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Research paper

Prediction of Layer Chicken Disease using Fuzzy Analytical Hierarcy Process

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Abstract

Chicken disease belong to the herpes group that often attacks poultry like laying hens. Various types of diseases that can attack such as marek, IB chicken, chicken NP, CA, EDS. Therefore it is necessary to be given a special vaccine for poultry that can anticipate the dominant diseases attacking poultry in particular chicken laying. So need a prediction model with the concept of fuzzy analytical hierarchy process. analytical hierarchy process is one of the methods in the decision-making system that uses several variables with a multilevel analysis process using criteria such as decreased egg production, cough, watery eyes, wings hanging down, a gray sprocket, legs paralyzed. From the test results obtained varied values with alternative results obtained: Marek 0.1487, IB chicken 0.3464, CA 0.1769, chicken NP 0.2407, EDS 0.0884. Then fuzzy analytical hierarcy process is good for predicting laying hens disease.

Keywords: *Fuzzy, Chicken Disease Prediction, Analytical Hierarcy Process (AHP).*

1. Introduction

The case of chicken disease was examined at the Veterinary Pathology Laboratory in 1999-2000 with the diagnosis of Marek disease. The cause of Marek disease is the Marek virus (MDV), especially serotypes that are oncogenic (capable of causing tumors) and have varying degrees of malignancy. This virus belongs to the Herpes group that only attacks the chickens and quails. If left continuously like this then the population of laying chickens and quailed birds will be reduced so that affect the quality and yield of eggs produced. Therefore, it is necessary to be given special vaccine for poultry that can anticipate the disease, so it will reduce the number of chickens and quails that Marek disease and can reduce mortality in poultry so that the production of laying hens [1].
Expert system research for the diagnosis of chicken disease caused by this virus is based on the need for tools for farmers or extension workers in mendiaknosis chicken livestock disease caused by viruses. Expert system other than to mendiaknosis, this system is expected to provide treatment suggestions [2]. Diagnosis of poultry disease with certainty factor method that attacks poultry (chicken) is very helpful to the poultry farmers in anticipating the symptoms of treatment for a fast, precise and efficient. This can reduce the losses that can be generated due to dissemination[3]. Mohamad Hadi, M. Misdram, Ratih Fitri Aini [4] designing expert system of chicken disease diagnosis with forward chaining method Choosing the technique of diagnosis of chicken disease is because the symptoms of the disease commonly suffered by the chicken is relatively easy to observe and relatively safe to be done by anyone who built this application is with a knowledge management system that is easy to use and dynamic. In a study titled laying chicken prediction using fuzzy Analytical Hierarchy Process that serves to predict the type of disease that attacks the laying hens so that obtained a quick and precise solution to better know if the livestock is fine and can maintain the quality of livestock for better.
One of the problems faced in chicken farms is the difficulty of breeders knowing how the characteristics of chickens that attack Marek disease. Thus, breeders are difficult to prevent the chickens from the disease. In this case if not addressed immediately will result in the productivity of eggs produced and cause cost losses. Based on the above problems researchers want to solve the problems often faced by chicken breeders in analyzing the diseases suffered by laying hens so as to know the characteristics of chickens attacked by Marek disease, helping poultry farmers to obtain superior eggs and quality if the farmers already know the cause-causes that hamper the productivity of livestock.

2. Literature Review

2.1 Decision Support System

Decision support system (DSS) is an approach to support decision making. Decision support systems use data, provide an easy user interface, and can incorporate decision-making thinking [5][6]–[8]. Decision Support System is an interactive information system that provides information, modeling, and data manipulation. The system is used to assist decision making in semi-structured situations and unstructured situations, where no one knows for sure how decisions should be made [9].

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2.2 Chicken Disease

Chicken disease is a major obstacle in intensive chicken farming in tropical environment such as in Indonesia. Economic losses from diseases, especially infectious diseases, can be described in the form of death, although more common is a form of decreased production as in the respiratory disease group. Many factors that cause chickens are often infected by diseases that can even spread to the same poultry, seasonal change factor one of them. The weather is too hot and the place is too humid too not good for chicken health[10][11].

2.3 Analytical Hierarchy Process Method

Fuzzy Logic can handle problems with imprecise data and give more accurate results. Professor L. A. Zadeh introduced the concept of Fuzzy Logic[11]–[14]. Fuzzy analytic hierarchy process (AHP) proves to be a very useful methodology for multiple criteria decision-making in fuzzy environments, which has found substantial applications in recent years[15]. AHP is a method for making alternative decision sequences and selecting the best alternative when decision makers with multiple objectives or criteria to make certain decisions[16]–[18]. The most important thing in the AHP is the functional hierarchy with the main input of human perception. With the hierarchy, a complex and unstructured problem can be solved into its group, then the groups are organized into a hierarchical form[19][20].

AHP is a practical approach to solving complex decision problems that include alternative comparisons. AHP also allows decision making to present a hierarchical relationship between factors, attributes, characteristics or alternatives in the decision-making environment. With special features, the hierarchy it possesses, unstructured complex problems solved in groups[21][22], [23].

3. Research Methods

3.1 Methods of data collection

Methods of data collection in this study, namely: Bibliography method, data collection method by reading and studying literautre or book related to research done in this research that is book of decision support system, fuzzy, AHP method and other book according to problem. Interview method, this method is done to collect data by asking a number of questions, the authors conducted interviews with chicken breeders about any disease that is attacking the cattle when ill. Methods of observation, data collection techniques where the authors rely on direct observation, in this study the author denied some chicken breeders to get the data about chicken disease and then draw conclusions from the observations.

3.2 Weight Value

The table below is the calculation that will be included to calculate the prediction of the disease in laying hens. Each criterion has different interests. Table 1 shows conversion to AHP value and Table 2 shows weight value.

Table 1: Conversion To AHP Value

Value Criteria of interest	Conversion to AHP value
Low (R)	1
Medium (S)	3
Middle (TH)	5
High (TI)	7
Very High (ST)	9

Table 2: Weight Value

Criteria	Weight value
Egg production declines (PTM)	15
Cough (B)	20
Watery eyes (MB)	20
Wings hanging down (R)	15
There are gays spots on it (JTBA)	20
Legs paralyzed (KL)	10
Sum	100

3.3 Research Framework

Flowchart Fuzzy Application Predicts Layer Chickens Analytical Hierarchy Process Method

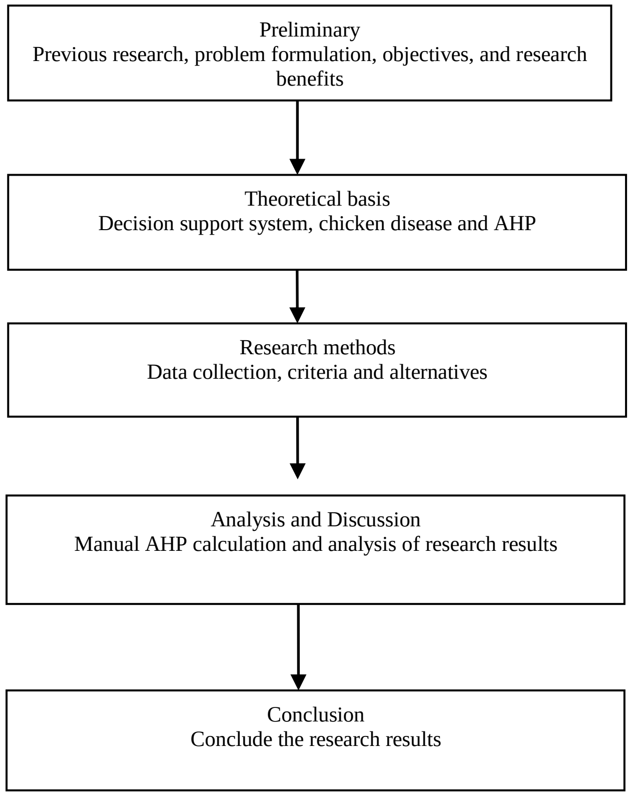

Fig. 1: Flowchart of the research flow

Figure 1 illustrates that the process of making a study is to make a preliminary, theoretical basis, determine the method of research, discuss and analyze the results of research, and conclude the research results.

4 Discussion

4.1 Stage Testing Analytical Hierarchy Process Method

Prediction of laying hens method of fuzzy analytical hierarchy process using 6 criteria are: decreased egg production, cough, watery eyes, wings hanging down, there are gray spots, legs paralyzed. The next stage of making this application is to calculate the alternative weighting done by arranging matrix in pairs for alternatives for each criterion. An alternative weighting for criteria enter the recommended criteria data in matrix form in pairs. Table 3 shows matrix of pairwise pairing criteria.

Table 3: Matrix of pairwise pairing criteria.

Criteria	PTM	B	MB	SBKB	JTBA	KL
PTM	1	2	3	4	5	6
B	1/2	1	2	3	4	5
MB	1/3	2/3	1	2	3	4
SBKB	1/4	2/4	3/4	1	2	3
JTBA	1/5	2/5	3/5	4/5	1	2
KL	1/6	2/6	3/6	4/6	5/6	1

The above matrix data is changed from fraction to decimal form.

Table 4: Paired comparison results of alternative weighting for temporary criteria.

Criteria	PTM	B	MB	SBKB	JTBA	KL
PTM	1	2	3	4	5	6
B	0,5	1	2	3	4	5
MB	0,33	0,67	1	2	3	4
SBKB	0,25	0,5	0,75	1	2	3
JTBA	0,2	0,4	0,6	0,8	1	2
KL	0,17	0,33	0,5	0,67	0,83	1
SUM	2,45	4,9	7,8	11,4	15,8	21

After determining the number of temporary values/weights, then each of the above cells divided by the number of columns respectively, for example to fill the second column of the second line is (PTM: Σ PTM weight) → (1.00: 2.45) = 0.4082 (use the same way to fill in other columns) to obtain results like those in the Table 4 above.

Table 5: Paired comparison results of alternative weightings for criteria

Criteria	PTM	B	MB	SBKB	JTBA	KL	SUM
PTM	0,4082	0,4081	0,3822	0,3488	0,4227	0,2857	2,2558
B	0,2040	0,2041	0,2545	0,2616	0,2527	0,2381	1,4151
MB	0,1347	1,1367	0,1274	0,1743	0,1895	0,1905	0,9531
SBKB	0,1020	0,1021	0,0955	0,0872	0,1263	0,1429	0,6559
JTBA	0,0816	0,0816	0,0764	0,0697	0,0631	0,0952	0,4676
KL	0,0694	0,0673	0,0637	0,0584	0,0524	0,0476	0,3588

Table 5 shows paired comparison results of alternative weightings for criteria. After the result is the number of each line, then calculate the value of the alternative priority for the average value criterion with the formula of the number of comparison results divided by the number of alternatives. Example to fill the priority of PTM criteria is (Σ comparison result: Σ criterion) → (2,2558 / 6) = 0,3760 (use same way to fill other column) to get result as shown in Table 6 below.

Table 6: Priority results based on criteria

Criteria	Priority Criteria	Rank
PTM	0,3760	I
B	0,1909	II
MB	0,1589	III
SBKB	0,1093	IV
JTBA	0,0779	V
KL	0,0598	VI

After the priority of the criteria is determined, the next step is to determine the priority of each alternative by entering the comparative value of each alternative for each as shown in Table 7.

Table 7: Pairwise comparison of decreased egg production criteria (PTM)

PTM	Marek	IB chicken	CA	NP chicken	EDS
Marek	1	0,5	2	0,33	3
IB chicken	2	1	4	0,66	6
CA	0,5	0,25	1	0,17	1,5
NP chicken	3	1,51	6	1	9
EDS	0,33	0,16	0,67	0,11	1
SUM	6,83	3,42	13,67	2,27	20,5

Next create a normalization table for the PTM criteria by dividing the value on each matrix box divided by the total column as shown in Table 8.

Table 8: Normalization of decreased egg production criteria (PTM)

PTM	marek	IB chicken	CA	NP chicken	EDS	SUM
Marek	0,15	0,15	0,15	0,15	0,15	0,75
IB chicken	0,29	0,29	0,29	0,29	0,29	1,45
CA	0,07	0,07	0,07	0,07	0,07	0,35
NP chicken	0,44	0,44	0,44	0,44	0,44	2,2
EDS	0,05	0,05	0,05	0,05	0,05	0,25

Then calculate the number of rows to divide by the number of alternatives to find the priority value. Result of calculation of egg production priority decrease (PTM) as shown in Table 9.

Tabel 9: PTM Prioritas

Alternative	Priority criteria	Rank
Marek	0,15	III
IB chicken	0,29	II
CA	0,07	IV
NP chicken	0,44	I
EDS	0,05	V

Table 10: Pairwise comparison of cough criteria

Cough	Marek	IB chicken	CA	NP chicken	EDS
Marek	1	4	0,25	3	2
IB chicken	0,25	1	0,06	0,75	0,5
CA	4	16	1	12	8
NP chicken	0,33	1,3	0,08	1	0,66
EDS	0,5	2	0,16	5	1
SUM	6,08	24,3	1,55	21,75	12,16

Table 10 shows pairwise comparison of cough criteria. Next create a normalization table for the criteria for cough by dividing the value of each box matrix divided by the total column as shown in Table 11.

Table 11: Normalization of cough criteria

Cough	Marek	IB chicken	CA	NP chicken	EDS	SUM
Marek	0,16	0,16	0,16	0,13	0,16	0,77
IB chicken	0,04	0,04	0,03	0,03	0,04	0,18
CA	0,66	0,65	0,65	0,55	0,66	3,17
NP chicken	0,06	0,05	0,05	0,04	0,06	0,26
EDS	0,08	0,08	0,11	0,23	0,08	0,58

Then calculate the number of rows to divide by the number of alternatives to find the priority value. Result of calculation of cough priority as shown in Table 12.

Tabel 12: Cough Priority

Alternative	Priority Criteria	Rank
Marek	0,154	II
IB chicken	0,036	V
CA	0,634	I
NP chiken	0,052	IV
EDS	0,116	III

Table 13: Pairwise comparison of watery eye criteria (MB)

WATERY EYES	marek	IB chicken	CA	NP chicken	EDS
Marek	1	0,5	2	0,33	4
IB chicken	2	1	0,4	0,66	8
CA	0,5	0,25	1	0,16	2
NP chicken	3	1,51	0,06	1	12,1
EDS	0,25	0,12	0,5	0,08	1
SUM	6,75	3,38	3,96	2,23	27,1

Table 13 shows pairwise comparison of watery eye criteria (MB). Next create a normalization table for watery eye criteria by dividing the value on each matrix box divided by the total column as shown in Table 14.

Table 14: Normalization of watery eye criteria

WATERY EYES	marek	IB chicken	CA	NP chicken	EDS	SUM
Marek	0,14	0,14	0,50	0,14	0,14	1,06
IB chicken	0,29	0,29	0,10	0,29	0,29	1,26
CA	0,07	0,07	0,25	0,07	0,07	0,53
NP chicken	0,44	0,44	0,01	0,44	0,44	1,77
EDS	0,03	0,03	0,13	0,03	0,03	0,25

Then calculate the number of rows to divide by the number of alternatives to find the priority value. The result of calculating the priority of watery eyes as shown in Table 15.

Table 15: Aqueous eye priority (MB)

Alternative	Priority criteria	Rank
Marek	0,212	III
IB chicken	0,252	II
CA	0,106	IV
NP chicken	0,354	I
EDS	0,05	V

Table 16: Comparison of pairwise wing pairs hanging down (SBKB)

SBKB	marek	IB chicken	CA	NP chicken	EDS
Marek	1	0,25	2	3	0,5
IB chicken	4	1	8	12	2
CA	0,5	0,12	1	1,5	0,25
NP chicken	0,3	0,08	0,66	1	0,16
EDS	2	0,5	4	6	1
SUM	7,8	1,95	15,6 6	23,5	3,91

Table 16 shows comparison of pairwise wing pairs hanging down (SBKB). Next create a normalization table for the wing criteria hanging down (SBKB) by dividing the value of each box matrix divided by the total column as shown in Table 17.

Table 17: Normalization of wings hanging down (SBKB)

SBKB	marek	IB chicken	CA	NP chick en	EDS	SUM
Marek	0,12	0,12	0,12	0,12	0,12	0,60
IB chicken	0,51	0,51	0,51	0,51	0,51	2,55
CA	0,06	0,06	0,06	0,06	0,06	0,3
NP chicken	0,03	0,03	0,03	0,03	0,03	0,15
EDS	0,25	0,25	0,25	0,25	0,25	1,25

Table 17 shows normalization of wings hanging down (SBKB). Then calculate the number of rows to divide by the number of alternatives to find the priority value. The wing priority calculation results hanging down (SBKB) as shown in Table 18.

Table 18: The wing priority is hanging down (SBKB)

Alternative	Priority criteria	Rank
Marek	0,12	III
IB chicken	0,51	I
CA	0,06	IV
NP chicken	0,03	V
EDS	0,25	II

Table 19: Comparison of pairs of criterion of comb is gray spots (JTBA)

JTBA	Marek	IB chicken	CA	NP chicken	EDS
Marek	1	0,2	0,33	2	3
IB chicken	5	1	1,5	10	0,15
CA	3	0,6	1	6,06	9,09
NP chicken	0,5	0,1	0,15	1	1,5
EDS	0,03	0,06	0,1	0,66	1
SUM	9,8	1,96	3,08	19,72	14,74

Table 19 shows comparison of pairs of criterion of comb is gray spots (JTBA)Next create a normalization table for the criteria of comb is gray spots (JTBA) by dividing the value of each box matrix divided by the total column as shown in Table 20.

Table 20: Normalization of comb is gray (JTBA)

JTBA	Marek	IB chicken	CA	NP chicke n	EDS	SUM
Marek	0,10	0,10	0,10	0,10	0,20	0,60
IB chicken	0,51	0,51	0,51	0,51	0,01	2,05
CA	0,30	0,30	0,30	0,30	0,61	1,81
NP chicken	0,05	0,05	0,05	0,05	0,10	2,1
EDS	0,03	0,03	0,03	0,03	0,06	0,18

Then calculate the number of rows to divide by the number of alternatives to find the priority value. The result of calculating the priority of the comb is gray (JTBA) as shown in Table 21.

Table 21: Priority criterion of comb is gray spots (JTBA)

Alternative	Priority criteria	Rank
Marek	0,12	IV
IB chicken	0,41	II
CA	0,362	III
NP chicken	0,42	I
EDS	0,036	V

Table 22: Pairwise comparison of leg limb criteria (TOS)

LEGS PARALYZED	Marek	IB chicken	CA	NP chicken	EDS
Marek	1	0,5	0,2	2	3
IB chicken	2	1	0,4	4	6
CA	5	2,5	1	10	15
NP chicken	0,5	0,25	0,1	1	1,5
EDS	0,3	0,16	0,06	0,66	1
SUM	8,8	4,41	1,76	17,66	26,5

Table 22 shows pairwise comparison of leg limb criteria (TOS). Next create a normalization table for leg paralysis criteria (KL) by dividing the value of each box matrix divided by the total column as shown in Table 23.

Table 23: Normalization of legs paralyzed (TOS)

LEGS PARALYZED	Marek	IB chick en	CA	NP chicken	EDS	SUM
Marek	0,11	0,11	0,11	0,11	0,11	0,55
IB chicken	0,22	0,22	0,22	0,22	0,22	1,1
CA	0,57	0,57	0,57	0,57	0,57	2,85
NP chicken	0,05	0,05	0,05	0,05	0,05	0,25
EDS	0,03	0,03	0,03	0,03	0,03	0,15

Then calculate the number of rows to divide by the number of alternatives to find the priority value. The calculation results of legs paralysis (KL) as shown in Table 24.

Table 24: Priority of limb legid criteria (TOS)

Alternative	Priority criteria	Rank
Marek	0,11	III
IB chicken	0,22	II
CA	0,57	I
NP chicken	0,05	IV
EDS	0,03	V

Finally, the last is to determine the most superior alternative in the prediction of laying chicken disease fuzzy analytical hierarchy process method and the final result of the calculation as follows as shown in Table 25.

Table 25: Final result of calculation

Alternative	PTM	B	MB	SBKB	JTBA	KL
Weight	0,15	0,2	0,2	0,15	0,2	0,1
M	0,15	0,154	0,212	0,12	0,12	0,11
IB	0,29	0,036	0,252	0,51	0,41	0,22
CA	0,07	0,034	0,106	0,06	0,362	0,57
NP	0,44	0,052	0,354	0,03	0,42	0,05
EDS	0,05	0,116	0,05	0,25	0,036	0,03

5 Results Analysis

Calculation of the final result by calculating the weighted value multiplied by the alternative priority.

Marek = (0.15 * 0.15) + (0.2 * 0.154) + (0.2 * 0.212) + (0.15 * 0.12) + (0.2 * 0.15) + (0 , 1 * 0.11) = 0.0225 + 0.0308 + 0.0424 + 0.018 + 0.024 +0.011 = 0.1487 = 15%

IB chicken = (0,15 * 0,29) + (0,2 * 0,036) + (0,15 * 0,51) + (0,2 * 0,41) + (0,1 * 0,22) = 0,0435 + 0,072 + 0,0504 + 0,0765 + 0,082 + 0,022 = 0,3464 = 35%

CA = (0.15 * 0.07) + (0.2 * 0.010) + (0.2 * 0.106) + (0.15 * 0.06) + (0.2 * 0.362) + (0.1 * 0,57) = 0,0105 + 0,0068 + 0,0212 + 0,009 + 0,0724 + 0,057 = 0,1769 = 18%

Chicken NP = (0.15 * 0.44) + (0.2 * 0.052) + (0.2 * 0.354) + (0.15 * 0.03) + (0.2 * 0.42) + (0,1 * 0,05) = 0,066 + 0,0104 + 0,0708 + 0,0045 + 0,0,084 + 0,005 = 0,2407 = 25%

EDS = (0,15 * 0,05) + (0,2 * 0,116) + (0,2 * 0,05) + (0,15 * 0,25) + (0,2 * 0,036) + (0 , 1 * 0,03) = 0,0075 + 0,0232 + 0,01 + 0,0375 + 0,0072 + 0,003 = 0,0884 = 9%

Table 26: Rating Results

Alternative	Final Score	Persentage	Rangking
Marek	0,1487	15%	4
IB ayam	0,3464	35%	1
CA	0,1769	18%	3
NP ayam	0,2407	25%	2
EDS	0,0884	7%	5

Table 26 shows rating results. From the results of calculations performed and supported by the determination of predetermined criteria, it is known alternative chicken disease most often is a chicken IB disease with the highest value of 0.3464 or 34.64% then it can be said that IB chicken is a dominant disease attack laying hens as shown in Figure 2.

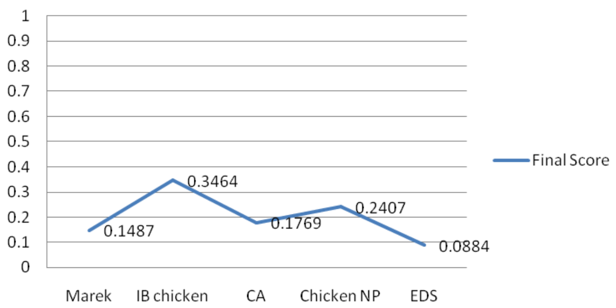

Fig. 2: Graph of the final result

6 Conclusion

There are a wide range of diseases that can influence chickens and it can be difficult to analyze them. The essential thought is that once ill found, we should remove it from the flock and isolate it, in case the disease is contagious. The conclusion that the authors stack based on the results of research turned out to be a disease that more often attacks the chickens is IB. IB disease obtained results of IB disease with the highest value of 0.3464 or 34.64%.

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