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Expert System For Determining Composition Of Replacement Feed
At The Time Of Raw Materials In Cow Fatting Companies
With Backward Chaining Inference
Case Study : (PT. Andini Agro Loka, Central Lampung)

Pakarti Riswanto [1] , Herman Affandi [2] and Sidik Rahmatullah [3]
[1 23]Information Technology, Dian Cipta Cendikia, Candimas, North Lampung, Indonesia
tutiriswanto@gmail.com , Herman@dcc.ac.id, sidik@dcc.ac.id

ABSTRACT

In the business of fattening cattle, cow feed nutrition is very supportive in the success of this business. But cattle farmers' understanding of the composition of feed nutrition is still low. In the business of fattening cattle, cow feed nutrition is very supportive in the success of this business. But cattle farmers' understanding of the composition of feed nutrition is still low.This expert system can be used as information and guidelines for determining nutrient composition in cattle feed using Backward Chaining. This method uses a chain that is crossed from a hypothesis back to facts that support the hypothesis. The use of this system can provide accurate information and references for users in the form of determining the nutritional composition of cattle feed. This system can provide assistance in the form of determining the composition of feed replacement during the lean season using raw material backward chaining by not reducing the nutritional value contained in the feed and the price remains economical.

Key words: cow feed nutrition, expert systems, and backward chaining

1. INTRODUCTION

The agricultural sector is one sector that is able to make a significant contribution to the Indonesian economy. One of Indonesia's leading agricultural sub-sectors that has long been promoted as a supporter of economic growth is a well-developed and managed farm through the agribusiness system approach. Beef cows are the largest contributor to ruminant meat production nationwide, so this livestock business has the potential to be developed as a profitable business. Agribusiness-oriented beef cattle business development with a partnership pattern is one alternative to increase the profits of farmers .

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Domestic meat production has not been able to meet the needs because of population and low productivity levels of livestock. The low beef cattle population is caused by the majority of livestock raised by small-scale farmers with limited land and capital (kariyasa 2005). According to Pusdatin Secretariat General of the Ministry of Agriculture (2016) the total national local cattle population in 2015 reached 17,200,000 head. Not all of these are ready to be slaughtered because most of them are calves and cows that are not allowed to be slaughtered. There is a shortage of cattle supply for the national needs of 247,000 tons of beef, equivalent to 1,383,000 head of cattle. Lampung Province is one of the Provinces that has very good potential in developing livestock business. This is proven that Lampung Province occupies the second position in the population of beef cattle on the island of Sumatra in 2015 as many as 653,357 tails after the province of North Sumatra (captured by the Ministry of Agriculture's Animal Health 2016). Central Lampung Regency is one of the regencies in Lampung Province that has very good potential in developing livestock business. Central Lampung Regency Occupies first position in beef cattle population data in Lampung Province with a total of 2,432,987 head (Department of Animal Husbandry and Animal Health of Lampung Province 2016).

The success of the cattle business in PT. Andini Agroloka which has been running for more than 10 years is greatly influenced by the quality of the feed. Feed becomes one of the main factors besides genetic and management factors. Therefore, good cow breeds from superior species from the selection must be balanced with good food too. . Many farmers do not know that good feed for cows, while the nutritional composition of good cow feed can produce quality meat, skin, and cow's milk, therefore determining the nutritional composition of cattle feed is very necessary.

To produce a standard composition of bovine feed requires an appropriate and accurate way, such as in predicting tropical infectious diseases by combining forward and backward chaining, the results obtained are close to the diagnosis results from a doctor of tropical infectious diseases where the level of appropriateness of disease symptoms that appear 97.96 % . Besides diagnosing the impact of using contact lenses using the backward chaining method, this study sampled prospective users of the expert system impact of using contact lenses, namely: 25 correspondents tested. The reliability test results reflect the reliability and reliability of a research instrument based on the level of stability and permanence of a measuring instrument, then the implementation of inference using the backward chaining method can easily find out the symptoms experienced by patients in diagnosing the impact of using contact lenses (M, Nurmala and Samsudin, 2015).

In this study, building a system for determining the composition of nutrients in cattle feed that is expected to overcome the problems of cattle farmers who do not know the composition of nutrients needed by cows from data that has been analyzed using backward chaining.

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2. MANUSCRIPT PREPARATION

2.1 Expert System

Expert systems are computer-based applications that are used to solve problems as thought by experts. The experts in question are people who have special expertise who can solve problems that cannot be solved by lay people (Kusrini, 2008). Expert systems are designed to be able to imitate the expertise of an expert in answering questions and solving a problem in accordance with the objectives of making the system. In general an expert system is a system that attempts to adopt human knowledge to a computer that is designed to model the ability to solve problems like an expert. Expert System is one branch of AI that makes extensive use of knowledge specifically for expert human-level problem solving. Computer-based expert systems are computer programs that have knowledge that comes from people who are knowledgeable or experts in a particular domain, where knowledge here is human knowledge that is very minimal to spread, expensive and difficult to obtain (Siswanto, 2010). Expert systems are computer programs designed to solve problems in domains where there are experts. Knowledge is built into the system that is usually obtained from experts in the field. Based on this knowledge, expert systems can mimic the processes of human experts thinking and make logical conclusions accordingly (Sunday Tunmibi, 2013). Examples of expert systems that are widely used are expert systems to diagnose diseases, where this expert system can help the work of doctors in carrying out their duties.

The main components of the expert system are twofold: the development environment (development environment) and the consultation environment. In the development environment is used by expert system makers to build expert system components and introduce knowledge into the knowledge base. The consultation environment is used by the user to conduct consultations to obtain solutions from the expert system such as consulting an expert. Figure 1.1 shows the important components in an expert system.
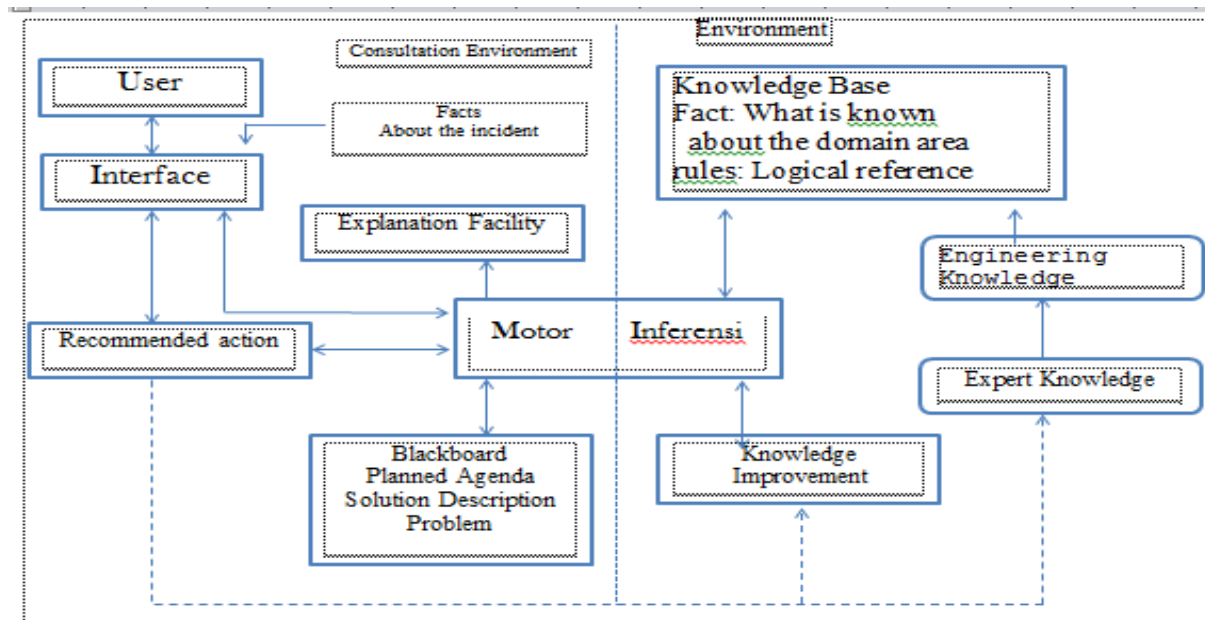
Figure 1. Important Components of a System

The components in the expert system are as shown in Figure 1, namely the user interface, knowledge base, knowledge acquisition, inference engine, workplace, explanation facilities, and knowledge improvement.

2.2 Feed ingredients

Feed material is any ingredient that is consumed, preferred, able to be digested thoroughly or only partially, does not contain substances that are harmful to its eaters and can provide benefits for its livestock. Cows need food every day about 10% of the body weight of the animals themselves, and around 1-2% of their body weight must be given additional feed. Cow's feed consists of several types, namely:

2.2.1 Forage beef food

Forage is one type of feed obtained naturally, such as grass. Forage is sometimes enough to be good food for cow growth. Forage types need to be stored as food reserves for livestock during the dry season. If the forage is not sufficient in making rations, food can use concentrate type food. Types of forage that can be said to be superior are elephant grass, grass grass, Bengal grass, cypress grass, bede grass and several other superior forages. Types of forage foods included as agricultural waste products are corn straw, long beans, rice straw and soy straw. The type of feed produced from waste tends to be of low quality so that sometimes it requires concentrate type food to maintain the quality of the ration.

2.2.2 Concentrate

Concentrate or can be called as food reinforcement is a food ingredient that has high levels of food substances such as protein or carbohydrates and low crude fiber (below 18%). Concentrates include feed that is easy to digest because it is made from a mixture of several feed ingredients that contain energy sources. Concentrate feed types are better used when lacking forage types or when undergoing fattening livestock programs only (Indonesia, 2013). Concentrate feed can be divided into two, namely as a source of protein and energy source. Examples of feed which are categorized as concentrated feed types include rice bran, tofu pulp, cassava pulp, and many more. Concentrate is sometimes given as additional feed ingredients after cows are given grass food or other forages.

2.3 Sales Report

The following is a dataset from the cattle sales report, from the data we obtain only a few attributes that are used by other than data that we cannot use.

Table 1. Cattle Sales Data

| TANGGAL | RFID | Entry | Entry Weight | Sold | |
		Date	Weight	Date	Weight
15 Januari 2016	942 000020234557	14 Oktober 2015	338	15 Januari 2016	485
15 Januari 2016	942 000020833337	14 Oktober 2015	338	15 Januari 2016	472
15 Januari 2016	951 000501179440	14 Oktober 2015	328	15 Januari 2016	469
15 Januari 2016	982 123508610138	14 Oktober 2015	329	15 Januari 2016	454
15 Januari 2016	900 116002683319	14 Oktober 2015	322	15 Januari 2016	437
15 Januari 2016	942 000011051587	14 Oktober 2015	323	15 Januari 2016	422
15 Januari 2016	942 000012205816	14 Oktober 2015	322	15 Januari 2016	494
15 Januari 2016	942 000016240407	14 Oktober 2015	311	15 Januari 2016	443
15 Januari 2016	942 000020832841	14 Oktober 2015	327	15 Januari 2016	470
15 Januari 2016	951 000501622388	14 Oktober 2015	332	15 Januari 2016	430

From the data above, there are only a few attributes that we use such as RFID as the identity of the cow, the date of the cattle entering and leaving so that we know how old the cow is at the fattening cage and the weight of the cow when entering and leaving so we know the weight of the cow's ADG.

2.3   Cow Feed Usage Report

Following is the Report on the Use of Cow Feed, from the data we will later process it and combine it with cattle sales data. So that we will get alternative feed when it is difficult to get feed raw materials.

Table 2. Report on the Use of Cow Feed

No	Nama Bahan Baku	1	2	3	4	5	6	7	Total
I	Bahan Baku								Minggu I
1	Molasis	83	146	88	93	153	87	87	738
2	Onggok	389	742	213	203	535	201	249	2.534
3	Tepung Jagung	22	27	28	23	20	19	19	159
4	Bekatul	9	19	11	9	16	7	7	79
5	Gaplek	9	11	12	8	9	9	7	64
6	Bungkil Kopra	114	433	103	98	409	104	134	1.395
7	Bungkil Kedelai	12	162	13	10	161	7	9	373
8	Bungkil Sawit	298	448	229	238	380	269	287	2.149
9	Silase	579	581	874	859	968	774	1.030	5.665
10	Greenchop R. Gajah	-	-	-	-	-	-	-	-
11	Greenchop T. Jagung	-	-	-	-	-	160	-	160
12	Greenchop Sorgum	-	-	-	-	-	-	19	19
13	Jerami	-	-	120	-	-	-	40	160

The data picture above is a report on the use of raw material for cattle commodity feed, in the form of a unit item composition. in this case the backward chaining method will obtain the use of feed every day. And the thing we will do is recommend substitute feed if a raw material crisis occurs, which occurs when the dry season comes, which often occurs in our country, Indonesia, between April and September.

3. ANALYSIS AND DESIGN

3.1 General description

Expert system for determining the nutritional composition of cattle feed using backward chaining inference methods. The selection of this method is based because this method is suitable to be applied to choose the nutritional composition of feed to improve the quality of cattle. Broilers are divided into fattening and enlarging calves. Feeding consists of concentrated forages and nutrients, forages in the form of elephant grass, king grass, cypress grass and Bengal grass. The concentrate consists of BK (dry matter), PK (crude protein), and TDN (total digestible nutrient) content.

3.2 Knowledge Base
According to Prof. Dr. Ir Hj. Yetti Marlida MS. the conclusion is that there are some things that need to be considered when gathering animal feed rations, namely:

3.2.1 Body weight of livestock
Knowing the body weight of a cow is needed related to the correlation between body weight with the capacity of the digestive tract to accommodate dry feed material. Excessive feeding

is inefficient, otherwise too little feed will cause livestock production to decline. General rules for feeding are: beef cattle 10% of the weight, and calf 9.7% of the weight

3.2.2 Availability of feed ingredients

The availability of feed ingredients needs to be considered to ensure the quality and connectivity of the feed. Feeding management needs to consider the availability of feed ingredients in an area and also look at the season. Broilers and calves are expected to gain a weight of 1 kg / day. The total feed is determined from the weight of cattle, beef cattle 10% of weight, and calf 9.7% of weight. Example of calculating total feed:

Broilers weighing 300 kg

Total feed = 10% * weight

cattle = 10% * 300 kg = 30kg

After the total feed is obtained, then the forage and concentrate composition is determined to be given to cattle. Comparison of forages and concentrates is as follows:

- 85% broilers forage and 15% concentrate
- Cow tillers 80% forage and 20% concentrate

From the facts and rules, an analysis of the needs of the expert system can be elaborated to determine the nutritional composition of cattle feed as follows:

1. IF cattle = beef cattle AND season = rain AND weight = 250
    THEN amount of forage = 21.3kg AND amount of Concentrate = 3.8kg AND Forage = grass
2. IF cattle = beef cattle AND season = rain AND weight = 300
    THEN amount of forage = 25.5 kg AND amount of Concentrate = 4.5kg AND Forage = grass
3. IF cattle = beef cattle AND season = rain AND weight = 350
    THEN amount of forage = 29.8kg AND amount of Concentrate = 5.3kg AND Forage = grass
4. IF cattle = beef cattle AND season = rain AND weight = 400
    THEN amount of forage = 34 kg AND amount of Concentrate = 6 kg AND Forage = grass
5. IF cow = cow tillers AND season = rain AND Weight = 100
    THEN number of forage = 7.8 kg AND amount of Concentrate = 1.9 kg AND forage = grass
6. IF cow = cow tillers AND season = rain AND Weight = 150
    THEN total forage = 22.6kg AND total Concentrate = 2.9 kg AND forage = grass
7. IF cow = cow tillers AND season = rain AND Weight = 200
    THEN amount of forage = 15.5kg AND amount of Concentrate = 3.9 kg AND forage = grass
8. IF cow = cow tillers AND season = dry season AND Weight = 100
    THEN amount of forage = 7.8kg AND amount of Concentrate = 1.9 kg AND forage = grass + Alternative feed
9. IF cow = cow tillers AND season = dry season AND Weight = 150
    THEN total forage = 22.6kg AND total Concentrate = 2.9 kg AND forage = grass + alternative feed
10. IF cow = cow tillers AND season = dry season AND Weight = 200

THEN amount of forage = 15.5kg AND amount of Concentrate = 3.9 kg AND forage = grass + Alternative feed

3.3 Inference Engine

Inference engine that is used backward chaining, trace back where the decision tracking starts from the goal continued on the sub goal then obtained a solution. The way backward chaining engine inference works in decision tracking is as follows:

Goal: 1. Broiler (X)

Database: rainy season (D), weight 300 kg (E),

Knowledgebase:
- IF rainy season (D) THEN Forage = Grass (A) - IF weight = 300kg (E) AND Number of Feed = 36 kg (F)
- IF amount of feed = 36 kg (F) THEN amount of Forage = 28.1kg (B) AND amount of concentrate = 7.9 kg (C)
- IF amount of Forage = 28.1 kg (B) AND amount of concentrate = 7.9kg (C) AND Forage = grass (A) THEN broilers (G) If symbolized as:

Goal: X
Database: D & E
Knowledge:
If D Then A
If E Then F
IF B & C & A Then G.
IF F THEN B & C
Search step:

1. Determine the goal is G, can G be executed? No, because B, C and F not in the database yet.
2. Search for A, can A be executed? Yes, because D is in the database
3. Search B & C, cannot be executed because F is not in the database
4. Search F, can be executed because E is in the database

Figure 2. How Backward Chaining Works

The expert system for determining the composition of Nutrition for cattle feed algorithm starts from the expert being asked to enter the type of feed, feed composition and nutrient content needed for a particular cow. This knowledge data is stored in knowledgebase which is the brain of the expert system. The workings of the inference machine are shown in Figure 2, the user inputting data and conducting consultations by inputting the type of cow they have, the type of cow, the season data during the consultation and the season weight of the cow determine the type of feed available and the composition of the feed obtained. The

desired goal is the composition of the feed input the system will check on the rule base, if the first rule base matches the composition of the feed will appear. If the first rule base does not match, then check the next rule base. The checking process is repeated until a match is found.
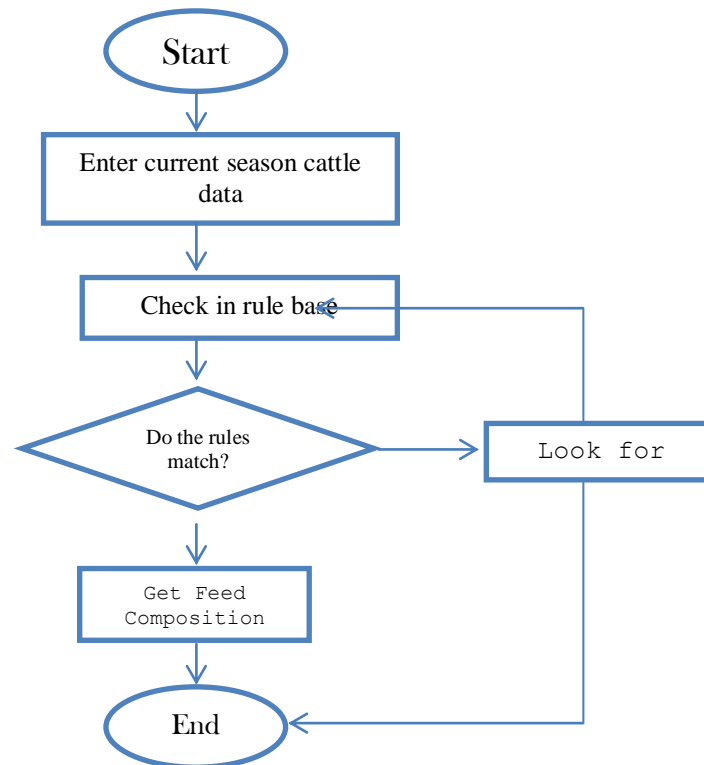

Figure 3. Flowchat Inference Machine

4. SYSTEM IMLEMENTATION

The initial stages of making this program starts from determining the data needed in making the program, such as cattle type data, feed type data and data feed composition. After all the required data is clear then the database is designed using Ms Access. After designing the database, the system interface is then designed, which is the forms needed in making the program using the VB Programming Language. The forms designed are equipped with operating buttons (Save, Delete, Edit and exit).

The program designed is equipped with user management for 2 user categories, namely admin level and user level. This is applied for system security if the system is later placed in a public place that is easily accessed by many people.

4.1 System Testing

Testing is done by matching the data given to the system with the existing rules in the system. Testing is done by matching goals, subgoal1, subgoal1. The following will be tested for beef cattle weighing 300 and the dry season presented in Figure 5.9 below:

Figure 4. System Testing Process

After the data has been entered, click the yield button to see the results of the recommended composition of cattle feed in accordance with the rules entered. The recommendation results provide a solution for the right type of feed in the dry season and the composition of feed in the form of many forages and concentrates in kg units. the results obtained are search results in the rule table, the rule code found will be saved into the results table in the form of a print out.

"EXPERT SYSTEM FOR DETERMINING COMPOSITION OF REPLACEMENT FEED AT THE TIME OF RAW MATERIALS IN COW FATTING COMPANIES WITH BACKWARD CHAINING INFERENCE "

No. Konsultasi   :
Tanggal   : 10 Desember 2019
Nama Pengunjung   : Didik Mulyadi
Alamat   : Jl. Anggrek Tandem, Binjai
Jenis Sapi   : Sapi Potong
Bobot Sapi   : 300 Kg
Musim   : Kemarau
Rekomendasi :

Molasis	3	
Onggok	10	
Tepung Jagung	3	
Bekatul	3	
Gaplek	3	
Bungkil Kopra	5	
Bungkil Kedelai	2	
Bungkil Sawit	3	
Silase	1	
Greenchop R. Gajah		
Greenchop T. Jagung		
Greenchop Sorgum		
Jerami		

Figure 5. The Result of feed recomendation

The following is the result of print out of recomended fememendation to get the best feed.

5. CONCLUSIONS
Based on the research and discussion conducted it can be concluded that:
1. To meet the nutrition of cattle feed is given additional concentrate, the ratio of the amount of forage and concentrate is different for each type of cow.
2. The application of the Backward Chaining method is very figure to determine the right feed composition to improve the quality of cattle. In this case the goal or goal is known, namely dairy cows, beef cattle and calves from the goal then traced sub goals so that the results obtained in the form of nutritional composition of cattle feed.
3. The development of an expert prototype system for determining the composition of feed nutrition to improve beef quality begins with gathering a knowledge base from the experts, creating a database to store data related to the composition of the feed, from the knowledge base and database is done perose determination of the appropriate feed composition using the backward chaining method . The next step is to create a user interface for the system to interact with the user and finally to arrange an explanation facility that contains procedures on how to use the program.

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