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Ergonomic design of paddy irrigation covers to increase agricultural productivity

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Abstract

The use of conventional galengan in rice fields in Rumpa'e hamlet, Telle Village, Ajangale District. Bone is still made from soil, banana trees and bamboo as raw materials for making galengan. This is easy for damage to occur because the soil is not dense and is not effective in making galengan, thus hampering the irrigation process system between rice fields. Therefore, the aim of this research is to design a rice irrigation cover design that is not easily damaged and makes the irrigation process system between rice fields easier. This research uses the method QFD (*Quality Function Deployment)*So there are 9 statements produced based on the results of interviews with farmers, these 9 statements have been classified based on the interests and needs of farmers. Based on the results of this research, it is possible to design a rice irrigation cover design based on the results of QFD data processing that is not easily damaged using various types of raw materials.(Stainless steel) and is efficient in the manufacturing process, making it easier for farmers in the process of using it because it uses a sliding system.

Keywords: Galengan; Ricefield; Product design; QFD; House of Quality

1. Introduction

The Big Indonesian Dictionary (KBBI) defines galengan as a small embankment in rice fields [1]. South Sulawesi Province has a rice field area of around 628 148.00 Ha based on 2015 Central Statistics Agency (BPS) data [2] which includes Bone district with a total rice field area of around 89,700 Ha [3]. Referring to this data, maximum irrigation processes are needed so that rice grows well [4]. Galengan is one of the determining factors in the success of the irrigation process between rice fields, based on data from the National Standardization Agency (BSN) 2010 defining rice fields as agricultural areas that must be flooded with water [5].

Reported by various news portals regarding irrigation problems experienced by rice farmers, rice farmers fight over irrigation water in the dry season [6], thousands of hectares of rice fields are threatened with puso due to drought [7], farmers' fields are prone to drought, irrigation water discharge is increasingly reduced [8] , fighting over water for rice fields, farmers in Subang Bacok Teman [9] due to heavy rain, hundreds of hectares of rice fields are threatened with crop failure [10]

The galengan used by farmers currently located in Telle village, Ajangale sub-district still uses soil and banana stems or bamboo as the basic materials for making galengan, because they still use simple materials, problems often occur which farmers experience, including frequent damage caused by the soil being used. The galengan media is not too dense or there is something else that causes the galengan to be damaged. On the other hand, farmers who want their galengan to be strong and minimize damage, farmers must add banana trees in making galengan, but not all rice fields are close to residential areas. This requires extra energy to carry the banana trees into the rice fields, and these banana trees cannot last long. and can only be used for approximately one rice planting season, it is less effective in the process of making galengan, thereby hampering the irrigation system between rice fields.

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The Quality Function Deployment (QFD) method was chosen because this method translates consumer needs, desires and values in technical form [11]. The identification of consumer requests and needs is carried out so that the product meets consumer needs and the data collection method requires direct interaction with consumers [12] was first developed in a Japanese company in the 1970s. One of the figures who discovered this method is Dr. Yoji Akao[13] This method was also used in previous research entitledRedesign of multifunctional tissue holder products using the Quality Function Deployment method [14] Design of multifunctional travel bag products using the Quality Function Deployment (QFD) method [15] Design and Development of Bed Showers Using the Quality Function Deployment (QFD) Method Based on Ergonomics Principles [16] Product design for portable cell phone chargers using the quality function deployment (QFD) method [17] Design of packaging design for processed Cekdol products using the quality function deployment method [18].

It is hoped that this tool will make it easier for farmers to irrigate rice fields and make rice fields that are not easily damaged so that they are not made over and over again. Using stainless steel materials [19]. Through this tool, it is also hoped that it will make farmers' work easier, and can be a means of creating village tourism, that currently there are a total of 978 tourist villages in Indonesia, this number has continued to increase sharply since 2009 when there were only 144 tourist villages. So farmers can earn income through foreign tourists or students who visit rice fields who have used this product as an educational medium [20].

2. Methodology

2.1. Place and time of research

The research site used was a rice farming location in Rumpae Hamlet, Telle Village, District. Ajangale District. Bone, the research period lasted approximately 3 months, starting from February to April 2021.

2.2. Population and sample

The population in this research were farmers in Rumpae Hamlet, totaling 535 people, the sample used in this research was 85 people. The sampling technique used was a purposive sampling technique with criteria including (1) rice field farmers in Rumpae Hamlet (2) understand and understand how to make galengan.

2.3. Product design

The product designed in this research is a galengan which consists of pole stakes, main door galengan walls, door linings and door locks. This research designs irrigation covers between rice fields based on the results of problems and farmers' requests.

2.4. Research procedure

2.4.1. Research study

The first stage was carried out before the research by conducting literature studies and field studies, with this collecting references to support the research, surveying the population, determining the number of samples, conducting direct surveys in the rice fields and conducting interviews with farmers.

2.4.2. Data collection

Primary data in this research was conducted by conducting direct interviews with farmers who then classified the results of the interviews and made them into questionnaires. Secondary data in this research comes from journal references regarding rice fields, product design, stainless steel and the Quality Function Deployment (QFD) method.

2.4.3. Data processing

Data processing in this research uses the Quality Function Deployment (QFD) method to determine consumer needs, desires and values translated into technical provisions. The data processing steps in this research use the Quality Function Deployment (QFD) method starting with (1) Validity tests are carried out to determine the extent to which this research questionnaire can measure what it should measure, (2) Reliability tests are used to determine the consistency of the questionnaire. in its use (3)*Importance To Customers*shows how big the level of desire is for each variable of the rice field flow cover design (4)*customer satisfaction Performance*is a response to a product or service that can meet consumer needs (5) Goals are set to determine the targets to be achieved by researchers, namely by assessing how far researchers want to meet farmers' needs by considering whether the farmers' needs can be met or not (6)

Improvement Ratio shows how much effort the company must make to achieve the Goal (7) sales point sales point shows how much influence it has in meeting farmers' demand for products (8) Raw Weight is the value of the overall importance of farmers' needs (9) Normalization of Raw Weight Raw Weight value which is made on a scale of 0 to 1 or in percentage (10). Determining technical response and consumer needs can be shown by a symbol that represents how strong the relationship is between technical response and consumer needs.

3. Results and Discussion

3.1. Descriptive statement

In the interview process to obtain information on the galengan problems experienced by Rumpae hamlet farmers, 9 points were classified. The 9 points are (1) rice field flow cover products that have standards for holding the volume of rice field water (2) Rice field flow cover products as an alternative means of crossing between rice field embankments (3) Products must be made from strong raw materials (4) Farmers want flow products rice fields that are resistant to pressure (5) Must have the quality of retaining water (6) Be efficient in the process of irrigating rice fields (7) This rice field flow cover product must be designed with its function (8) The use system must make it easier for farmers (9) The capital spent is not too expensive.

3.2. Data processing results

3.2.1. Validity test

The validity test was carried out on the distribution of research questionnaires to 85 respondents. Thus it can be concluded that statement number 1 is declared valid because r calculated > from r table: 0.395 > 0.252.

3.2.2. Reliability test

The instrument used with 9 questions had a Cronbach's alpha value of 0.665 which was declared reliable as being greater than 0.252. Then you can proceed to the design stage using Qaulity Function Deployment (QFD).

3.2.3. Importance To Customer

The highest Itc value is 4.892. Resistant to pressure loads, this shows that consumers really hope for the development of secang products that are resistant to pressure because the function of rice field bunds is also as a road to their land. Then for the lowest variable, the ITC value is 4.432, namely covering the flow of rice fields as a alternative means of crossing between rice fields.

3.2.4. Customer Satisfaction Performance

The highest Cusp value is 5.257 which is felt according to consumer perception in the variable Resistant to load pressure. Then for the lowest variable the value obtained is4,554namely the appearance of a rice field cover design that is appropriate to its function and pleasing to the eye.

3.2.5. Goals

The highest Goal value is the variable Farmers want a rice field flow product that is resistant to pressure of 4.892 then for the lowest variable the Goal value is 4.432, namely the product of rice field flow cover as an alternative means of crossing between rice fields.

3.2.6. Improvement Ratio

The highest Improvement Ratio value is 1.029 for the system variable. The use system must make it easier for farmers. Then the lowest value, namely 0.931, is found in the variable Farmers want rice field products that are resistant to pressure. This shows that the greater the effort that must be made by the farmer and this variable needs special treatment by the farmer in fulfilling consumer desires.

3.2.7. Sales points

Determining sales points is based on Importance To Customer. The variable that has the highest level of importance is 1.5, which means strong sales value. Of the ten variables that consumers want, there are 9 variables that are given a value of 1.5 because the farmers are optimistic that they can fulfill consumers' desires and are considered to have high selling value by farmers.

3.2.8. Raw Weight

The highest Raw Weight value is 7.364 for the variable. The use system must make it easier for farmers. Then the lowest value, namely 5.769, is found in the product variable covering rice fields as an alternative means of crossing between rice fields.

3.2.9. Normalized Raw Weight

The highest Normalized Raw Weight value is 0.121, which is the highest for the variable. The use system must make it easier for farmers. Then for the lowest 0.106, the variable must have the quality of holding water.

3.2.10. Determining technical responses and consumer needs

From the calculation results, the priority order is obtained, namely0.214for variable resistance to corrosion. Then the lowest variable value is 0.042, namely the door design that has water holes at the top.

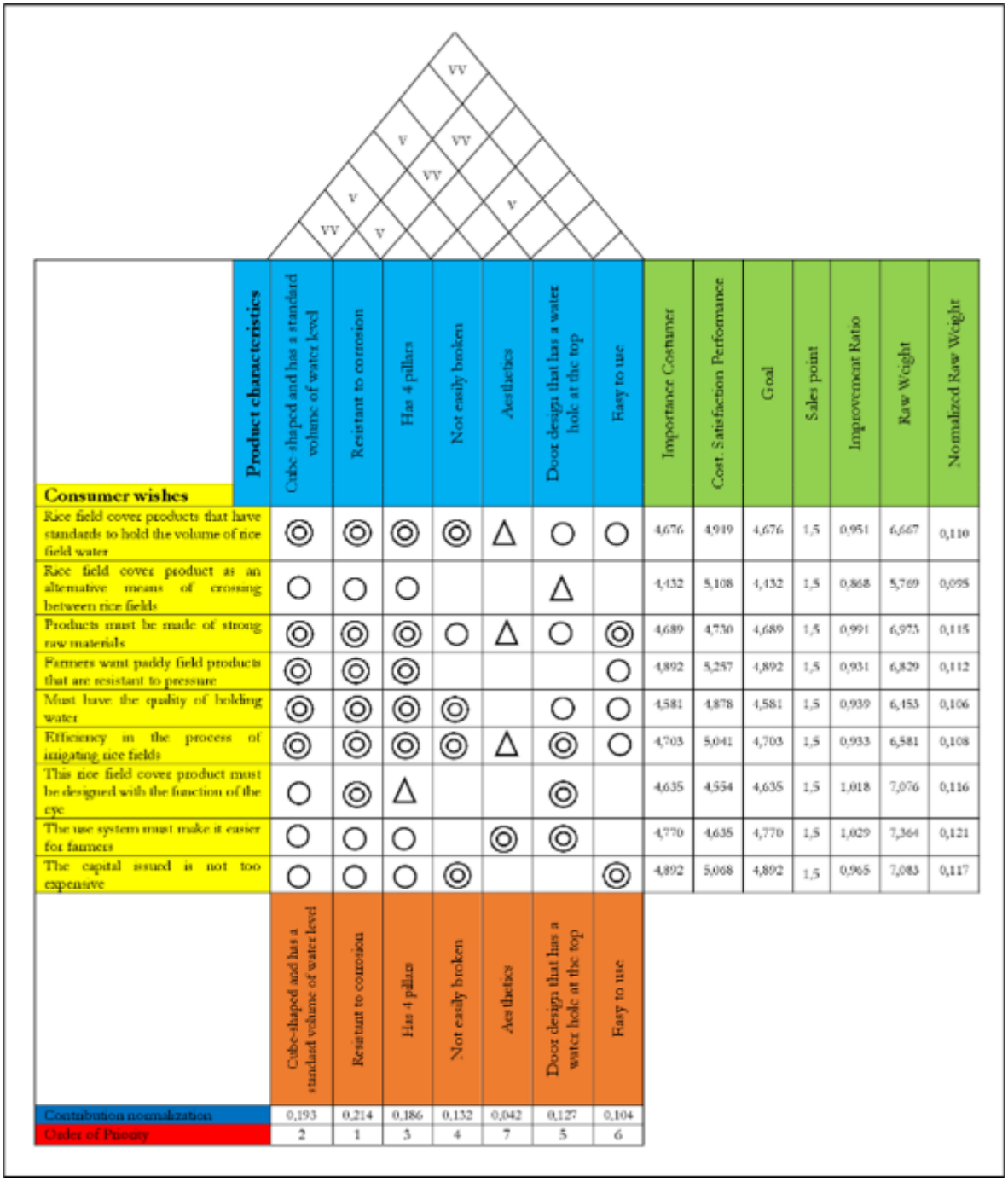
3.3. Specification targets

The target specification is a result developed from the development of technical characteristics obtained from consumer identification. The following is a table of target specifications that will be achieved.

Table 1 Target specifications

Level of interest	Target specifications
Rice field cover products that have standards to hold the volume of rice field water	This product is designed with the product door designed not full to the top (25 cm) so that there is a gap for water to pass if the volume of rice field water exceeds the limit.
Rice field cover product as an alternative means of crossing between rice fields	Maintaining the volume of water level so that it has an indirect influence on rice growth
Products must be made of strong raw materials	The material used is stainless steel which is coated with paint so it is strong in retaining water
Farmers want paddy field products that are resistant to pressure	With strong raw materials so that it is resistant to pressure (from animal walkers and two-wheelers)
Must have the quality of holding water	Strong water holding qualities because when there is an increase in water volume
Efficiency in the process of irrigating rice fields	Efficient in the process of irrigating rice fields because only one time makes galengan.
This rice field cover product must be designed with its function	The product design is in accordance with its functionality with size specifications (pxwxh) 95 x 35 x 40 cm, for detail sizes the author lists it in CHAPTER V
The system of use must make it easier for farmers	How to use it is very easy because it uses a sliding system for the first door and an open and close system for the second door
The capital issued is not too expensive	The capital for making this product does not require a large enough cost, the raw materials used depend on the wishes of the farmers, but the author recommends using manifold raw materials (Stainless steel).

3.4. House Of Quality Product design



Consumer wishes	Product characteristics: Cube shaped and has a standard volume of water level	Resistant to corrosion	Has 4 pillars	Not easily broken	Aesthetics	Door design that has a water hole at the top	Easy to use	Importance Cosnumer	Cost. Satisfaction Perfomance	Goal	Sales point	Improvement Ratio	Raw Weight	Normalized Raw Weight
Rice field cover products that have standards to hold the volume of rice field water	◎	◎	◎	◎	△	○	○	4,676	4,919	4,676	1,5	0,951	6,667	0,110
Rice field cover product as an alternative means of crossing between rice fields	○	○	○			△		4,432	5,108	4,432	1,5	0,868	5,769	0,095
Products must be made of strong raw materials	◎	◎	◎	○	△	○	◎	4,689	4,730	4,689	1,5	0,991	6,973	0,115
Farmers want paddy field products that are resistant to pressure	◎	◎	◎				○	4,892	5,257	4,892	1,5	0,931	6,829	0,112
Must have the quality of holding water	◎	◎	◎	◎		○	○	4,581	4,878	4,581	1,5	0,939	6,153	0,106
Efficiency in the process of irrigating rice fields	◎	◎	◎	◎	△	◎	○	4,703	5,041	4,703	1,5	0,933	6,581	0,108
This rice field cover product must be designed with the function of the eye	○	◎	△			◎		4,635	4,554	4,635	1,5	1,018	7,076	0,116
The use system must make it easier for farmers	○	○	○		◎	◎		4,770	4,635	4,770	1,5	1,029	7,364	0,121
The capital issued is not too expensive	○	○	○	◎			◎	4,892	5,068	4,892	1,5	0,965	7,083	0,117
	Cube-shaped and has a standard volume of water level	Resistant to corrosion	Has 4 pillars	Not easily broken	Aesthetics	Door design that has a water hole at the top	Easy to use							
Contubution normalization	0,193	0,214	0,186	0,132	0,042	0,127	0,104							
Order of Priority	2	1	3	4	7	5	6							

Figure 1 House of Quality

3.5. Product design

3.5.1. Conventional canned food

The appearance of the conventional galengan used by Rumpae hamlet farmers is shown in figure 1. Conventional galengan generally still uses soil and banana stems or bamboo as the basic materials for making galengan and is less efficient in the process of making galengan, thus hampering the irrigation system between rice fields.

Figure 2 Cover conventional rice irrigation

3.5.2. Galengan product design

The design of this rice field cover is in the form of a rectangular box made from stainless steel plates with dimensions (pxwxh) 95 x 35 x 40 cm, equipped with four stakes that hold this product so that it does not shift with dimensions (pxwxh) 4 x 4 x 75 cm , apart from that the flow cover is usedusing a sliding system with dimensions (pxwxt) 45 x 5 x 40 cm and added with a second layer covering the up and down system.

The rice field cover design process uses SkhetcUp, AutoCad, V-ray and Adobee PhotooShop software. This product design is based on 9 variables which have been classified, the product design results can be seen in the attachment which includes the complete product design, product materials and product projections. The product design can be seen in picture 2.

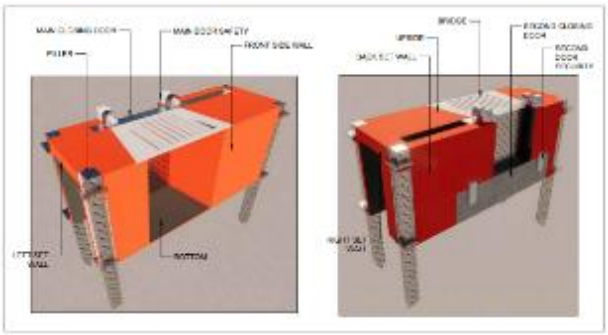


Figure 3 Design of rice irrigation cover

3.5.3. Product application

The author developed a product to cover rice fields using stainless steel plates as a base material and using a sliding system to open and close the flow and this product is equipped with four stakes that hold this product sturdy. Each rice field uses 3 – 4 rice field flow covers. For a view of the design when applied to rice fields, see the attachment.

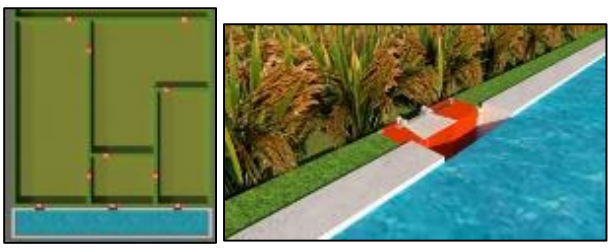


Figure 4 Product installation illustration

4. Conclusion

Based on the research objective of designing a paddy irrigation cover that is not easily damaged and makes it easier to irrigate between paddy fields, it can be concluded that conventional paddy irrigation covers that still use soil, banana stems or bamboo as the main raw material are subject to damage because the soil is not dense. or caused by pedestrians and animals or motorbikes used by farmers to transport the harvest, by designing a rice irrigation cover design using Stensliss steel as raw material (recommended) so that damage does not occur easily and is resistant to load pressure.

The irrigation cover between paddy fields is strong and not easily damaged, making it easier for farmers to process the irrigation system between paddy fields because they do not make the irrigation cover repeatedly and it is easy to use with a sliding system.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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