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Cowshed Design Using Quality Function Deployment (QFD) Method

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ABSTRACT

The increase in population and public awareness of the importance of animal protein have also caused increasion of animal protein consumption, especially beef. Therefore, it is necessary to increase beef production by increasing the livestock cattle. Cage condition plays an important role in increasing beef production. The better condition of the cowshed, the greater cow's health will improve. The QFD method aims to design cowshed based on user desires by translating them into attribute forms. The criteria desired by users for the design of cowshed include: a) There is waste disposal; b) Using brick walls; c) Using wooden poles; d) The pen does not smell; e) Using an asbestos roof; f) There is good ventilation/air circulation; g) Simple shape; h) Individual pen model; and i) There is urine and feces processing. The results of cowshed design using the QFD method that are in accordance with user desires include: a) There is a liquid waste drainage channel; b) There is a place for cow dung; c) The boundary wall in the pen is made of brick with a height of 100 cm; d) The poles in the pen are made of wood with a round shape; e) The slope of the floor is approximately 2 degrees so that the floor is dry; f) Using an asbestos roof; g) The design of a simple cage is as needed; h) There are food and drink containers for each cow; i) There is a place to tie but no divider for each cow; and j) There is a place to store liquid waste and a place for solid waste.

Kata kunci: *Quality Function Deployment, cowshed, product design*

A. INTRODUCTION

Facts shows that from 2021 to 2023, Indonesia's population has increased on average 1.13 percent [1][2]. This phenomenon in line with increasing public awareness of the importance of animal protein. This causes consumption of animal protein, especially beef, to increase. The price trend for beef is always increasing due to high demand, while the supply of beef on the market is not yet sufficient mencukupi [3][4][5]. Therefore, it is necessary to increase beef production by increasing the number of cattle livestock.

The problem in increasing beef production lies in the condition of cowshed. The better the condition of the cowshed, the better the cow's health will be. A good cowshed needs to pay attention on several things, such as: selection of the cowshed location, cowshed layout, cowshed construction, cage materials, and cage equipment, so that it can increase the productivity of beef cattle [6]. Among these things, cage construction is one of the most important. Cage construction is influenced by several principles, including the shape of the cage, roof, slope, ventilation, drainage and environmental sanitation around the cage [7].

In design, QFD (Quality Functional Deployment) is one of the successful methods used. The advantages of using the QFD method are that it is not too complicated, easy to use and implement [8]. The QFD method aims to design based on user desires by translating them into attributes [9]. QFD also involves stakeholders to provide systematic consideration of the needs

and features of the product to be made [10]. Based on that, it is necessary to design a good cowshed that suits user desires using Quality Function Deployment Method.

B. LITERATURE

B.1. Cowshed

Some of the requirements needed in building a cage include (1) Qualify the health requirements of the livestock, (2) Having good ventilation, (3) Efficient management (4) Protecting livestock from the effects of climate and theft (5) Has no impact on the surrounding environment. [11] [12].

Functions of the cowshed:

1. Protecting livestock from extreme weather or climate changes (heat, rain and wind).
2. Preventing and protecting livestock from disease.
3. Maintaining livestock security from theft.
4. Facilitating livestock management in the production process such as feeding, drinking, compost management and mating.
5. Increasing efficiency of labor use.

B.2. Product Design

Product design is a scheme where functional elements and products are arranged into several collections of components in physical form. To design a new product, you must first understand the concept in developing a product. The concept development process includes activities such as: identifying customer needs, determining target specifications, drafting concepts, selecting concepts, testing concepts, determining final specifications, project planning, economic analysis, analyzing competing products, modeling and prototyping [13].

In determining product design, companies generally go through careful consideration and cover all aspects. In its development, sometimes the decision-making for the final product design is more dominantly determined by engineers, when an engineer also becomes a designer. Design is determined during the concept development and system level design phases. While the method for determining product design consists of several stages, such as [14]:

1. Creating a product scheme.
2. Grouping the elements contained in the scheme.
3. Creating a rough geometric design.
4. Identifying fundamental and incidental interactions

B.3. Quality Function Deployment (QFD)

Quality Function Deployment (QFD) is the practice of designing a process in response to customer needs. This is accomplished by involving customers in the product development process as early as possible. Thus, QFD allows a company to prioritize customer needs, find innovative responses to these needs, and improve processes until maximum effectiveness is achieved [15][16].

The steps taken in designing with the Quality Function Deployment method include eight steps. These steps are: (1) Identifying customers/consumers, (2) Determining customer needs or desires, (3) Conducting a consumer survey to determine the importance level and competitor evaluation, (4) Building a consumer matrix, (5) Building a technical needs matrix, (6) Determining technical interests, (7) Analyzing the matrix and choosing the priority of attributes to be developed (8) Comparing initial design concepts and choosing the best [17].

To design a cow shed that has functions that suit the needs, a product design method is needed to translate user needs into technical requirement. The QFD method is used starting from identifying the functions needed to the technical requirement in the cow shed. The product

design process is carried out after the concept and technical requirement are formulated. Product design is carried out by creating concept drawings for each technical need.

C. RESEARCH METHOD

C.1. Population and Sample

The population in this study were cattle owners or breeders in the Klaten area, Central Java. While the sample in this study were cattle owners and breeders in the Bayat sub-district of Klaten, Central Java.

C.2. Data Collection

Data collection process was carried out in several ways; (1) Interviews by asking general questions to cowshed users about the lack of existing cowsheds and what they want; (2) Questionnaires were used to identify user needs for good cowsheds; (3) Literature studies were conducted by reading and studying several references such as literature, scientific reports and other supporting scientific writings.

C.3. Research Procedure

First stage is preparation stage, the activities in this stage are prepare the tools and materials that will be used in the research, including: (1) Questionnaires, (2) Stationery, (3) Measuring tools/meters, and (4) Design computers.

Second stage is user desire indentification using the Quality Function Deployment (QFD) method. (1) The first stage is to provide a questionnaire containing open questions to 40 respondents who use cowshed. This questionnaire was given to cattle breeders, about what kind of cowshed they want. (2) The second stage, the questionnaire will be given again to determine the level of importance from each criterion for the cowshed desired by the breeder. (3) The third stage is that each criterion desired by the user is translated into technical specifications for the cowshed to be designed. (4) Create a cowshed design based on existing technical specifications. All of the stage can be seen in Figure 1.

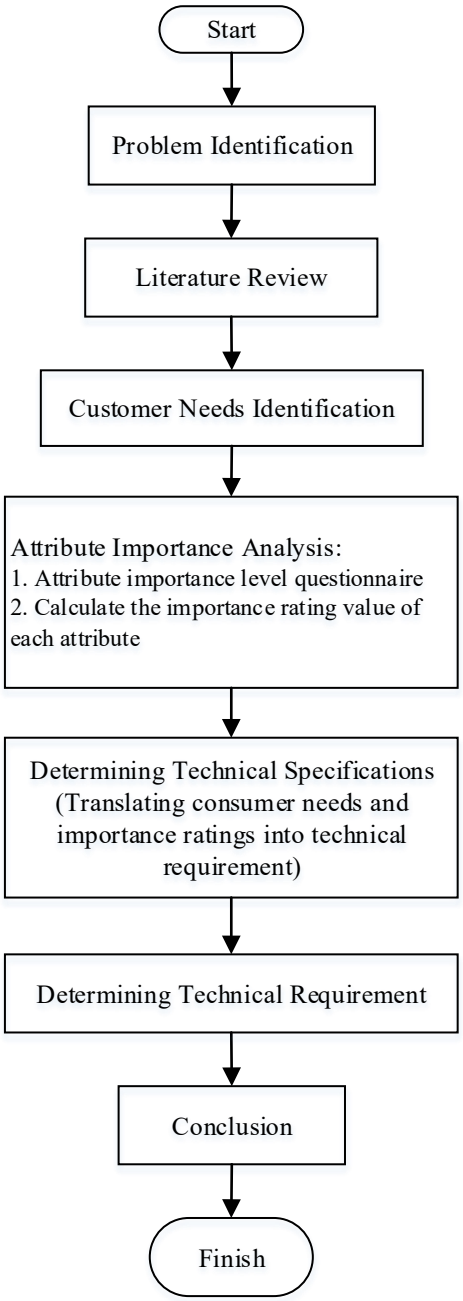

Figure 1. Research Flowchart

D. RESULT AND DISCUSSION

D.1. User Needs Questionnaire Data

From the results of distributing questionnaires to 40 respondents consist of owners and workers on cattle farms/fattening farms, a list of user needs can be seen in Table 1 below:

TABEL 1
USER NEEDS

No	Atribut	Number of Respondents
1	Available Waste Disposal	24
2	Brick Wall	21

3	Wooden Pole	15
4	Odorless	13
5	Asbestos	20
6	Ventilation	16
7	Simple	14
8	Individual model	14
9	Urine and feces processing facility	13

The results of the first questionnaire using the QFD method consisted of 9 consumer desires and needs for cowshed. The consumer's desires and needs in Table 1 will be used as input to find the importance rating value in the second questionnaire.

D.2. Importance Rating

This importance rating data was obtained from the second questionnaire distribution which contained questions about the level of importance from each attribute based on each respondent. The importance rating value for each attribute can be seen in Table 2 below:

TABEL 2
***IMPORTANCE* RATING OF COWSHED ATTRIBUTE**

No	Atribut	Importance Rating
1	Available Waste Disposal	4,45
2	Brick Wall	3,65
3	Wooden Pole	3,9
4	Odorless	3,7
5	Asbestos	4
6	Ventilation	4
7	Simple	3,95
8	Individual model	3,7
9	Urine and feces processing facility	4,1

D.3. Technical Requirement

Technical requirements are a translation of consumer needs into technical form the product can be created directly. In this section there are specific targets that will be set based on the company's capabilities that have been determined through customer needs. The technical requirements of each consumer need can be seen in Table 3 below:

TABEL 3
TECHNICAL REQUIREMENT

No	***Customer Needs***	***Technical Requirement***
1	Available Waste Disposal	Available liquid waste disposal channel
		Available cow dung container
2	Brick Wall	The cage boundary wall is made of brick with a height of 100 cm.
3	Wooden Pole	The poles in the cage are made of wood with a round shape
4	Odorless	The floor slope is approximately 2 degrees to keep the floor dry (Aziz *et al*, 2013)
5	Asbestos	Using an asbestos roof
6	Ventilation	Open cage with a 100 cm fence

7	Simple	Simple cage design according to needs
8	Individual model	Available food and drink containers for each cow
9	Urine and feces processing facility	Available tying place but no barrier for each cow
		Available liquid waste storage and solid waste storage

D.4. Cowshed Design

The technical characteristics obtained from interpreting consumer desires, then used as a basis for designing a cowshed. The cowshed design results are as follows:

1. Cowshed

As seen in Figure 2 and Figure 3, tying pole cow's height is 1.6 meters, iron pipe fence height is 1.5 meters, feed and drink container height is 0.8 meters, and height of the fence from the outside is 1 meter.

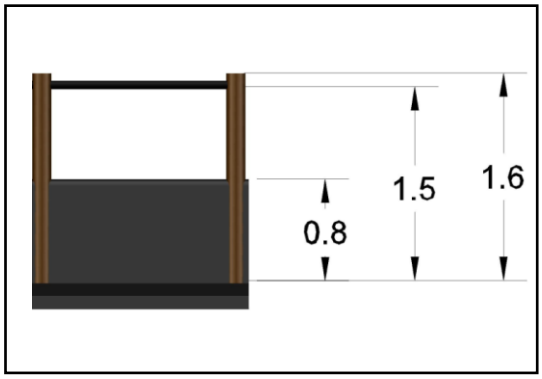

Figure 2. Rear view of Cowshed

Figure 3. Side view of Cowshed

The cowshed design results has a length of 7.5 meters and a width of 3.3 meters without a water channel for a capacity of 5 adult cows. The room size for each cow is 1.5 x 2.5 meters. The top view design of cowshed is as follows:

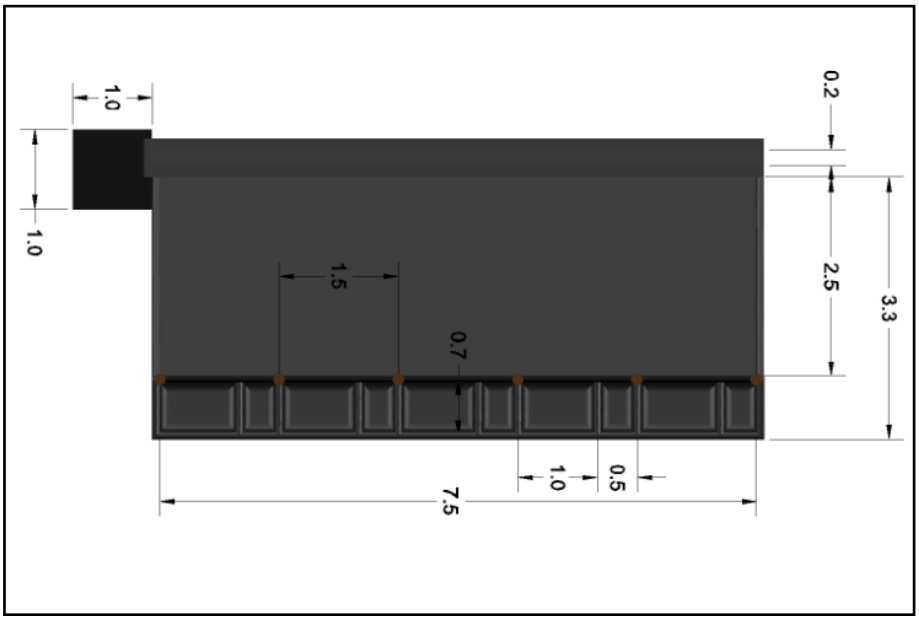

Figure 4. Top view of cowshed

2. Cow Feeding and Drinking Area

The cow's feed and drink area is made higher on the part facing the cow's body, which aims to minimize cow feed falling into the area inside the cage, which will make it difficult to clean, making the cage dirty and smelly. Feeder and drinker edges area are designed in an oval shape so if it comes to cow's skin it will not cause injury to the cow. Oval shape inside the cow's feeder is designed so that the cows can reach all corners of the feeder. This aims to ensure that all the feed is used up and can be replaced with new feed.

The width of cow feed and drink area is 0.6 meters, the depth is 0.3 meters for the front side and 0.4 meters for the back side. Cow's feed area length is 1 meter and cow's drink area length is 0.5 meters. Design of cow feed and drink area is described as follows:

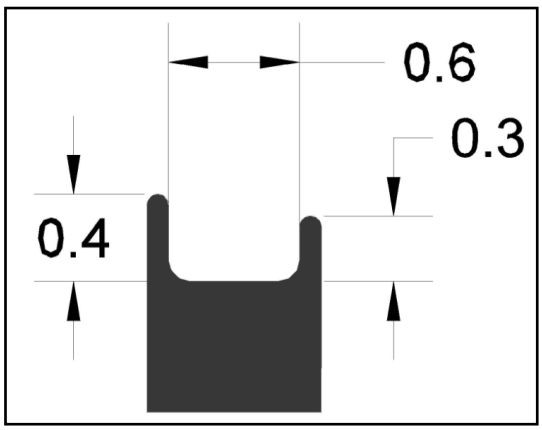

Figure 5. Side View of Feeding and Drinking Area

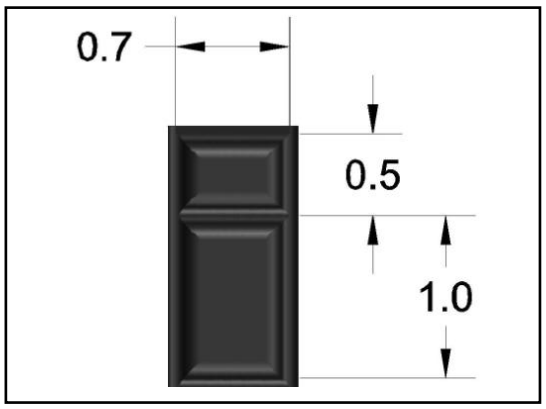

Figure 6. Top View of Feeding and Drinking Area

3. Cowshed Floor

Cage's front floor thickness is 0.2 meters while the back is 0.1 meters. Floor length to the back is 2.5 meters with a slope of 2 degrees (Aziz et al, 2013) to ensure that liquid waste can flow in one direction towards the back where there is a liquid waste channel to then be channeled to the storage. Top floor is covered with a rubber sheet to prevent the floor from being slippery. Cowshed floor design looks like Figure 7 below:

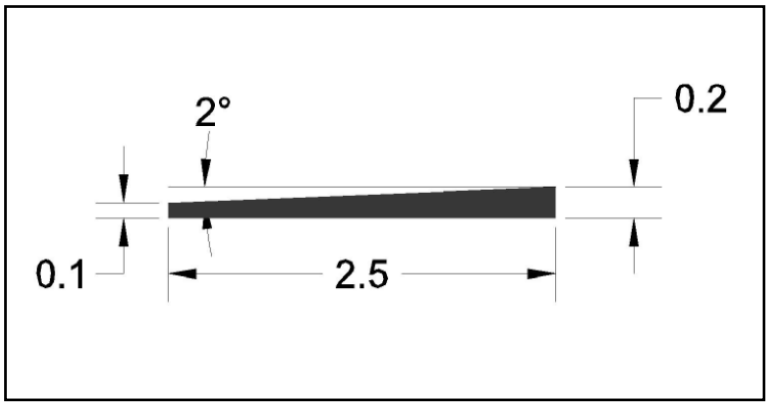

Figure 7. Cowshed's Floor

4. Liquid waste channel

The liquid waste channel is located at the back of the cow and slopes to one side so that the liquid waste can flow towards the reservoir. The cover on the liquid waste channel can be a wooden structure or iron plate that is given small holes for water to fall into the channel. The width of the liquid waste channel is 0.2 meters. The depth of the liquid waste channel on the low side which is the direction of flow is 0.3 meters. For the slope of the liquid waste flow 3 degrees. From this channel, the liquid waste goes directly to the reservoir. The design of the liquid waste channel seen Figure 8 and Figure 9:

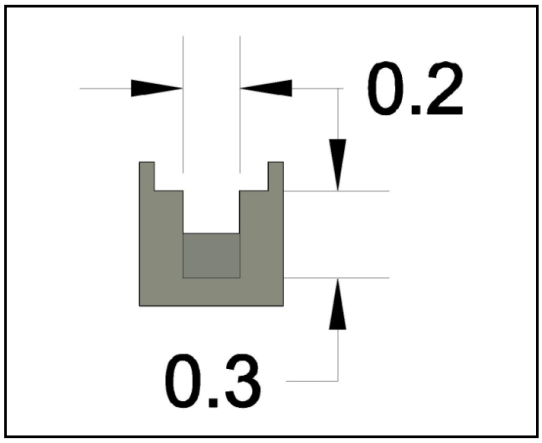

Figure 8. Side View of Liquid Waste Channel

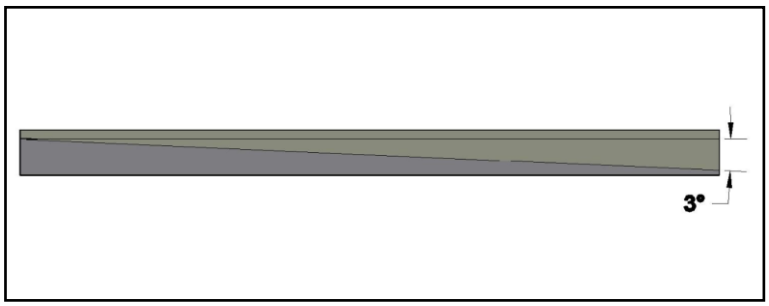

Figure 9. Front View of Liquid Waste Channel

5. Liquid Waste Storage

The liquid waste storage area is located at cage back side at the end of the liquid waste channel. Made from concrete with a thickness of 0.1 meters. The dimensions of outer liquid waste storage are 1 meter long, 1 meter wide, and 1 meter deep. The dimensions of the inner part: 0.8 meters long, 0.8 meters wide and 0.9 meters deep. Reinforced concrete cover installed on the top, sized 1 meter x 1 meter with a thickness of 0.1 meters. The following is a picture (Figure 10 and Figure 11) of liquid waste storage design:

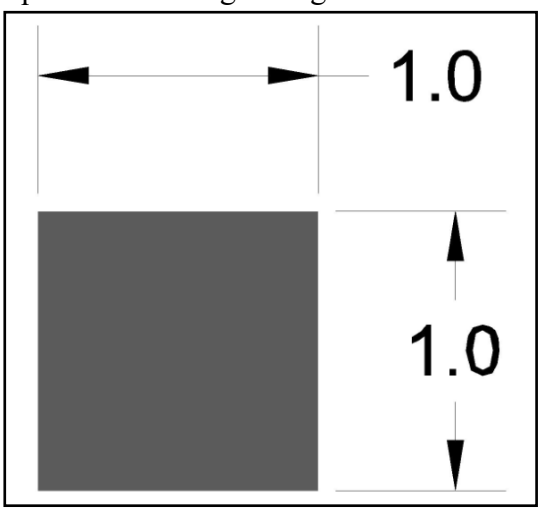

Figure 10. Side View of Liquid Waste Storage

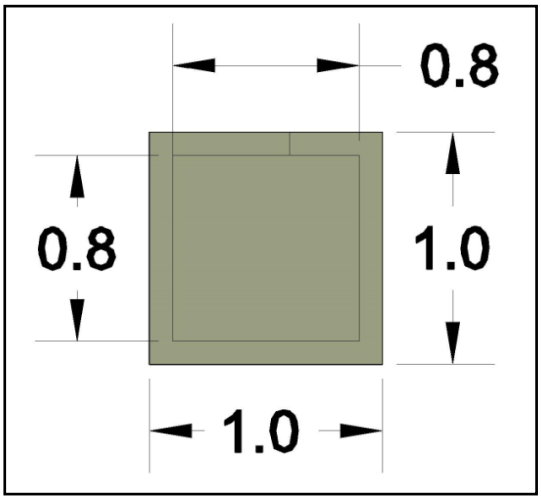

Figure 11. Top Side of Liquid Waste Storage

From the several parts of cowshed above, the complete cowshed shape with pillars, roof and outer fence is as shown in the following picture. Front view of cowshed seen in Figure 12. Side view of cowshed seen in Figure 13 and isometric view of cowshe seen in Figure 14.

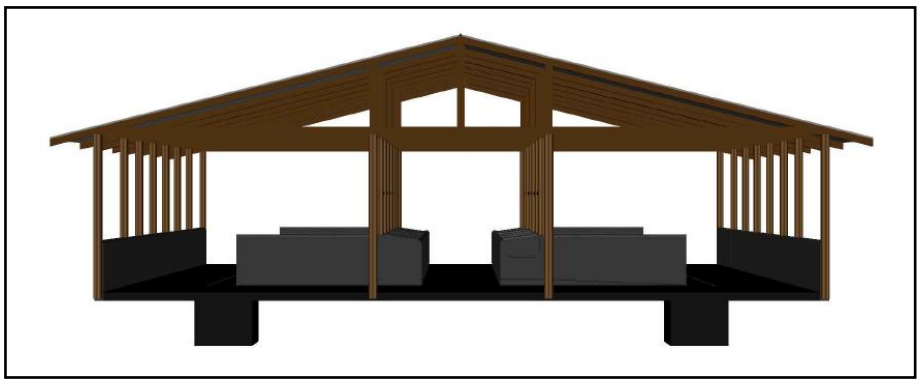

Figure 12. Front View of Cowshed

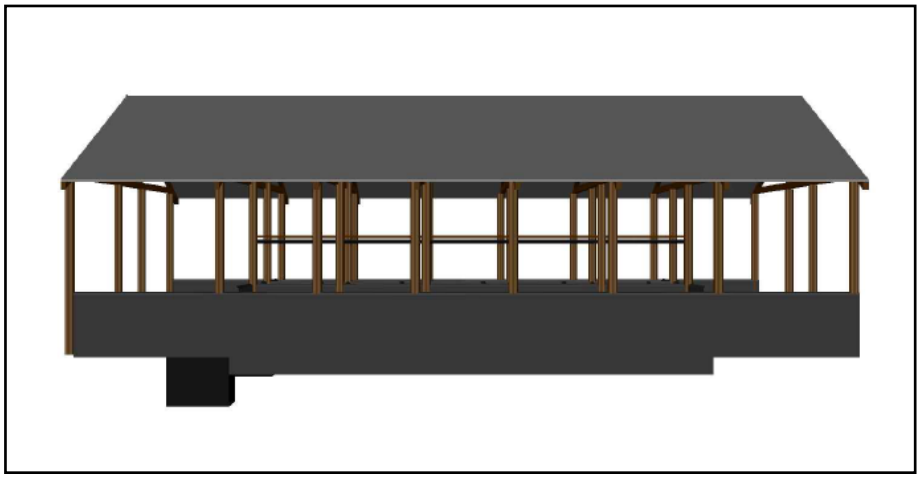

Figure 13. Side View of Cowshed

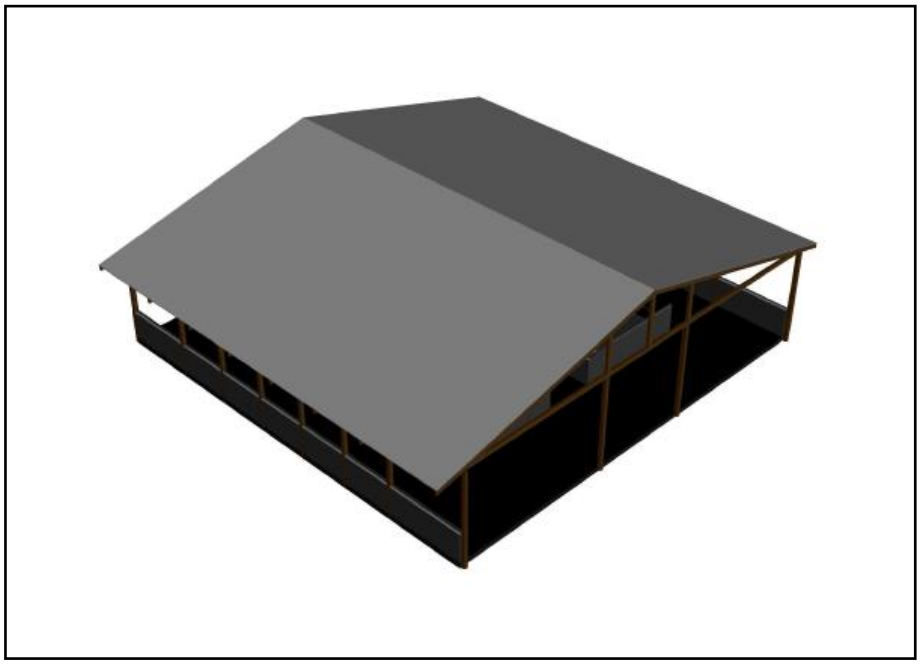

Figure 14. Isometric View of Cowshed

E. CONCLUSION

From the research, it can be concluded that the criteria desired by users for cowshed design are: a) Available waste disposal; b) Using brick walls; c) Using wooden poles; d) Odorless cage; e) Using an asbestos roof; f) Good ventilation/air circulation; g) Simple shape; h) Individual cage model; and i) Urine and feces processing facility. Cowshed designs that suits user desires include: a) Available liquid waste drainage channel; b) Available cow dung container; c) The cage boundary wall is made of brick with a height of 100 cm.; d) The poles in the cage are made of wood with a round shape; e) The floor slope is approximately 2 degrees to keep the floor dry; f) Using an asbestos roof; g) Simple cage design according to needs; h) Available food and drink containers for each cow; i) Available tying place but no barrier for each cow and j) Available liquid waste storage and solid waste storage.

For the future research, it is recommended to involve stakeholders consisting of experts who are needed so that the cowshed design result is more better.

Bibliography

[1] Ionica, A. C. (2015). QFD integrated in new product development-Biometric identification system case study. Procedia Economics and Finance, 986-991.

[2] Statistik, B. P. (2024). Laju Pertumbuah Penduduk. https://www.bps.go.id/id/statistics-table/2/MTk3NiMy/laju-pertumbuhan-penduduk.html.

[3] Agustin, N. (2017). Faktor-Faktor yang Mempengaruhi Harga Daging Sapi di Indonesia.

[4] Ilham, N. (2009). Kebijakan Pengendalian Harga Daging Sapi Nasional. Analisis Kebijakan Pertanian, 7(3), 211-221.

[5] Getaevan, T. Y. (2019). Penyebab Harga Daging Sapi Lokal Lebih Tinggi Dari Harga Daging Sapi Impor Serta Cara Mengubah Kesenjangan Harga. Calyptra : Jurnal Imliah Mahasiswa Universitas Surabaya, 8(1).

[6] Sandi, S., & Purnama, P. P. (2017). Manajemen Perkandangan Sapi Potong di Desa Sejaro Sakti Kecamatan Indralaya Kabupaten Ogan Ilir. Jurnal Peternakan Sriwijaya, 6(1).

[7] Suwiti, N. K., Besung, I., Sriyani, N., Sampurna, & Agustina. (2016). Aplikasi Teknologi Pada Peternakan Sapi Bali Dengan Sistem Pemeliharaan Berbasis Terintegrasi Lingkungan. Jurnal Udayana Mengabdi, 216-222.

[8] Moubcahir, Y., & Bouami, D. (2015). A New Approach For The Transition Between QFD Phases. Procesia CIRP, 82-86.

[9] Zadry, H. R., & Irfansyah, D. A. (2015). Investigation of Customer and Technical Requirements for Designing an Ergonomics Notebook Soft Case Using Quality Function Deployment (QFD) Approach. Industrial Engineering, Management Science and Applications , 949-957.

[10] Schillo, R. S., Isabelle, D. A., & Shakiba, A. (2017). Linking Advanced Biofuels Policies with Stakeholder Interests: A Method Building on Quality Function Deployment. Energy Policy, 126-137.

[11] Pakari, A., & Ghani, S. (2021). Comparison of different mechanical ventilation systems for dairy cowsheds: CFD simulations and field measurements. Computers and Electronics in Agriculture.

[12] Lv, M., Xiao, I., Mentenich, C., Jia, Z., Xie, N., Zhang, W., & Bretz, L. (2024). Quality Function Deployment (QFD) for human-robot collaboration (HRC): Systematic selection of key performance indicators in HRC. 57th CIRP Conference on Manufacturing Systems 2024 (CMS 2024).

[13] Pessôa, M. V., & Becker, J. M. (2020). Smart Design Engineering: A Literature Review of The Impact of The 4th Industrial Revolution on Product Design and Development. Research in Engineering Design , 175-195.

[14] Ulrich, K. T., & Eppinger, S. D. (2001). Perancangan dan Pengembangan Produk. Jakarta: Salemba Teknika.

[15] Yohanes, & Azhar, H. A. (2023). Design of Biomass Stove Using the Quality Function. Journal of Ocean, Mechanical and Aerospace, 29-33.

[16] Yasmi, M. R. (2023). Pengembangan Desain Produk Kemasan Kopi Di Sapuangin. Jurnal Syntax Admiration.

[17] Yang, C., & Wang, J. C. (2019). Hybrid quality function deployment method for innovative new product design based on the theory of inventive problem solving and Kansei evaluation. Advances in Mechanical Engineering, 1-17.