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To cite this article: Arini Putri Hanifa *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **807** 022023

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A promotional banner for the 240th ECS Meeting. The banner features a colorful striped border at the top. On the left, the ECS logo is displayed in a green circle. To its right, the text reads "240th ECS Meeting" in large blue font, followed by "Oct 10-14, 2021, Orlando, Florida" in a smaller black font. Below this, it says "Register early and save up to 20% on registration costs" in bold black text, and "Early registration deadline Sep 13" in a smaller black font. At the bottom left, there is a red "REGISTER NOW" button. On the right side of the banner, there is a photograph of a diverse group of people in a professional setting, with a man in a white shirt and tie clapping and smiling.

Comparing satisfaction index on traditional pigmented rice plant attributes between upland and lowland farmers

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Abstract. This study is conducted to evaluate the satisfaction index of traditional pigmented rice plant attributes from farmer perspectives. Farmer respondents are selected from two regions of traditional pigmented rice producers in South Sulawesi: the lowland of Jeneponto and the upland of Toraja. Face to face data collection using questionnaires are used as a research instrument. Respondents were required to rate the importance and satisfaction of plant attributes based on five-point Likert scales. The answers are analysed using Customer Satisfaction Index formula. Result showed that the satisfaction index in the lowland of Jeneponto is higher than in upland of Toraja, as much as 67.16 and 56 respectively. Similar agreement from both lowland and upland farmers was found in lower yield performance of traditional pigmented rice than expected. As the end-user of released varieties, farmers' perspective on importance and satisfaction level on plant attributes is essential for guidance in breeding and varietal improvement.

1. Introduction

The diversity of pigmented rice landraces in South Sulawesi have been reported [1, 2, 3]. Most landraces (traditional varieties) are retained by farmers intergeneration for their attributes that met farmers' demand in certain locations.

In South Sulawesi, pigmented rice landraces can be found in upland and lowland [4]. Toraja is known for its variability and conservation of rice landraces, and many of them are pigmented rice [5,6]. Beside upland, pigmented rice landraces are also found in the lowland of Jeneponto. Each of both regions has its characteristic of agroecology and socio-economic. However, they share a similarity in pigmented rice demand as signature dishes for religious and cultural ceremonies [7].

Despite culture-related, the importance of pigmented rice includes food security at farmer's household, genetic pool for varietal development, and agroecosystem stability. Besides, with the emerging market of functional food and healthy lifestyle, pigmented rice is potential economic leverage for farmers.

Due to the importance of pigmented rice, it is expected that farmers keep retaining the cultivation of such landraces. However, there is a gap of information in regards to farmers (growers)' attitude towards pigmented rice. Attitude is a crucial aspect related to farmers' satisfaction. For instance, if farmers experience low satisfaction, they stop using the product and disseminate the negative review to others [8].



Farmers have a subjective preference for different plant attributes, and their perceptions significantly affect the varietal demand [9,10]. Unrevealing each plant attribute's value by weighing its importance and satisfaction by different groups of farmers is essential to increase the retention rate of cultivation or adoption rate of selected variety.

One of the analytical tools to stipulate overall satisfaction by weighing the score of importance is Customer Satisfaction Index (CSI). Many research uses CSI to assess farmers' attitudes and responses towards superior rice [11,12] and newly introduced maize [13].

To date, very little information about farmers' attitudes and satisfaction with pigmented rice landraces. By knowing farmers' attitudes and satisfaction, appropriate strategies can be implemented to meet farmers' requirements.

This paper will investigate the performance of pigmented rice plant attributes and their importance from the farmer's perspective in both lowland and upland South Sulawesi. Farmer perspectives on pigmented rice plant attributes will be assessed using Satisfaction Index. This study aims to compare between lowland satisfaction index and upland farmers on traditional pigmented rice plant attributes.

2. Methods

2.1. Location and timing of the survey

Data collection occurred from August-October 2019. Locations selected were lowland (Bontomattene Village, Jeneponto Regency) as a representative of a developed village; and upland (Lili' Kira Ao Gading, North Toraja Regency) regions in South Sulawesi to represent a typical medium/transition village of Toraja. Many farmers in both locations are pigmented rice growers.

2.2. Sampling methods

Farmers, as respondents in this study, must have some experience in planting traditional pigmented rice. The selection of thirty (30) respondents was based on volunteer sampling aided by Agriculture Extension Officers. As the growers, farmers are the end-user of rice varieties. Hence in this study, farmers act as the costumers.

The questionnaire consisted of closed-ended questions from plant attributes to assess the importance and satisfaction level of local pigmented rice varieties performance based on farmer experience. Plant attributes include yield, pest and disease resistance, threshability, seedling vigour and viability, lodging resistance, grain colour, aroma (cooked rice), texture (cooked rice), days to mature, plant stature, economic value, and market demand.

2.3. Data analysis

Customers Satisfaction Index (CSI) is used to measure customer satisfaction from the closed-ended questionnaire. CSI was used to determine overall user satisfaction by considering the variable interest and the product's attributes. Comparison between CSI indicator values against the expectation of consumers determined the CSI level [14].

A Likert scale is used as a quantitative scale measure for the value of customer perception and the actual performance level of a product, presented in consumer satisfaction responses [15]. Five-point scales are generally regarded as the most reliable to measure the level of interest or expectation and customer satisfaction level [16]. The following are the five ratings on a Likert scale for importance:

- Very important attribute is scored 5
- Important attribute is scored 4
- Quite important attribute is scored 3
- Unimportant attribute is scored 2
- Very unimportant is scored 1

Range score in five-point Likert score for performance/satisfaction:

- Very satisfied is scored 5, meaning the performance is very good; thus, the satisfaction level is very satisfied

- Satisfied is scored 4, meaning the performance is good; thus, the satisfaction level is satisfied
- Quite satisfied is scored 3, meaning the performance is quite good; thus, the satisfaction level is quite satisfied
- Dissatisfied is scored 2, meaning the performance is bad; thus, the satisfaction level is dissatisfied
- Very dissatisfied is scored 1, meaning the performance is very bad; thus, the satisfaction level is very dissatisfied

The range scale needs to be determined using the formula below to make a numeric linear scale [15]

$$Rs = \frac{(m - n)}{b} = \frac{(5-1)}{5} = 0.8$$

where: Rs = range scale

m = maximum score

n = minimum score

Thus, range scale for importance level as follows:

1.00-1.79	very insignificant/not important
1.80-2.59	not important
2.60-3.39	quite important
3.40-4.19	important
4.29-5.00	very important

Range scale for performance level as follows

1.00-1.79	very dissatisfied
1.80-2.59	dissatisfied
2.60-3.39	quite satisfied
3.40-4.19	satisfied
4.29-5.00	very satisfied

Measuring the overall level of customer satisfaction on a product type can be undertaken using the Customer Satisfaction Index (CSI).

According [17], there are four steps to count CSI:

1. Decide Mean Important Score (MIS) and Mean Satisfaction Score (MSS) The score is based on the interest rate and performance of each respondent:

$$MIS = \frac{\sum_{i=1}^n Y_i}{n}$$

$$MSS = \frac{\sum_{i=1}^n X_i}{n}$$

n = Total respondent

Y_i = Interest attribute score-i

X_i = Performance attribute score -i

2. Create Weigh Factors (WF)

This weight is the percentage score of MIS per attribute to total MIS of all attribute

$$WFi = \frac{MISi}{\sum_{i=1}^p MISi} \times 100\%$$

Where:

p = total of attributes

i = attribute -i

3. Create weight score (WS)

This weight is the multiplication between weight Factors (WF) and Means Satisfaction Score (MSS)

$$WSi = WFi \times MSSi$$

Total of Weight Score (WS) of the first attribute(a-1) to the last (a-p) is called Weight Average Total (WAT)

4. Calculate CSI

$$CSI = \frac{\sum_{i=1}^p WSi}{HS} \times 100 \%$$

p = attribute of p

HS = maximum scale used

Satisfaction index criteria use the range of 0 to 100% (not satisfied to very satisfied). Scale of the range is adjusted with formula as follows:

$$Rs = \frac{(m-n)}{b}$$

Range of scale: Rs = range of scale

m = Highest score

n = Lowest score

b = Total class to be used

Scale range of CSI to be used in this study :

$$Rs = \frac{100\%-0\%}{5} = 20$$

Based on the range scale, 5 class criteria are determined in Table 1.

Table 1. Customer Satisfaction Index Criteria [18].

CSI value %	CSI criteria
0<CSI≤20	Very dissatisfied
20<CSI≤40	Dissatisfied
40<CSI≤60	Quite satisfied
60<CSI≤80	Satisfied
80<CSI≤100	Very satisfied

3. Results and discussion

3.1. Upland farmers satisfaction index

CSI measurements provide user satisfaction data at a specific time range for regular evaluation to improve satisfaction toward a product [19]. Satisfaction Index can be utilised to measure the satisfaction level of farmers growing pigmented rice. The satisfaction index of traditional pigmented rice for upland farmers is presented in table 2.

Table 2. Upland farmer satisfaction index of traditional pigmented rice.

Attribute	Means of importance score (MIS)	Ascending rank	Means satisfaction score (MSS)	Ascending rank	Weighting factors (WF)	Weight score (WS)
Yield	4.67	9	2.47	3	0.09	0.22
Pest & disease resistance	4.70	10	2.30	2	0.09	0.21
Threshability	4.47	8	2.83	6	0.09	0.25
Seedling vigour & viability	4.37	6	2.47	3	0.08	0.21
Lodging resistance	4.47	8	2.50	4	0.09	0.22
Grain colour	4.33	5	3.83	8	0.08	0.32
Aroma (cooked rice)	4.30	4	3.43	7	0.08	0.29
Texture (cooked rice)	4.43	7	2.67	5	0.09	0.23
Days to mature	4.03	3	2.20	1	1.02	2.23
Plant stature	3.97	2	2.50	4	0.08	0.19
Value(\$)	3.27	1	2.67	5	0.06	0.17
Market demand	4.43	7	3.93	9	0.09	0.34
Total score	51.44		Weight Average Total (WAT)			2.82
CSI	56.00%	(Quite satisfied)				

Importance Score interpretation: (1) Very unimportant; (2) Not important; (3) Quite important (4) Important; (5) Very important
Satisfaction score interpretation: (1) Very dissatisfied; (2) Dissatisfied; (3) Quite satisfied; (4) Satisfied; (5) Very satisfied

Pest and disease resistance attributes achieved the highest mean of importance score (4.70), followed by yield (4.67). In contrast, the least important feature for upland farmers was economic value (3.27). The highest mean satisfaction score was for market/consumer demand (3.93) and grain colour (3.83). Whereas the least score of satisfaction attribute was days to maturity (2.2) and pest and disease resistance (2.5). The widest gap between importance and performance was for pest and disease resistance and yield, followed by yield, indicating the need for improvement in the attributes. The overall satisfaction index of pigmented rice plant attributes for upland farmers was 56%, indicating quite satisfied.

3.2. Lowland farmers satisfaction index

The means score of importance and satisfaction on plant attributes from lowland farmers differed from upland farmers, and so were the ranks (Table 3). The highest importance score was attributed to yield (5), followed by economic value (4.9). However, satisfaction score for yield was also the lowest. Plant

stature was rated least for importance (3) among the plant attributes, indicating that farmers are not happy with the height of their pigmented rice varieties. Except for Bakka Eja, most traditional pigmented rice varieties are tall, especially in lowland areas with warmer temperatures and greater sunlight.

Table 3. Lowland farmer- satisfaction index for traditional pigmented rice.

Attribute	Means of importance score (MIS)	Ascending rank	Means satisfaction score (MSS)	Ascending rank	Weighting factors (WF)	Weight score (WS)
Yield	5	12	2.5	1	0.106	0.268
Pest & disease resistance	3.8	7	3.4	8	0.081	0.278
Threshability	3.3	2	3.4	7	0.071	0.24
Seedling vigour & viability	4.1	9	2.9	4	0.087	0.254
Lodging resistance	3.4	3	3.1	6	0.073	0.227
Grain colour	3.9	8	3.6	9	0.083	0.302
Aroma (cooked rice)	3.8	5	2.7	2	0.08	0.213
Texture (cooked rice)	3.8	15	3.6	9	0.08	0.29
Days to mature	3.5	4	3.1	8	0.075	0.229
Plant stature	3	1	2.9	3	0.063	0.18
Value(\$)	4.9	11	4.4	12	0.104	0.453
Market demand	4.7	10	4.3	11	0.099	0.422
Total score	47.23		Weight Average Total (WAT)			3.36
CSI	67.15%		(Satisfied)			

Importance Score interpretation: (1) Very unimportant; (2) Not important; (3) Quite important (4) Important; (5) Very important
Satisfaction score interpretation: (1) Very dissatisfied; (2) Dissatisfied; (3) Quite satisfied; (4) Satisfied; (5) Very satisfied

The satisfaction index for traditional pigmented rice among lowland farmers was 67.12%, meaning that they are satisfied with the attributes of the crop in general. The present study indicates the need for continuous support and strategy based on farmers' demand, which can differ among different farmer groups by locations.

A paired-sample t-test was conducted to compare the importance scores and satisfaction scores of upland and lowland farmers. There was a significant difference in satisfaction score from upland farmers ($M=2.8$, $SD=0.58$) and lowland farmers ($M=3.3$, $SD=0.58$) ($P= 0.043$). Pearson's correlation between the importance and satisfaction of both lowland and upland farmers did not show a significant correlation, meaning that upland farmers have a different set of priorities than the lowland farmers.

Farmers' perception of importance and performance differed between upland and lowland farmers. Upland farmers had higher importance of overall pigmented rice crop attributes but lower satisfaction; in contrast, lowland farmers had lower importance and higher satisfaction. Hence, the final score of satisfaction index was higher in lowland.

The low satisfaction index of upland is undesirable since it can affect the sustainability in cultivating pigmented rice landraces. Whereas, Toraja region has a significant contribution to the rice landrace

preservation. As mentioned by [20], farmers' perceived image has importance influences on their satisfaction and loyalty.

4. Conclusion

The comparison of satisfaction index between lowland and upland farmers showed higher satisfaction index of lowland farmers than in upland. Hence, upland farmers' low satisfaction index indicated the discrepancy between plant performance and farmers expectancy towards plant attributes. Minimising the gap between expectancy and plant performance is suggested for further research by participatory varietal selection.

Farmers' perception of pigmented rice landraces' attributes is one of the critical factors in retaining the traditional varieties on their farm. The existence and variability of pigmented rice landraces are essential for the genetic pool of rice diversity and the food security of local people. The nutraceutical compound of pigmented rice, along with concern and demand for a healthy diet, are positive factors for retaining the pigmented rice landraces cultivation.

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