzzy reasoning. Fuzzy inference system receives input crisp. This input is then sent to a knowledge base that contains fuzzy rules in the form of IF-THEN. Fire strength will be sought at every rule. If the number of rules is more than one, it will be the aggregation of all the rules. Furthermore, the aggregation results will be defuzzy to get crisp value as output system (Kurniawan, 2004).

The method used in building this system is the method of Tsukamoto fuzzy inference system. Tsukamoto method is an extension of the monotonous reasoning. In Tsukamoto method, each consequent upon the rules that forms If - Then shall be represented by a fuzzy set membership functions are monotone.

The results of this study are to predict number of information systems on corn production in the SPSS South Lampung District Court and to get the desired results

KEY WORDS: corn production information system, the prediction system

I. INTRODUCTION

1.1 Background

Optimization of the production of maize in farmer groups Alam Jaya affects the financial sector because it can estimate the expenditure of raw materials, while also in terms of production costs and the cost of transportation and storage. For that reason we need a method that can predict the amount of corn production of the maize and maize production optimization problems. Many methods and techniques used. The most commonly used method is the logic firmly set. But logic firmly set cannot be operated or used by the general public (only the analysis), because in addition to rather complicated in the calculation, constraints in production will also complicate the completion of maize production optimization problems. Besides logic firmly set, fuzzy logic can also be used in corn production optimization problems.

Alam Jaya Farmers Group has been producing corn as much, so much the rest of the corn stored in inventory warehouse. Due to the large supply of corn stored in warehouse, very large costs incurred due to a decrease in the quality of maize. So, the Farmers Group Alam Jaya requires a system that can predict the amount of corn production.

The application of fuzzy logic to the completion of maize production problems uses fuzzy inference system. The problem resolved is how to determine if corn production uses only two variables as input data, namely: demand and supply. The first step problem solving corn production using fuzzy method in determining the output variable is set firmly, the second step is to convert the input variables into fuzzy set with fuzzification process, the next step is the third data processing and fuzzy set with maximum method. And the last or the fourth step is to change the output to be set firmly with the defuzzification process, so it will obtain the desired results.

1.2 Problem Formulation

The formulation of the existing problems in this research is how to design and build a system to predict the amount of corn production using Tsukamoto Fuzzy Inference System.

1.3 Research Objectives

The objective of this study is to develop and produce the number of corn production prediction systems using Tsukamoto Fuzzy Inference System at Farmers Group Alam Jaya in the great teak.

1.4 Benefits of the Research

The benefits of the research to be carried outa are:

a. Software for designing prediction system helps Farmers Group Alam Jaya in Jatiagung in determining the amount of corn production using Tsukamoto Fuzzy Inference System.
b. The result of the research can be used as one of the basic considerations in the decision making corn production quantities using Tsukamoto Fuzzy Inference System.

II. LITERATURE REVIEW

2.1 Fuzzy Inference System

Fuzzy logic approach is broadly implemented in three stages which can be described as follows (Kurniawan, 2004):

1. Phase blurring (fuzzification), the mapping of input to the set of fuzzy firmly.
2. Phase of inference, namely the generation of fuzzy rules.
3. Phase assertion (defuzzyfication), the transformation of the output of fuzzy value to the firm value.

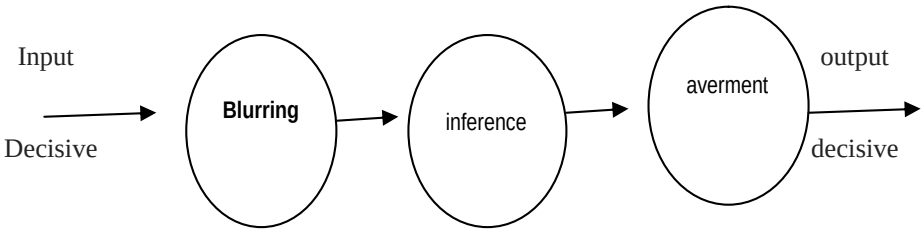

Figure 1. Stages of Process in Obscure Logic

2.2 Method of Tsukamoto

Tsukamoto method is an extension of the monotonous reasoning. In Tsukamoto method, each consequent upon the rules that form If-Then shall be represented by a fuzzy set membership functions are monotone. As a result, the output of the inference results of each rule is given explicitly (crisp) by α-predicate (fire strength). The final result is obtained by using a weighted average. (Kusumadewi, 2010).

The steps to resolve Tsukamoto method is as follows: 1) .Input fuzzy set, 2) Determine the membership degree of fuzzy sets, 3) Calculate the predicate rule (α), 4) Defuzzyfication

At this stage of the calculation of Defuzzyfication average (Weight Average / WA) of each predicate in each variable is done by using the following equation:

$$WA = \frac{\alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \ldots + \alpha_n Z_n}{\alpha_1 + \alpha_2 + \alpha_3 + \ldots + \alpha_n}$$

Description αn= predicate value to-n

Zn = index value to the output – n

2.3 System Design

2.3.1 Context Diagram

Context diagram is the highest level in the data flow diagram and only contains one process, showing the overall

system. The process is numbered zero. All external entities are shown in the following context data flow diagram-major data flow to and from the system. The diagram does not contain simple data storage and seem to be created, so external entities as well as the flow of data-flow of data to and from the known system analyzer of interviews with users and as a result of analysis of documents (Pressman, 2002).

Diagram Context highlighted a number of important characteristics of a system (Pressman, 2002):

a.The user group, the parties will provide data to the system
b.Data, what is received / generated by the system from / to the outside world
c.Storage of data, a system must provide information or reports
d. Limitation, which distinguishes between system and environment

2.4 Method of Software Development Method Using the System Development Life Cyclemodel Waterfall

In this research, the method of software engineering that is used is the Waterfall model as shown in the following picture:

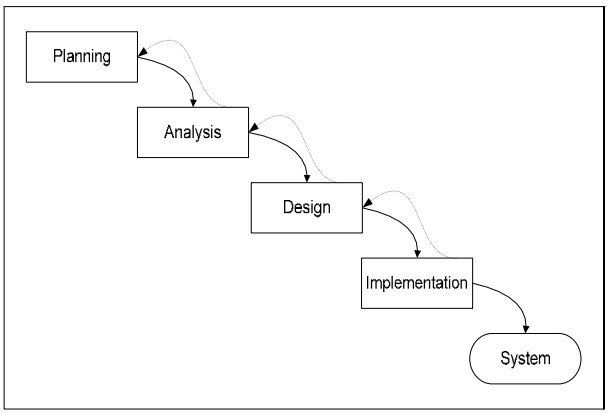

Figure 2. Waterfall Model Development Method

Description (Dennis, 2003):

1).Planning,2).Analysis,3).Design,4).Implementation,5).System

III. METHODS

3.1 Data Collecting Methods

Data collecting method is used in this study to obtain data. The data in the research gained from: a). Field studies, b).interview, c).Observation, d).documentation

3.2 Application of Tsukamoto Fuzzy Inference System (FIS)

In the base model is, in general, there are three steps to predict the amount of corn production are: define variable, inference, and defuzzification (specify the crisp output). The valuea analyze the large amount of corn production with numbers, with a range of 0 to infinity, while the variable is considered that the number of requests and the amount of inventory

3.2.1 Defining fuzzy variables (Fuzzyfication)

This stage, the value of the current set membership searched using fuzzy set membership functions with due regard to the maximum value and minimum value of each variable is variable. Each variable consists of 2 fuzzy sets, namely: up and down.

3.2.2 Determination of the amount of production in the manual Tsukamoto method (Tsukamoto-based Model)

Table 1. Assessment of Fuzzy Association and Range

Variabel		**Fuzzy Set**	**Range**
Input	1. Demand	Down Normal Up	0 – 75 (quintals) 50 – 125 (quintals) 75 – 150 (quintals)
	2. Supply	Few Normal Many	0 – 50 (quintals) 25 – 75

			(quintals) 50 – 100 (quintals)
Output	Rice production	Diminish Normal Increase	0 –80 (quintals) 50 – 130 quintals) 80 – 160 (quintals)

The design of the variable input and fuzzy output variable (fuzzification)

3.3 Structure Design of Tsukamoto fuzzy method

Based on the nine fuzzy rules, will be determined value of min for each rule

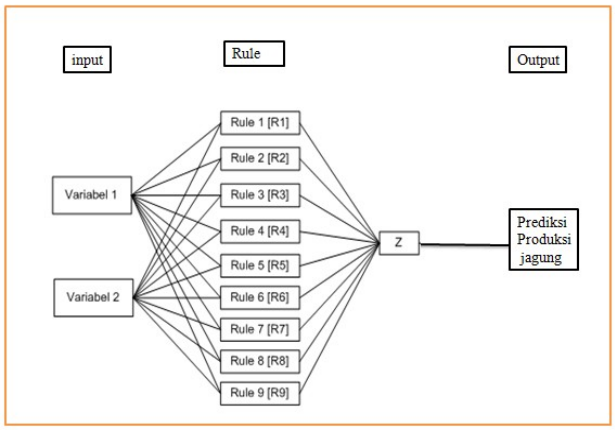

Figure 3. Structure of the Tsukamoto FIS

The specification:

• Input is a number

• All rules are evaluated in parallel

• defuzzification

• Output of the number

3.4 Calculation of Tsukamoto FIS

Table 2. Variable Value Table

No.	Name	Demand	Supply
1.	Farmer groups Alam jaya	100	60

Variable Demand (100):

Down for $x \leq 50$; then μ Down = 0

Normal = (125-100) / (125-75) = 25/50 = 0.5; then μNormal = 0.5

Up = (100-75) / (125-75) = 25/50 = 0.5; then μ Up = 0.5

Variable Inventory (60):

if $x \leq 25$; then μ Bit = 0

Normal = (75-60) / (75-50) = 15/25 = 0.6; then μ Normal = 0.6

Many = (60-50) / (75-50) = 10/25 = 0.4; Many then μ = 0.4

The rules are rules used in the function MIN implications:

[R1] IF demand falls and stocks are low then the maize production is normal

α-predikat1 = μ Request (Down) ∩ μ Inventory (Slightly)

= Min (μ Request (0) ∩ μ Supplies (0) ∩)

= Min (0; 0) = 0

[R2] IF demand falls and inventory is normal, then corn production is reduced

[R3] IF demand falls and supplies much then corn production is reduced

[R4] IF demand is normal and then supply of corn production is increased slightly

[R5] IF demand is normal and supply is normal, then maize production is normal

Z (Normal Production || down) = (130-Z) / (130-80) = 0.5

= (130-Z) / 50 = 0.5

= 130-Z = 50 (0.5)

= 130-Z = 25

= Z = 130-25 = 115

Z (Normal Production || ascending) = (Z-50) / (80-50) = 0.5

= (Z-50) / 30 = 0.5

= Z-50 = 30 (0.5)

= Z-50 = 15

= Z = 15 + 50 = 65

[R6] IF demand is normal and supply is much, then corn production is reduced

Z (Production Decreased || down) = (80-Z) / (80-50) = 0.4
= (80-Z) / 30 = 0.4
= 80 Z = 30 (0.4)
= 80 Z = 12
= Z = 80-12 = 68

[R7] IF demand rises and supplies are slight, then corn production is increased

[R8] IF demand rises and inventory is normal, then corn production is increased

Z (Production Increases || ascending) = (Z-80) / (130-80) = 0.5
= (Z-80) / 50 = 0.5
= Z-80 = 50 (0.5)
= Z-80 = 25
= Z = 25 + 80 = 105

[R9] IF demand rises and supplies are great, then maize production is normal

Z (Normal Production || down) = (130-Z) / (130-80) = 0.4
= (130-Z) / 50 = 0.4
= 130-Z = 50 (0.4)
= 130-Z = 20
= Z = 130-20 = 120

Z (Normal Production || ascending) = (Z-50) / (80-50) = 0.4
= (Z-50) / 30 = 0.4
= Z-50 = 30 (0.4)
= Z-50 = 12
= Z = 12 + 50 = 62

In Tsukamoto method, to determine the output of firm used an average defuzzification centralized, namely:

z = (a1z1 + a2z2 + ... + anzn)) / (a1 + a2 + ... + an)

for nine fuzzy rules, the average formula is centralized as follows:

$$z = \frac{a1z1 + a2z2 + a3z3 + a4z4 + a5z5 + a6z6 + a7z7 + a8z8 + a9z9)}{a1+a2+a3+a4+a5+a6+a7+a8+a9}$$

Firm value can be obtained by using the formula for the average centralized 9 fuzzy rules above. The middle value is output on the problems of the prediction of the amount of corn production.

Table 3. Table of Value defuzzification

Defuzzification
$Z = \frac{(0*50) +(0*80) +(0*80) +(0*80) +(0,5*65) +(0,4*68) +(0*80) +(0,5*105) +(0,4*62)}{0+0+0+0+0,5+0,4+0+0,5+0,4}$
$Z = \frac{(0) +(0) +(0) +(0) +(32,5) +(27,2) +(0) +(52,5) +(24,8)}{1,8}$
$Z = \frac{137}{1,8} = 76,111$

Firm value obtained is 76.111. Then the number of predicted amount of corn production is 76 Quintal.

IV. RESULTS AND DISCUSSION

4.1 Weather Prediction Amount of Production

Farmer Alam Jaya clicks the link production quantities. In this page there is a form input data for the prediction of the amount of corn production. It can be seen in Figure 4. Below

Figure 4. Page on Predicted Amount of Production

4.2 Predicted Results Page on Amount of Production

In this page the results of predicted amount of corn production can be seen in Figure 5 below

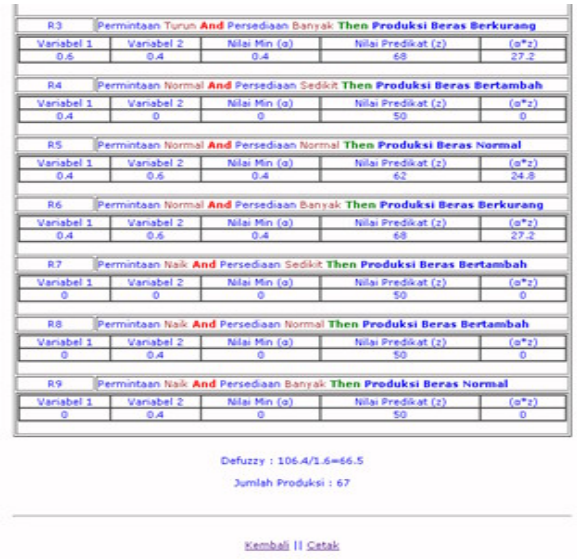

Figure 5. Page of Results of Predicted Amount of Production

4.3 Home Rule

This page contains a list of rules that can be seen in Figure 6. below.

Figure 6. Rule Page

4.4 Weather Prediction of Total Production (Administrator)

This page contains a prediction page of production quantities. It can be seen in Figure 7 below:

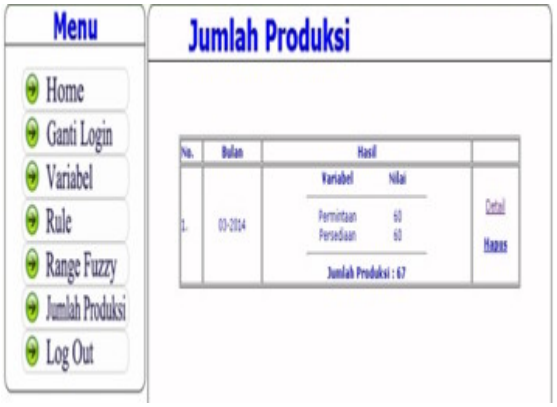

Figure 7. Pages of Predicted Total Production (Administrator)

4.5 Page of Result of Predicted Amount of Production

This page contains Prediction Result of Details Total Production. It can be seen in the image below.

Figure 8. Predicted Result Details Page of Amount of Production

4.6 Testing

Software testing serves to determine the achievement of objectives based on the criteria. In this case the testing is done by connecting each entity of the system in accordance with the specifications of the hardware and software.

Application performance testing is only done on the processing of applications related to the database in Dreamweaver 8 program and MySQL database. Whereas, testing is done with the variation in the number of databases should be executed. In addition, the performance of the software is related to the condition of the used database connectivity.

After Xampp installed for temporary server used is localhost. Arrangements can be made through phpmyadmin database that serves to create, modify and delete databases. With this facility will facilitate the making of the mysql database because it does not use the command (syntax) sql manual.

4.7 Test Results

The software is implemented in accordance with the specification requirements on the analysis and design. This is evidenced by the success of each subsystem do what the specification as has been asked in the test results above, so that the process is happening already with the procedures specified. The number of tables is not a barrier to process the data. But while this is the access delay is the time required to complete the application process all the data but it can also be caused by the quality of the server used. To perform maintenance or care that these websites should have their own server as the use fresshosting will have difficulty, for example, at the time of opening the website will take a long time because the server does not support the program. In the web hosting has to be considered available capacity that can support the programming language PHP and MySQL scripts and supporting software used and the cost to get hosting.

V.CONCLUSION

Based on the analysis and discussion of the problem, the conclusions of this study are as follows:

a. The result of the study can be used to generate a prediction of the amount of corn production system using Tsukamoto Fuzzy Inference System.
b. Prediction of the amount of corn production system helps farmers to determine the amount of rice production to the fore.

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