Rice Quality Improvement with Taguchi concept:
A Systematic Literature Review

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Abstract

This study aims to apply the taguchi concept in improving the quality of rice. Quality is the level of good or bad level or degree of an object and living thing. While the taguchi concept is an experiment that allows steps taken by producers in choosing a product or process that functions more consistently and minimizes other factors. uncontrollable factors. This study uses the System Literature Review method which is used to determine the methodology with relevant questions by presenting evidence that underlies the relevant data. As a source of energy, almost half of the world's population consumes rice as a staple food. Until now, the way of planting rice is still the traditional way. This has a direct impact on the quantity and quality of rice produced. With objective considerations of color and milling results or subjectively with taste and aroma in order to measure the availability of consumers to pay for superior rice quality. However, the results show that to capture this value, rice sellers must be able to convey information about quality and storage attributes. Consumers need to know what information is in rice. In addition, it is important to have further learning about good rice handling, so that one day they can deal with obstacles such as pest attacks or crop failure. new environmentally friendly rice.

Keywords:
Literacy Review, Rice, Farmers, Taguchi Concept, Systematic Literature Review

1. Introduction

Rice is the staple food of rice consumed by more than half of the human population and has been combined with many cultures from various countries. (Haiyan Cen, Dawai Sun 2019) (A. Rita, C. Jorge 2018). Food quality and characteristics affect consumer interest so that consumer demand increases and influences to improve the quality of rice quality (Bao 2014).

Environmental conditions greatly affect rice quality factors, such as cold temperatures will make rice less good (Li et al 2018). Combining yield and quality in rice is not easy, because measuring quality cannot explain sensory (Calingacion 2015). Rice value increases with reduced grain damage during harvest and postharvest (C Prom-u-thai, B. Rerkasem 2020). The commercialization of rice production means that farmers' decisions regarding quality can be influenced by consumer preferences in other parts of the country or in other parts of the world. Throughout Asia, where most of the world's rice is grown and consumed, rice varieties are often recognized by their grain quality features (C Prom-u-thai, B.Rerkasem 2020).

Biochemical content is one of the essential rice seed parameters used for grading rice quality, and it is time consuming (Figure 1), laborious and expensive to measure, so as to achieve high throughput phenotypes for genetic studies on rice seed quality, such as molecular breeding programs and functional genomic studies. (Sun et al. 2019).

Figure 1. Rice that has been processed into rice.

In each dimension, parameters were then selected taking into account their differentiating capacity of the different rice varieties (resulting in a large number of homogeneous groups), their repeatability (low variation between replicate measurements), and that in each dimension the selected parameter would have high orthogonality between them and describes a high portion of the total variance of the data (115 loadings in different principal components) (Rita 2018).

The generally recognized diversity of rice quality has been solid in efforts to characterize rice quality in various countries and regions with input from local experts combined with the determination of the physico-chemical properties of the grain (Chanakan et al. 2020). high quality rice to meet the world's growing demand. Rice quality is a multi-faceted property that includes physical appearance, cooking and sensory properties, and nutritional value (Jing Li-Quan1 et al. 2022). The perceived characteristics of good quality rice are uniformity of size and shape, whiteness, long and thin raw grains (i.e. long and slender), and mature grains that are round and fat (i.e., thick cooked grains). The latter suggests that consumers in Southeast Asia, in general, prefer rice that exhibits volume expansion over increased grain elongation. Good quality rice is also thought to provide a higher satiety (i.e., make you feel full faster). Poor quality rice is considered to have dirt, hard and dry texture, coarse texture, poor cooking quality, and small, cracked grains (Custodio et al. 2019).

1.2 Problem Formulation
1. Why is the quality of rice important for producers?
2. How to improve the quality of rice using the Taguchi concept?

1.3 Scope, Focus, and Objectives of the Research
This article aims to provide an overview of how rice quality is very influential for farmers to increase their yields (Custodio et al. 2019). Helping farmers avoid the problems that cause crop failure (Su et al.2007). It is hoped that this article will be accepted by agricultural extension workers, and agricultural economists to gather information about agricultural systems and be used to gain viewpoints and ideas on research issues to evaluate, analyze, prioritize target requirements, formulate appropriate interventions, and check acceptability/level of acceptance. respondent's resistance to new technology, knowledge, or technology. ideas (Mariyono, et al. 2021).

2. Literacy Review
Rice, as a product, is a set of characteristics that give rise to its utility. Through these characteristics, consumer preferences are expressed. Perceptions of rice quality can also be assessed based on these characteristics or attributes, which can be classified as intrinsic or extrinsic (Demont & Ndour, 2015). The first refers to grain quality characteristics such as color, cleanliness, purity, grain shape and size, uniformity of size and shape, rice head (HR), softness, and aroma while extrinsic attributes include packaging, labeling, and branding. These attributes acquire meaning through the historical, geographic, and socio-cultural contexts in which rice consumption is embedded (Custodio et al. 2019).

The storage time of rice after harvest can affect the aroma of rice, regardless of the variety. Generally, the content of protein and amylose determines the taste of rice. Rice that tastes good after cooking is known to have a protein content

of less than 7% (Gyu-Ho Lee, Byung-Wook Yun, and Kyung-Min Kim Division, 2014). Rice accounts for about 40% of protein intake (Tripathy et al. 2017). And has a moisture content of 15.5–16.5% (Lee et al. 2014). Minerals play a beneficial role in human metabolism. Rice, grains are relatively low in some essential micronutrients such as iron (Fe), zinc (Zn) and calcium (Ca) compared to other crops. Rice varieties vary in mineral content (Tripathy et al. 2017). Rice with high protein content is hard, less elastic, and less viscous after cooking (Lee et al. 2014).

Commercially, more than 2000 varieties of rice are cultivated worldwide. About 85% of the rice consumed is in the form of polished white rice, with the remainder of the rice being pigmented. Pigmented rice is a grain without skin, which exhibits characteristic red, purple or black pigmentation caused by anthocyanin compounds (Khor et al.2015). Wider variations in the composition of polished rice and rice bran are observed in the literature, given the different cultivars produced in areas with different agricultural practices. Furthermore, the composition of white rice and rice bran is influenced by the degree of polishing (Daneysa et al. 2020).

3. Methodology

In this study, the author uses a systematic literature review method, namely by collecting, entering, processing, and storing data as well as to manage, control, and report information in such a way as to obtain the data information needed in making rice improvement journals through this taguchi method. In the literature review method, you can review and identify journals systematically, which in each process follows the steps or protocols that have been set. The results showed that the dominant platform used in the development of information systems was website-based while the dominant method used in completing the development of information systems was a structured method (Triandini et al. 2019).
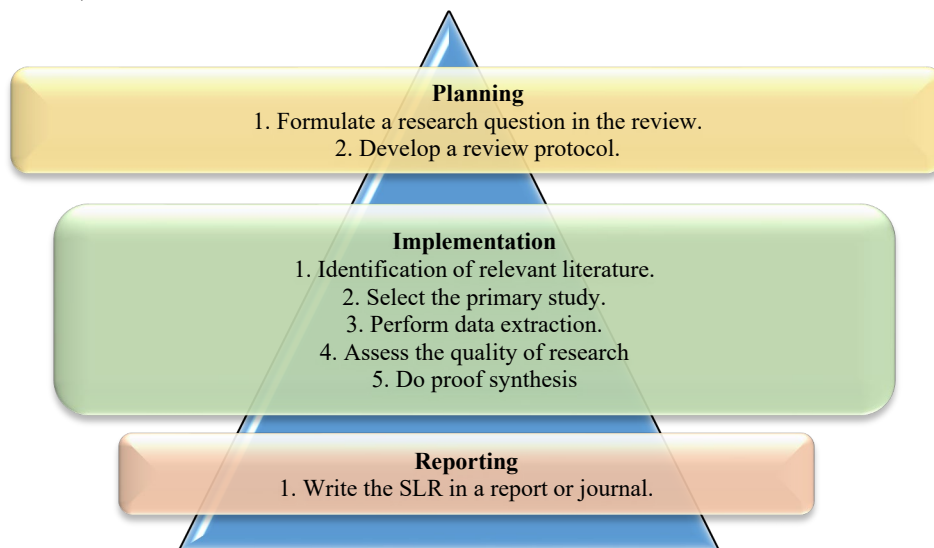

Planning
1. Formulate a research question in the review.
2. Develop a review protocol.

Implementation
1. Identification of relevant literature.
2. Select the primary study.
3. Perform data extraction.
4. Assess the quality of research
5. Do proof synthesis

Reporting
1. Write the SLR in a report or journal.

Figure 2. Systematic Literature Review steps
Source: Wahono (2015)

Steps to write a Literacy Review journal (Figure 2):
a. First, it is necessary to select the source database among the available. The online database chosen is Google Scholar because it covers the areas of publication (mainly such as papers and journal articles) that focus on the chosen topic.
b. Second, it is necessary to select the most suitable keywords and search criteria to extract a representative subset from the selected database. The system is asked to search for journals on superior rice quality by the taguchi method only in the title of the paper and exclude all citations and patents. In this way, the search results include 42 papers. Then, the Google Scholar database was asked to sort all results by year of publication in the 2011-2021 range. The authors chose this ten-year span to have a reasonable representative subset excluding the rice quality development from year to year, the criteria for superior rice quality, the use of the taguchi method. After screening, the search results for about 40 journals in question were obtained.

c. Third, evaluation in "all phases means limiting the amount of literature identified by keyword searches to articles relevant to the topic discussed. In this phase LRS-D" is used as the source input platform and several criteria are applied to limit the search. Indeed, the author deletes: duplicates, theses, power point presentations, white papers, book introductions, announcements of competitions, all works in English and not in Indonesian (Renata Paola Dameri, Camille Rosenthal, Sabroux, 2014).

4. Collecting Data

The literature or journals used in this study were obtained from several sources, such as Google Scholar, Academia.edu, Oxford Academic. This platform is a platform to access complete and easy reference searches, such as journals, books, scientific works, and articles from academic publishers, universities, and academic organizations. The author found references to improving the quality of rice with the taguchi method in this platform of 40 journals taking into account the year of publication of the journal (Figure 3).
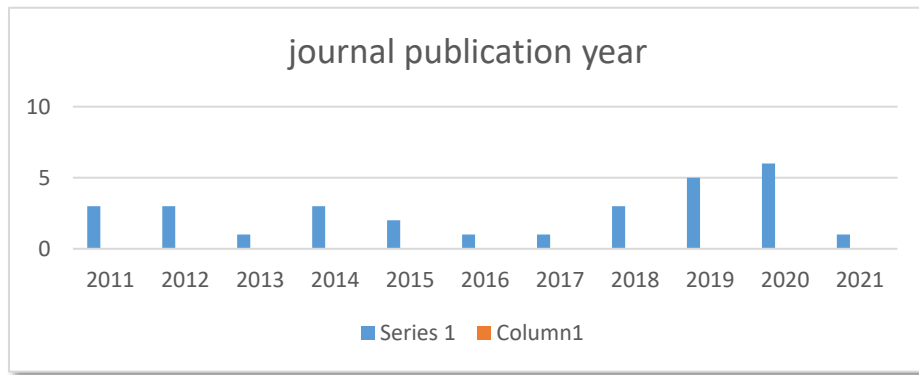

Figure 3. Publication of journals by year of publication.

Figure 3 contains the year of publication of journals where the authors used journals a lot in 2020 for research, while the journals that were used less were in 2017. The journals used in this study used the literature review method or often called SLR (Figure 4). The SLR method can be reviewed and systematic identification of journals that in each process follow the steps or protocols that have been set. In addition, the SLR method can avoid subjective identification and it is hoped that the identification results can add to the literature on the use of the SLR method in journal identification (Triandini et al. 2019).
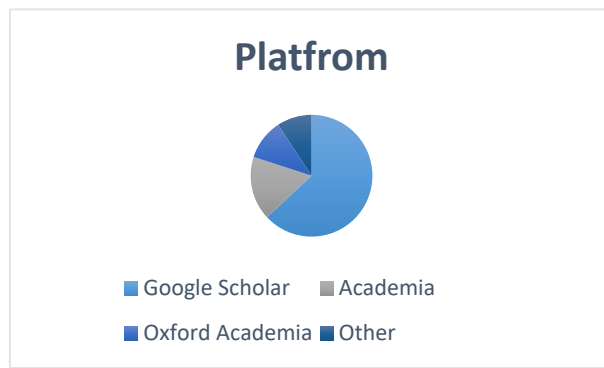

Figure 4. Platform search journal.

Of the 40 journals used, as many as 20 relevant journals according to the improvement of rice quality from the researchers (Haiyan Cen, Dawai Sun) (A. Rita, C. Jorge) (X, Li, L Wu, X. Geng et al) (M. Calingacion, L. Fang, L Quiatchon-baeza)(C Prom-u-thai, B.Rerkasem) (Gyu-Ho Lee, Byung-Wook Yun, and Kyung-Min Kim Division, 2014)(Marie Claire Custodio, Rosa Paula Cuevas, Jhoanne Ynion, Alice G. Laborte, Maria Lourdes Velasco, Matty

Demont International)(Rong Gong, Daoqiang Huang, Yibo Chen & Hong Li, Zhidong Wang. Degui Zhou, Lei Zhao, Yangyang Pan, Yuxiao Chang, Yong Xiang, Chongrong Wang, Shaochuan Zhou) (Nico Harro Silalahi, Rizdha Okkianty Yudha, Evita Izza Dwiyanti, Desiana Zulvianita, Salsabilla Nur Feranti, and Yooce Yustiana)(Eero Irri, Cindy Llorente, Roslen Anacleto, Rosario Irri, Rochie Cuevas Cite SK)(Tripathy SK), Dash M, Behera SK, Ithape DM Maharana M)(Pranowo Sidi, Muhammad Thoriq Wahyudi)(Didiek Setiobudi)(Gatot Santoso, Slamet Hani, Ragil Prasetiyo), (Piengtawan Tappiban, Yining Ying , Feifei Xu and Jinsong Bao), (Tosin Victor Adegoke, Yifeng Wang, Lijuan Chen, Huimei Wang, Wanning Liu, Xingyong Liu, Yi-Chen Cheng, Xiaohong Tong, Jiezheng Ying and Jian Zhang, 2021), (Priyadarsini Sanghamitra, Rameswar Prasad Sah, Torit Baran Bagchi, Sri Gopal Sharma, Anjani Kumar, Sushmita Munda, Ravindra Kumar Sahu, 2018), (Li, Pei Chen, Yu Hao Lu, Jun Zhang, Chang Quan Liu, Qiao Quan Li, Qian Feng, 2022).

5. Research Process Results
5.1 Importance of rice quality for producers
In general, the quality of the rice grain should be closely related to the characteristics of the rice seed. In short, the structure of the rice seed mainly includes the grain coat, seed coat, aleurone layer, embryo, and endosperm. For example, in most cases, the size of the spikelet hull determines the grain size. Grain size is an important agronomic property of rice, which is not only a key element of rice yield, but is also a direct index of rice quality. Rice grain size includes grain length, width and thickness (Li, Pei Chen, Yu Hao Lu, Jun Zhang, Chang Quan Liu, Qiao Quan Li, Qian Feng, 2022). Parameters of good rice quality such as appearance, nutritional value, and taste and rice texture, color, and whole kernel morphology are important factors influencing consumer preferences. In addition, the main chemical components, namely carbohydrates (72-75%), protein (7-10%), and lipids (1%), are important factors that reflect the nutritional aspects of rice; structure and composition of protein and fatty acids are also very important (Gyu-Ho Lee, Byung-Wook Yun, and Kyung-Min Kim Division, 2014). In addition, premium quality rice is considered to have nutritional benefits (that is, it contains vitamins and minerals), softness (i.e., soft and shiny, and soft when chewed), and aroma (Marie Claire Custodio∗, Rosa Paula Cuevas, Jhoanne Ynion, Alice G. Laborte, Maria Lourdes Velasco, Matty Demont International, 2019). The formation of amino acid compounds, phenolamides, flavonoids, lipids, and carbohydrates from rice so that it affects the taste and aroma of rice. These results will provide an important theoretical basis for exploiting the characteristics of markers of flavor compounds and benefits for the development of superior high quality rice breeding. Rong Gong & Daoqiang Huang & Yibo Chen & Hong Li & Zhidong Wang & Degui Zhou & Lei Zhao & Yangyang Pan & Yuxiao Chang & Yong Xiang & Chongrong Wang & Shaochuan Zhou, 2020). will create superior grain after grinding and will give producers a premium price (Nico Harro Silalahi, Rizdha Okkianty Yudha, Evita Izza Dwiyanti, Desiana Zulvianita, Salsabilla Nur Feranti, and Yooce Yustiana, 2018). to explore modern tools for:
- ✓ Exploit genetic diversity in rice breeding ponds using phenotypic plasticity of grain quality to obtain superior rice quality.
- ✓ Further validate grain quality (proxy) measurements via sensory profiling,
- ✓ Broaden the phenotypic assessment of grain quality preferences by revealing metabolic markers.
- ✓ Associating multiple levels of phenotypic measurements with high-throughput genotypic data to augment grain quality (including sensory attributes) potentially leading to the identification of diagnostic markers that reflect consumer preferences (Eero Irri, Cindy Llorente, Roslen Anacleto, Rosario Irri, Rochie Cuevas Cite, 2015).

With the increasing demand and preference of rice consumers, producers need to focus on developing high quality, nutrient-dense rice for added value and thereby eradicating malnutrition. High yielding nutrient dense cultivars can be bred by selective breeding or through genetic modification. Genomics can dominate these efforts to develop more efficient nutrient-rich rice cultivars. In other words, producers find ideas to improve the quality of their rice (Tripathy SK, Dash M, Behera SK, Ithape DM Maharana M, 2017).
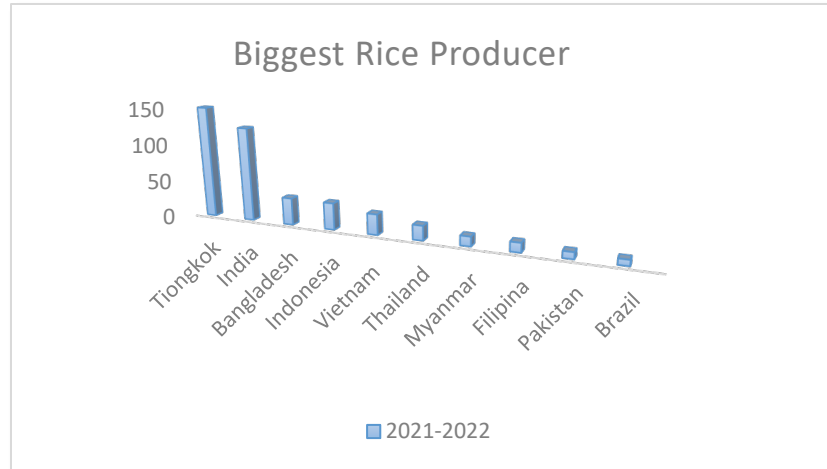
Figure 5. Graph of the world's largest rice producer for 3 years

As the global population grows, it is estimated that by 2035, additional demand will be about 112 million metric tons of rice need to be produced to maintain food security (Figure 5) (Tappiban 2021). So producers are required to be able to improve the quality and quantity of their products (Sanghamitra et al. 2018).

5.2 Improving the quality of rice with the Taguchi concept.

This method is a new methodology in engineering that aims to improve product and process quality and can reduce costs and resources to a minimum. Taguchi has a concept to determine quality, namely (Sidi et al. 2013):
1. Quality should be designed into the product and not just checking it.
2. The best quality is achieved by minimizing the deviation from the target.
3. The product must be designed so that it is robust against uncontrollable environmental factors.
4. The cost of quality should be measured as a function of deviation from a certain standard and losses should be measured throughout the system. In this case, the quality of rice can be improved with the taguchi concept, namely by paying attention to:

1. Water absorption
It is also a parameter with greater distinguishable capacity and repeatability (lower mean standard deviation) and was therefore chosen to define this quality dimension. WVAC (weight variation in adjusted cooking) is highly correlated with these 218 2: simple multilinear model WVAC(normalized) = a + b*WVS(normalized) + 219 c*WVC(normalized) has a correlation coefficient of 0.91 with experimental data, therefore WVAC can be considered to be largely determined by the other 2 parameters and removed (Ferreira, Ana Rita; Oliveira, Jorge C.; Pathania, Shivani; Almeida, Ana S.; Brites, Carla, 2017). Water consumption and alternative techniques used for water distribution as well as comparison variables with superior varieties and to examine the efficiency of water use (Setiobudi, 2017).

2. Temperature parameters
Several factors that affect the value of soil moisture include the provision of irrigation water for rice plant soils and the temperature of the hot sun which affects the evaporation of water) (Lee et al.2014). With this system, farmers in the future can monitor the fertility conditions of their paddy fields and can take appropriate actions according to the needs of their paddy fields. A monitoring system that makes rice soil quality in real time with four parameters can work well with a response speed of 1.2 seconds. (Santoso et al. 2020).

3. Increased protein content
Rice seeds consist of a very small embryo containing most of the genetic information and a relatively large endosperm containing most of the nutrient storage (Tappiban, et al. 2021). Rice is composed of amylose, and amylopectin is synthesized by a series of enzymes, which are responsible for the nature and function of rice starch, and then affect the cooking and eating quality of rice (Nico Harro Silalahi, Rizdha Okkianty Yudha, Evita Izza Dwiyanti, Desiana Zulvianita, Salsabilla Nur Feranti, and Yooce Yustiana). Several entrepreneurs have used proteomic technology for

the formation of different expressed starch biosynthesis-related proteins and identification of modifications. posttranslational (PTM) targets starch biosynthetic proteins as well (Piengtawan Tappiban, Yining Ying, Feifei Xu and Jinsong Bao, 2021). Rice starch can be converted into various forms by reducing or increasing the amylose content, depending on consumer and regional preferences. Low-amylose rice is preferred by consumers because of its softness and sticky appearance. A better way to improve plants than downregulation and overexpression of genes or genes can be achieved through posttranslational modification of regulatory sites or enzymes that regulate them because of their significance (Tosin Victor Adegoke, Yifeng Wang, Lijuan Chen, Huimei Wang, Wanning Liu, Xingyong Liu, Yi-Chen Cheng, Xiaohong Tong, Jiezheng Ying and Jian Zhang, 2021). The starch biosynthetic proteins in rice seeds are differentially expressed in developing seeds at different developmental stages. All proteins involved in starch biosynthesis were identified using proteomic methods. Most of the proteins related to starch biosynthesis basically increased at 6-20 days after flowering (DAF) and decreased at high temperature conditions. A total of 10, 14, 2, 17, and 7 proteins related to starch biosynthesis were identified as targets of phosphorylation, lysine acetylation, succinylation, lysine 2-hydroxyisobutyrylation, and malonylation. Phosphoglucomutase is generally targeted by five types of PTM (Piengtawan Tappiban, Yining Ying, Feifei Xu and Jinsong Bao, 2021).

6. Conclusion

Rice is an important commodity that is a source of staple food for some countries, therefore the quality of rice is also highly considered. With improved rice quality, it can help the economy of a country and help farmers. With proper handling, it reduces the risk of crop failure. how to deal with problems in rice plants, such as pests and diseases on rice leaves that result in later rice growth, besides that this journal will help rice producers and farmers increase their yields and products in order to get more profits and customer satisfaction and consumers are carried out.

The Taguchi concept helps the understanding of producers to determine the correct way of planting rice. The Systematic Literature Review also aims to find or process data that helps in improving the quality of superior rice.

7. Suggestions

To the farmers to know the survival of rice, in addition to expanding the land to be used as rice fields because a lot of land has been converted. Use of fertilizers in accordance with the guidelines of the local Agriculture Service. Counseling to farmers about new methods to improve rice quality. Hope for further research namely making better research with more accurate methods and so that this research can be used as a guide for future research.

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