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# Android-Based Qurban Animal Selection Recommendation System Using AHP and SMART Method

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**ABSTRACT**

Currently, technological advancements have undergone incredibly rapid development. Modern technology is capable of contributing to solving various challenges in different sectors, including the field of animal husbandry. Computers have been integrated as tools to perform tasks or identify existing issues, thus determining the suitability of selecting sacrificial animals. Essentially, whether or not an animal is accepted as a sacrificial offering depends on a series of conditions. Therefore, it is crucial to ascertain whether the animal meets the requirements. Based on research findings, the assessment of code P001 is made using criteria such as Animal Weight, Animal Age, Animal Gender, Blindness, Illness, Limping, Emaciation, and Complete Ears. The assessment is conducted according to the SMART method. The final calculated value for the selection of sacrificial animals is 0.61. Based on the weighting of the final value, it can be concluded that animals with a value of 0.61 are recommended for selection.



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## 1. INTRODUCTION

Currently, technological advancements have undergone an exceptionally rapid development. Present-day technology is capable of contributing to solving various challenges in diverse sectors, including the field of animal husbandry[1]. Computers have been integrated as tools to perform tasks or identify existing issues, thus assessing the feasibility of selecting sacrificial animals[2].

Qurbani worship is one of the obligatory rituals performed by Muslims every year on the occasion of Eid al-Adha. In Indonesia, the number of sacrificial animals slaughtered in 2020 reached approximately 1.8 million, consisting of cattle, buffalo, goats, and sheep. This number has been increasing year by year. Qurban originates from the Arabic language, meaning "Qurban" ( ,قربان) which means close. In Islamic teachings, the ritual of Qurbani is also known by the terms "al-udhhiyyah" and "adh-dhahiyyah," which refer to the act of sacrificing animals such as camels, cattle, buffalo, and goats. This practice is performed during the celebration of Eid al-Adha as well as on the days of Tashriq, with the intention of drawing closer to Allah as an expression of taqarrub[3].

Sacrificial animals must meet several criteria to be valid for slaughter. These criteria include age, weight, blemishes, gender, and the animal's color. The age of sacrificial animals must be at least 1 year

for goats or sheep, and 2 years for cattle or buffalo. The weight of the sacrificial animal must correspond to its type. For example, goats or sheep weighing less than 20 kilograms are not valid for sacrifice. Blemishes that can render an animal invalid for sacrifice include blindness, limping, severe emaciation, and illness. Valid genders for sacrificial animals are male camels, male cattle, male buffalo, male goats, or male sheep. The color of the sacrificial animal is not a criterion for its validity for sacrifice[3].

The study[4] employed the Analytic Hierarchy Process (AHP) and SMART (Specific, Measurable, Achievable, Relevant, Time-bound) method to determine promotion regions. The AHP method was utilized to establish the weights of the considered criteria, while the SMART method was employed to determine the ranking of the promoted regions.

Based on the existing issue, a recommendation system is required for the selection of sacrificial animals, where buyers can choose based on criteria using an Android-based application. This system utilizes the AHP and SMART methods. Considering the analysis and issues presented above, the author proposes the title **"Android-Based Qurban Animal Selection Recommendation System Using AHP and SMART Method.**

## 2. RESEARCH METHODE

### 2.1 Data Collection Technique

The method of gathering materials and data involves the actions of searching for and acquiring information that supports the development of this application. The gathered data can originate from two types: primary data, which is obtained directly from its source, or secondary data, which is acquired from other sources that have been processed previously[5]. In the data collection phase, the researcher employs various data collection methods, including Observation, Interviews, and Literature Review.

1. Observation
   The data collection method through observation is carried out by observing and directly recording on-site. Observation is conducted to gain a comprehensive understanding of aspects related to system development[6].
2. Interview
   The data collection method is conducted through interviews with the Arjuna Farm Livestock. The purpose of the interviews is to gather information about the business processes occurring on the farm, as well as the challenges being faced[7].
3. Literature Review
   This approach is chosen to support the study conducted by the researcher in gathering materials from books and journals and designing the system. Literary references are used to obtain theories from experts as guidelines in designing and implementing the program[8].

### 2.2 System Development Method

The waterfall method can also be referred to as the sequential linear method or the classic life cycle[9]. The approach used by the researcher to design and build this software involves the waterfall method. The waterfall approach is one of the software development methods that can be seen in the diagram, starting from requirement identification, followed by design, implementation, verification, and finally maintenance. The selection of the waterfall method in the creation and design of this system aims to ensure that the workflow can be carried out in a structured manner[10]. Below are the stages involved in the waterfall method.

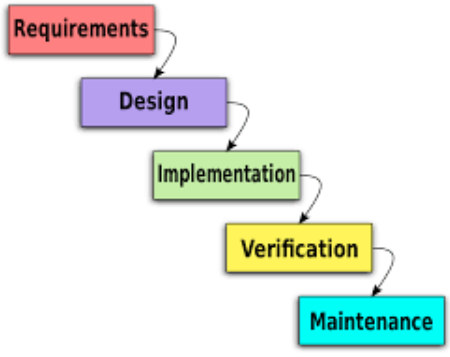


Figure 1. Waterfall Method Steps

### 2.3 Decision Support System

A Decision Support System (DSS) is a system designed to provide support to managerial decision-makers in facing semi-structured decision conditions[11]. The purpose of a Decision Support System is to serve as a tool for decision-makers to enhance their skills, but it is not intended to replace their judgment. DSS is a combination of individual intelligence and component capabilities aimed at improving the quality of decisions made[12]. A Decision Support System, also known as DSS, is a system designed to provide support to decision-makers at the managerial level when confronted with decision situations of semi-structured nature [13][14].

### 2.4 AHP (Analytical Hierarchy Process)

The Analytic Hierarchy Process (AHP) method is an effective and precise decision-making tool as it utilizes predetermined scales or weights and adopts a hierarchical structure consisting of three levels: goal, criteria, and alternative options[15][16].

The Analytic Hierarchy Process (AHP) is an approach to solving problems with multiple criteria that requires decision-makers to provide opinions on the relative importance levels of each criterion used. This model relies on human perspectives considered as "experts" as the primary input. The term "expert" here does not necessarily imply an individual must possess genius, extraordinary intelligence, a doctoral degree, and the like, but rather refers to someone who has a deep understanding of the problem at hand, feels the impact of a problem, or has a vested interest in the issue[17]. The following are the stages in decision-making using the AHP method[13]:

1. Compiling pairwise comparison table
2. Summing up the numbers in each column with the total of that column to obtain matrix normalization.
3. To obtain matrix normalization, divide each value in the column by the total of that respective column.
4. To obtain the average value of each matrix, sum up its values and divide the result by the number of elements.
5. Calculating the Consistency Index using the formula.
   $CI = (\lambda max - n)$
   $n - 1$
   Where:
   CI = Consistency Index
   $\lambda\ max$ = The largest eigenvalue of an n x n matrix.
   n = Matrix order
6. Calculating the Consistency Ratio using the formula.
   $CR = CIIR$
   Where:
   CR = Consistency Ratio
   IR = Random Indeks
7. Checking hierarchy consistency. If the value exceeds 10%, corrective steps in the calculation process are required. However, if the stability ratio (CI/IR) is below or equal to 0.1, then the calculation is acceptable. Table of Random Index Consistency (IR).

### 2.5 SMART (Simple Multi Attribute Rating Technique)

This method falls under the category of decision support systems by considering various attributes. Each attribute is assigned a value and determining factors that depict their relative importance. The goal of this method is to identify alternatives that score the highest among the available options. This method is characterized by flexibility, simplicity, transparency, and adaptability[18]. In this method, decisions are influenced by specific parameters. Each parameter has a unique range of values and weights. These parameter values are used to make informed decisions[19]. In the SMART method, there are several steps involved in its resolution, including[20]:

1. Define the alternatives and criteria to be used.
2. Assign relative values to each criterion on a scale of 1-100, then normalize by comparing weight values to the total weight.
3. Evaluate each alternative based on each criterion.
4. Normalize the data of alternative values for each criterion.
5. Calculate the average value of normalized data.

6. From the previous calculations, generate a matrix R that compares each alternative pairwise for each criterion.
7. Calculate the utility value.
8. Benefit-type criteria can be calculated using the formula.

$$U_i(a) = \left(\frac{c_{out}-c_{min}}{c_{max}-c_{min}}\right) \times 100\%$$

Cost criteria can be calculated using the formula.

$$U_i(a) = \left(\frac{c_{mzx}-c_{out}}{c_{max}-c_{min}}\right) \times 100\%$$

Explanation:
$U_i(a)$ = Utility value of criterion-i
$c_{max}$ = Maximum value
$c_{min}$ = Minimum value
$c_{out}$ = Value of criterion-i

9. Calculating the final score by multiplying the normalized value with the normalized weight of the criteria and then summing them up[13].

## 3. RESULT AND ANALYSIS

In this discussion, the application of the methods to be used in the Android-based qurban animal selection recommendation system using AHP and SMART will be explained. The flowchart depicting the system's implementation can be seen in the figure below.

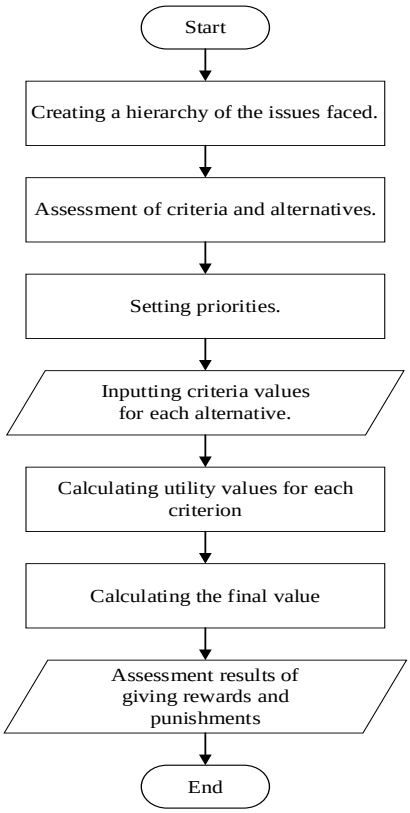


Figure 2. Flowchart of AHP and SMART Method

In this stage, the process involves determining weight values using the AHP method. Several qurban animals will undergo evaluation for qurban animal selection using the assessment code P001, considering Animal Weight, Animal Age, Animal Gender, Blindness, Limping, and Complete Ears. The steps that need to be taken for selecting sacrificial animals are as follows:

1. Creating Pairwise Comparison Matrix
   In this stage, a comparison assessment is conducted between one criterion and other criteria.

Table 1. Pairwise Comparison Matrix

| Criteria | Animal Weight | Animal Age | Gebder | Blindness | Limping | Complete Ears |
|---|---|---|---|---|---|---|
| Animal Weight | 1 | 3 | 4 | 5 | 3 | 4 |
| Animal Age | 0.33 | 1 | 3 | 3 | 4 | 5 |
| Gender | 0.25 | 0.33 | 1 | 3 | 3 | 3 |
| Blindness | 0.20 | 0.33 | 0.33 | 1 | 3 | 3 |
| Limping | 0.33 | 0.25 | 0.33 | 0.33 | 1 | 3 |
| Complete Ears | 0.25 | 0.20 | 0.33 | 0.33 | 0.33 | 1 |
| **Amount** | **2.37** | **5.12** | **9.00** | **12.67** | **14.33** | **19.00** |

The number 1 in the "Animal Weight" column for the "Animal Weight" row signifies the same level of importance between animal age and animal weight. Meanwhile, the number 3 in the "Animal Age" column for the "Animal Weight" row indicates that animal age is slightly more important than animal weight. The number 0.33 in the "Aniamal Weight" column for the "Animal Age" row is the result of calculating 1 divided by the value in the "Animal Age". The other numbers are obtained in a similar manner.

2. Creating a Criteria Value Matrix
   This matrix is obtained using the following formula:
   New row column value = Old row column value / Sum of respective old column values

Table 2. Criteria Value Matrix

| Criteria | Animal Weight | Animal Age | Gender | Blindness | Limping | Complete Ears | Amount | Priority |
|---|---|---|---|---|---|---|---|---|
| Animal Weight | 1 / 2.37 = 0.42 | 3 / 5.12 = 0.59 | 4 / 9.00 = 0.44 | 5 / 12.67 = 0.39 | 3 / 14.33 = 0.21 | 4 / 19.00 = 0.21 | **2.27** | **0.38** |
| Animal Age | 0.33 / 2.37 = 0.14 | 1 / 5.12 = 0.20 | 3 / 9.00 = 0.33 | 3 / 12.67 = 0.24 | 4 / 14.33 = 0.28 | 5 / 19.00 = 0.26 | **1.45** | **0.24** |
| Gender | 0.25 / 2.37 = 0.11 | 0.33 / 5.12 = 0.07 | 1 / 9.00 = 0.11 | 3 / 12.67 = 0.24 | 3 / 14.33 = 0.21 | 3 / 19.00 = 0.16 | **0.89** | **0.15** |
| Blindness | 0.20 / 2.37 = 0.08 | 0.33 / 5.12 = 0.07 | 0.33 / 9.00 = 0.04 | 1 / 12.67 = 0.08 | 3 / 14.33 = 0.21 | 3 / 19.00 = 0.16 | **0.63** | **0.11** |
| Limping | 0.33 / 2.37 = 0.14 | 0.25 / 5.12 = 0.05 | 0.33 / 9.00 = 0.04 | 0.33 / 12.67 = 0.03 | 1 / 14.33 = 0.07 | 3 / 19.00 = 0.16 | **0.48** | **0.08** |
| Complete Ears | 0.25 / 2.37 = 0.11 | 0.20/ 5.12 = 0.04 | 0.33 / 9.00 = 0.04 | 0.33 / 12.67 = 0.03 | 0.33 / 14.33 0.02 | 1 / 19.00 = 0.05 | **0.28** | **0.05** |

Column sum values are obtained by adding up each row. For the first row, the value 2.27 is the result of summing 0.42 + 0.59 + 0.44 + 0.39 + 0.21 + 0.21. Priority column values are obtained by dividing the values in the sum column by the number of criteria, which is 6 in this case.

3. Creating a Summation Matrix for Each Row

This matrix is created by multiplying the priority values in table 2 with the pairwise comparison matrix in table 1. The calculation results can be seen in table 3.

Table 3. Matrix Summation for Each Row

| Criteria | Animal Weight | Animal Age | Gender | Blindness | Limping | Complete Ears | Amount |
|---|---|---|---|---|---|---|---|
| Animal Weight | 0.38 * 1 = 0.38 | 0.24 * 3 = 0.72 | 0.15 * 4 = 0.60 | 0.11 * 5 = 0.55 | 0.08 * 3 = 0.24 | 0.05 * 4 = 0.20 | **2.69** |
| Animal Age | 0.38 * 0.33 = 0.13 | 0.24 * 1 = 0.24 | 0.15 * 3 = 0.45 | 0.11 * 3 = 0.33 | 0.08 * 4 = 0.32 | 0.05 * 5 = 0.25 | **1.72** |
| Gender | 0.38 * 0.25 = 0.10 | 0.24 * 0.33 = 0.08 | 0.15 * 1 = 0.15 | 0.11 * 3 = 0.33 | 0.08 * 3 = 0.24 | 0.05 * 3 = 0.15 | **1.05** |
| Blindness | 0.38 * 0.20 = 0.08 | 0.24 * 0.33 = 0.08 | 0.15 * 0.33 = 0.05 | 0.11 * 1 = 0.11 | 0.08 * 3 = 0.24 | 0.05 * 3 = 0.15 | **0.71** |
| Limping | 0.38 * 0.33 = 0.13 | 0.24 * 0.25 = 0.06 | 0.15 * 0.33 = 0.05 | 0.11 * 0.33 = 0.04 | 0.08 * 1 = 0.08 | 0.05 * 3 = 0.15 | **0.51** |
| Complete Ears | 0.33 * 0.33 = 0.11 | 0.23 * 0.33 = 0.08 | 0.17 * 0.33 = 0.06 | 0.12 * 0.33 = 0.04 | 0.09 * 0.33 = 0.03 | 0.06 * 1 = 0.06 | **0.38** |

4. Consistency Ratio Calculation
   This calculation is used to ensure that the consistency ratio (CR) value is <= 0.1. If the CR value is found to be greater than 0.1, then the pairwise comparison matrix needs to be revised. To calculate the consistency ratio, a table is created as shown in Table 4.

Table 4. Calculation of Consistency Ratio

| Criteria | Sum per Row | Priority | Result |
|---|---|---|---|
| Animal Weight | 2.69 | 0.38 | 3.07 |
| Animal Age | 1.72 | 0.24 | 1.96 |
| Gender | 1.05 | 0.15 | 1.20 |
| Blindness | 0.71 | 0.11 | 0.82 |
| Limping | 0.51 | 0.08 | 0.59 |
| Complete Ears | 0.38 | 0.05 | 0.43 |
| | **Amount** | | 8.07 |

The column sum per row is obtained from the "Sum" column in Table 3, while the priority column is obtained from the "Priority" column in Table 2. From the consistency ratio calculation table, the following values are obtained:

Sum = 8.07
N (Number of criteria) = 6
$\lambda$ Max (Sum/N) = 8.07 / 6 = 1.35
CI (($\lambda$ Max-N)/N) = ((1.35 - 6)/6) = -0.78
CR (CI/IR (See table 3.5)) = -0.78 / 1.24 = -0.63
Since CR < 0.1, the consistency ratio of the calculation is acceptable.

From the calculation results of the steps above, the weights for each criterion are obtained and can be seen in Table 5.

Table 5. Weights for Each Criterion

| Criteria | Weights |
|---|---|
| Animal Weight | 0.38 |
| Animal Age | 0.24 |
| Gender | 0.15 |
| Blindness | 0.11 |
| Limping | 0.08 |
| Complete Ears | 0.05 |

After obtaining the weights for each criterion, the next step is to perform calculations for the selection of sacrificial animals using the SMART method. Calculation of sacrificial animal selection using the SMART method. This method is chosen as a decision support method based on the concept of seeking the best alternative from a number of alternatives based on specific criteria, in this case, selecting sacrificial animals according to expectations.

The process of calculating the utility value weights for the animal with code P001 in the qurban animal selection is as follows:

a. Weight of Animal Weight Utility Value

$$= \frac{\text{Animal Weight Utility Value} - \text{Minimum Animal Weight Utility Value}}{\text{Maximum Animal Weight Utility Value} - \text{Minimum Animal Weight Utility Value}}$$

$$= \frac{0.2 - 0.07}{0.42 - 0.07} = 0.37$$

b. Weight of Animal Age Utility Value

$$= \frac{\text{Animal Age Utility Value} - \text{Minimum Animal Age Utility Value}}{\text{Maximum Animal Age Utility Value} - \text{Minimum Animal Age Utility Value}}$$

$$= \frac{0.24 - 0.08}{0.36 - 0.08} = 0.57$$

c. Weight of Gender Utility Value

$$= \frac{\text{Gender Utility Value Weight} - \text{Minimum Gender Utility Value}}{\text{Maximum Gender Utility Value} - \text{Minimum Gender Utility Value}}$$

$$= \frac{0.4 - 0.07}{0.4 - 0.07} = 1$$

d. Weight of Blindness Utility Value

$$= \frac{\text{Blindness Utility Value} - \text{Minimum Blindness Utility Value}}{\text{Maximum Blindness Utility Value} - \text{Minimum Blindness Utility Value}}$$

$$= \frac{0.39 - 0.07}{0.39 - 0.07} = 1$$

e. Weight of Limping Utility Value

$$= \frac{\text{Limping } utility \text{ Value} - \text{Minimum Limping Utility Value}}{\text{Maximum Limping Utility Value} - \text{Minimum Limping Utility Value}}$$

$$= \frac{0.24 - 0.07}{0.4 - 0.07} = 0.52$$

f. Weight of Complete Ears Utility Value

$$= \frac{\text{Complete Ears Utility Value} - \text{Minimum Complete Ears Utility Value}}{\text{Maximum Complete Ears Utility Value} - \text{Minimum Complete Ears Utility Va;ue}}$$

$$= \frac{0.24 - 0.12}{0.38 - 0.12} = 0.46$$

$$= \frac{0.12 - 0.12}{0.38 - 0.12} = 0$$

Table 6. Weight of Criteria Utility Value

| Animal Code | Criteria Name | Weight of Utility Value |
|---|---|---|
| P001 | Animal Weight | 0.37 |
| | Aniamal Age | 0.57 |
| | Gender | 1 |

| Animal Code | Criteria Name | Weight of Utility Value |
|---|---|---|
| | Blindness | 1 |
| | Limping | 0.52 |
| | Complete Ears | 0.46 |

5. Calculate the Final Value
   The process of calculating the final value for animal code P001 in qurban animal selection is as follows:
   Final Value = (Normalized Weight of Animal Weight * Weight of Animal Weight Utility) + (Normalized Weight of Animal Age * Weight of Animal Age Utility) + (Normalized Weight of Gender * Weight of Gender Utility) + (Normalized Weight of Blindness * Weight of Blindness Utility) + (Normalized Weight of Limping * Weight of Limping Utility) + (Normalized Weight of Complete Ears * Weight of Complete Ears Utility)
   = (0.38 * 0.37) + (0.24 * 0.57) + (0.15 * 0.1) + (0.11* 1) + (0.08 * 0.52) + (0.05 * 0.46)
   = 0.14 + 0.14 + 0.015 + 0.11 + 0.04 + 0.023
   = 0.61

Here is the assessment for animal code P001 based on the criteria of Animal Weight, Animal Age, Gender, Blindness, Illness, Limping, Emaciation, Complete Ears using the SMART method. The final calculated value for the qurban animal selection is 0.61. Based on the weighting of the final values, it can be concluded that the animal with a value of 0.61 and code P001 is the chosen option for selection. The following is the display of the Android application for qurban animal selection, as seen in the following image:

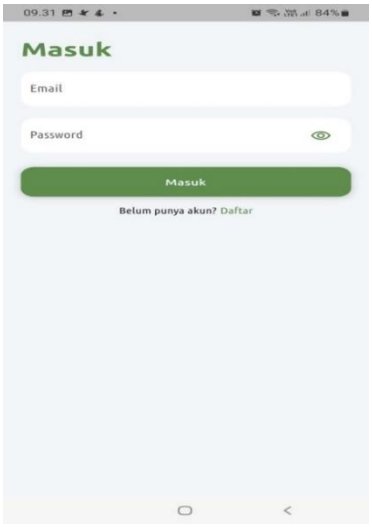


Figure 3. Login Menu

In this menu, admins can log in using the email admin@gmail.com and password 123456, while users can log in using the email user@gmail.com and password 123456.

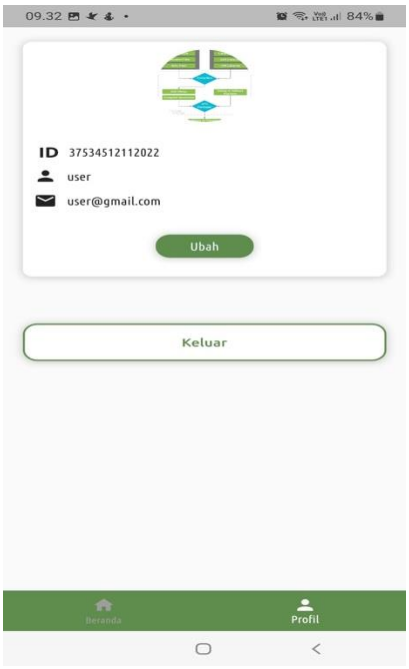


Figure 4. Profil Menu

In the profile menu, users can change their name, email, place of birth, and password.

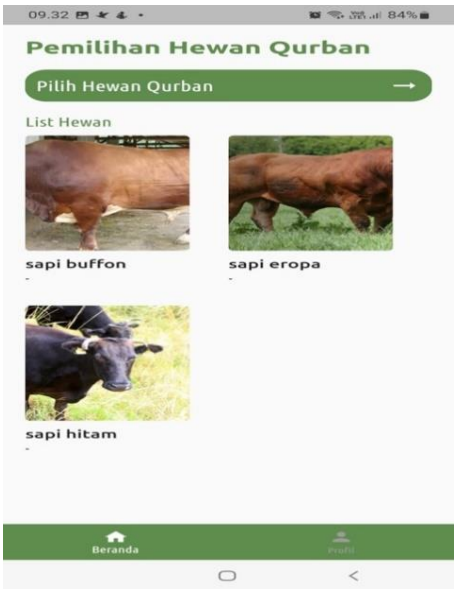


Figure 5. Menu List of Sacrificial Animals

In this menu, users can view descriptions of the sacrificial animals.


Figure 6. Select The Sacrificial Animals


Figure 7. Recommendations For The Selection of Sacrificial Animals

In this menu, recommendations based on the comparison of several selected sacrificial animals will be displayed.


Figure 8. Menu List of Sacrificial Animals In Admin Login

In this menu, the admin can add the quantity of sacrificial animal lists.

## 4. CONCLUSSION

This research focuses on an Android-based recommendation system for qurban animal selection using the AHP and SMART methods, designed to assist the community in making informed decisions about their chosen qurban animals. The simulation calculations yielded positive results with three test data. The selected criteria are based on reliable references, encompassing important and justifiable

factors. However, in future system developments, these criteria could be expanded to enhance the quality of qurban animals produced. By implementing this system, it is expected to elevate the quality of qurban animals. The assessment for animal code P001 based on the criteria of Animal Weight, Animal Age, Gender, Blindness, Illness, Limping, Emaciation, Complete Ears using the SMART method resulted in a final calculated value of 0.61. Based on the weighting of the final values, it can be concluded that the chosen animal has a value of 0.61 with code P001.

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