PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol 11(sp4): 01–06
https://doi.org/10.14719/pst.5955

HORIZON
e-Publishing Group
HePG

RESEARCH ARTICLE

Optimizing organic fertilizer: Importance-performance analysis of farmers satisfaction in Navsari, Gujarat

Shikha[1], C Muralidharan[2*], Gangai Selvi R[3], A Rohini[1] & M Prahadeeswaran[4]

[1]Department of Agricultural and Rural Management, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India

[2]Directorate of Agri Business Development, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India

[3]Department of Physical Science and Information Technology, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India

[4]Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore 641 003, Tamil Nadu, India

*Email: muraliarm@tnau.ac.in

OPEN ACCESS

ARTICLE HISTORY
Received: 18 October 2024
Accepted: 14 November 2024
Available online
Version 1.0 : 29 December 2024
Version 2.0 : 17 May 2025

Check for updates

Additional information
Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

Copyright: © The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited (https://creativecommons.org/licenses/by/4.0/)

CITE THIS ARTICLE
Shikha, Muralidharan C, Gangai SR, Rohini A, Prahadeeswaran M. Optimizing organic fertilizer: Importance-performance analysis of farmers satisfaction in Navsari, Gujarat. Plant Science Today.2024;11(sp4):01-06. https:/doi.org/10.14719/pst.5955

Abstract

Organic fertilizers play a crucial role in sustainable farming by enhancing soil health and reducing reliance on chemical inputs. This study, conducted in the Navsari district of Gujarat, involved 120 respondents selected by the researcher. The objective was to evaluate farmers awareness, satisfaction and the factors influencing their purchasing decisions regarding organic fertilizers. The results revealed that 88.33% of the respondents were aware of organic fertilizers, with a significant correlation observed between education levels and awareness. The satisfaction index, calculated at 74.80%, indicated that farmers were generally satisfied with the use of organic fertilizers. Key factors influencing their purchasing decisions included price, quality, availability and recommendations from agricultural dealers.

Keywords

awareness; customer satisfaction index; importance performance analysis (IPA); organic fertilizer; satisfaction

Introduction

Organic fertilizers, derived from plant or animal sources, provide essential nutrients to plants while improving soil structure, enhancing microbial activity, and gradually releasing nutrients. Examples include compost, manure, and bone meal (1). Organic fertilizers generally supply key nutrients like nitrogen, phosphorus, and potassium, along with micronutrients and beneficial microbes that boost soil health. In contrast to chemical fertilizers, which deliver nutrients rapidly, organic fertilizers release them gradually. This controlled release promotes consistent plant growth and minimizes the risk of nutrient runoff into water bodies (2). The concept of the "new green revolution" integrates advanced scientific techniques with traditional farming practices to meet global food requirements while promoting sustainability (3). Historical evidence suggests that ancient Egyptians enriched the fertile soils along the Nile by applying animal manure and composted plant materials, thereby maintaining agricultural productivity (4). Composting, a foundational technique in traditional organic farming, continues to play a central role today, with modern enhancements such as biochar and other organic amendments that improve soil health (5). Similarly, cover crops, once solely used to prevent soil erosion, are now combined with modern practices such as green manure to further enhance soil fertility (6).

The use of organic fertilizers increases soil organic matter, which in turn, improves water retention, aeration and root penetration (7). For instance, incorporating 20% biochar into sandy soil at a depth of 15 cm can increase total soil

water storage (SWS) from 0.56 mm in control conditions to between 0.83 and 0.91 mm (8). While chemical fertilizers can increase crop yields, their overuse can cause environmental issues often leads to water pollution and soil degradation (9). Shifting from chemical to organic fertilizers presents a cost-efficient approach for smallholder farmers, leading to improved crop productivity and greater sustainability (10).

This research study focused on assessing farmers acceptance and understanding of organic fertilizers in the Navsari district of Gujarat. It also explored the influence of various demographic factors on these aspects. The study's primary objective was to evaluate farmers awareness, satisfaction levels and the factors affecting their purchasing decisions regarding organic fertilizers in the region.

Materials and Methods

Study area

Navsari district, known for its agricultural activities, was chosen as the study area, making it a significant agricultural hub in Gujarat. A random sampling method was used to collect the data. Five taluks were chosen for the study, and 24 farmers were randomly selected, resulting in a total sample of 120 farmers. Both primary and secondary data sourced were used in the research study.

Percentage analysis

Percentage analysis was used to analyze the socio-economic profile of the farmers (11).

Percentage = (No. of samples taken/ Total Sample) x 100

Chi-Square test

The chi-square test was conducted to determine the relationship between the education levels of farmers' and their adoption level of organic fertilizers in Navsari, Gujarat (12).

$$\chi^2 = \Sigma [(O_i - E_i)^2 / E_i \quad \text{(Eqn. 01)}$$

Where:

χ^2 is the chi-square test statistic; Σ represents the summation; Oi is the observed frequency; Ei is the expected frequency

Satisfaction analysis

The study employed importance performance analysis (IPA) and the customer satisfaction index (CSI) to assess the level of satisfaction among farmers in Navsari regarding organic fertilizers.

Importance performance analysis (IPA)

It is an analytical tool that compares consumer perceptions of product performance with their desired levels of satisfaction. Both importance and performance were measured using a Likert scale. This study focused on comparing two sub-variables: the importance of different attributes and their performance. There are different steps to calculate the IPA (13).

- Calculating the conformity level (CLi)

It is the first step which is done using the specified formula:

$$Cli = \frac{X_i}{Y_i} * 100\% \quad \text{(Eqn. 2)}$$

CLi represents the level of conformity of organic farmers to attribute X, calculated by dividing the performance score (Xi) by the importance score (Yi).

- Calculating the average performance ($\bar{X}$) and average importance ($\bar{Y}$)

It is for farmers and is calculated using the provided formulas.

$$\bar{X} = \frac{\Sigma xi}{n} \quad \text{(Eqn. 3)}$$

$$\bar{Y} = \frac{\Sigma Yi}{n} \quad \text{(Eqn. 4)}$$

Where n is the number of farmers using organic fertilizers (n=120).

- Plotting on a Cartesian diagram

The average importance and performance values are plotted on a Cartesian diagram using average interest rate as the coordinate pair as illustrated in Fig.1.

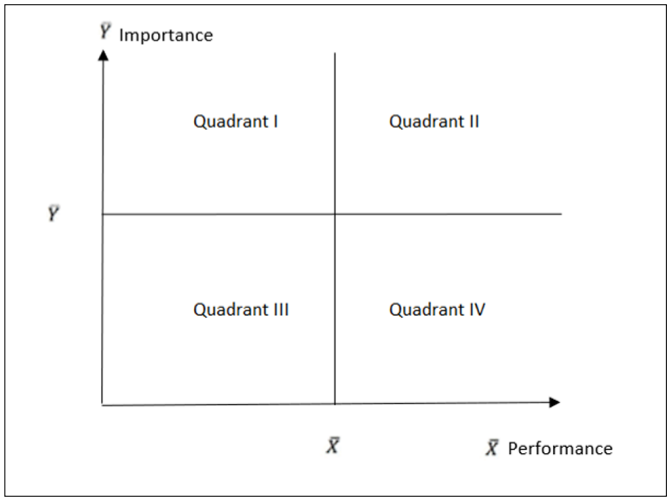

Fig. 1. Cartesian importance-performance analysis diagram.

Customer satisfaction index (CSI)

The CSI evaluates the satisfaction of farmers with organic fertilizers, following these four key steps:

- The mean importance score (MIS) and mean satisfaction score (MSS) are calculated using the provided formula (14):

$$MIS = \frac{\Sigma_{i=1}^{n} Xi}{n} \quad \text{(Eqn. 5)}$$

$$MSS = \frac{\Sigma_{i=1}^{n} Xi}{n} \quad \text{(Eqn. 6)}$$

The MIS is calculated by dividing the importance score of each variable (Yi) by the number of rice farmers (n). The MSS is obtained by dividing the performance score for each variable (Xi) by the number of farmers (n).

- Calculate the weight factors (WF)

It is calculated by dividing the MIS of each attribute

by the total MIS for all attributes, expressed as a percentage (100%), using the specified formula:

$$WFI = \frac{MIS}{\sum_{i=1}^{p} Xi} \quad 100\% \quad \text{(Eqn. 7)}$$

Where p represents the number of attributes (p = 7).

- Calculate the weight score (WS)

It is calculated by multiplying the WF by the average Satisfaction Score (MSS) using the formula:

$$WSi = WFi \times MSSi$$

- Determine the customer satisfaction index (CSI)

It is calculated using the provided formula:

$$CSI = \frac{\sum_{i=1}^{p} WSi}{5} \quad 100\% \quad \text{(Eqn. 8)}$$

The maximum scale is set to 5 in this analysis. The CSI criteria are mentioned in Table 1.

Factor analysis

Factor analysis was used to identify the underlying factors influencing farmers preferences for organic pesticides. This technique helps simplify the dataset by reducing the number of variables while retaining essential insights. The factor analysis model is as follows:

$$X_i = A_{i1}F_1 + A_{i2}F_2 + A_{i3}F_3 + \ldots\ldots + A_{im}F_m + V_iU_i \quad \text{(Eqn. 9)}$$

Where, X_i= i^{th} Standardized variable; A_{ij}= Standardized multiple regression coefficient of variable i on common factor j; F= Common factor; V_i= Standardized regression coefficient of variable i on unique factor i; U_i= Unique factor for variable i; m= Number of common factors

In this study, factor analysis was employed to examine the factors influencing farmers' purchasing decisions based on 13 statements.

Table 1. CSI criteria

S. No.	CSI value	Criteria
1.	81%-100%	Very satisfied
2.	66%-80.99%	Satisfied
3.	51%-65.99%	Quite satisfied
4.	35%-50.99%	Less satisfied
5.	0%-34.99%	Not satisfied

Results and Discussion

Socio-economic profile of farmers

Table 2 presents the socio-economic profile of the farmers. Most of the farmers are males (75.83%), with 24.17% female. The largest age group is 41-50 years (40%), followed by 31-40 years (27.50%), 21-30 years (16.67%) and those above 50 years (15.83%). Regarding land holdings, 32.50% of farmers own 2-4 ha, 27.50% have 1 ha, 24.17% own 1-2 ha, 11.67% possess 4-10 ha and 4.17% own more than 10 ha.

Association between the education of the farmers and their awareness level

H0: The null hypothesis states that there is no correlation between farmers education and their awareness of organic fertilizer.

H1: There is a significant correlation between farmers education and their awareness of organic fertilizer.

According to Table 3, the p-value is 0.001 which is less than 0.05, indicating a significant relationship between farmers education and their awareness of organic fertilizers (15).

Satisfaction level

The satisfaction level among farmers regarding organic fertilizer was assessed using IPA, as shown in Fig. 2. IPA as a tool for evaluating how well performance meets consumer expectations for satisfaction (14). The quadrants-based attributes are shown in Table 4.

Quadrant I (main priority)

This represents the highest priority. The performance of the organic fertilizer in this quadrant was poor. Among the key attributes, the consistency of quality in organic fertilizer application emerged as the most crucial and significant aspect for organic farmers. This area does not meet the farmers expectations, indicating a need for improvement.

Table 2. Socio-economic profile of the sample farmers

S. No.	Particulars	No. of respondents (n=120)	Percentage (%)
1.	**Gender**		
	Female	29	24.17
	Male	91	75.83
2.	**Age**		
	21-30	20	16.67
	31-40	33	27.5
	41-50	48	40
	Above 50	19	15.83
3.	**Land holding**		
	1 ha	33	27.5
	1-2 ha	29	24.17
	2-4 ha	39	32.5
	4-10 ha	14	11.67
	Above 10 ha	5	4.17

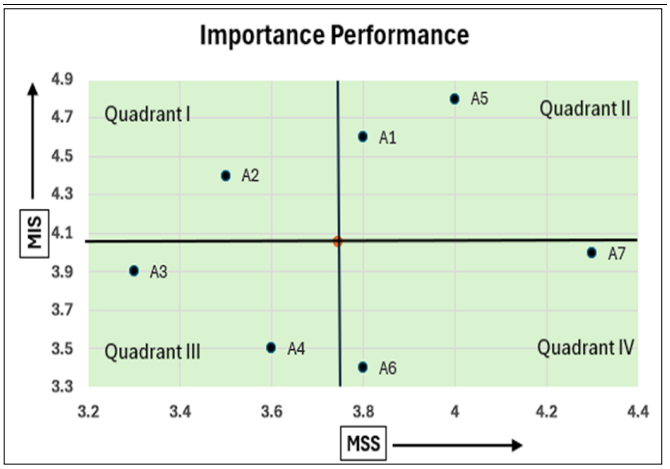

Fig. 2. Cartesian chart showing organic fertilizer attributes by importance and performance.

Table 3. Education and awareness cross-tabulation

			Awareness		
			No	Yes	Total
Education	Illiterate	Count	7	10	17
		Expected count	2.0	15.0	17.0
		% of total	5.8%	8.3%	14.2%
	Post graduate	Count	0	11	11
		Expected count	1.3	9.7	11.0
		% of total	0.0%	9.2%	9.2%
	Primary	Count	4	31	35
		Expected count	4.1	30.9	35.0
		% of total	3.3%	25.8%	29.2%
	Secondary	Count	1	36	37
		Expected count	4.3	32.7	37.0
		% of total	0.8%	30.0%	30.8%
	Undergraduate	Count	2	18	20
		Expected count	2.3	17.7	20.0
		% of total	1.7%	15.0%	16.7%
Total		Count	14	106	120
		Expected count	14.0	106.0	120.0
		% of total	11.7%	88.3%	100.0%

X^2 value = 18.766 p value =0.001

Quadrant II (maintain achievement)

This quadrant, termed "maintain achievement," includes attributes such as soil health performance and the availability and consistency of supply. These attributes were highly important and satisfactory, meeting or exceeding farmers expectations and thus warranting continued emphasis.

Quadrant III (low priority)

This includes attributes that are less important to farmers, with adequate but unexceptional performance. These include price and ease of application, which were given lower priority, potentially due to limited awareness among farmers about the effective use of organic fertilizers.

Quadrant IV (excessive}

This quadrant, labelled "excessive" contains attributes such as yield (nutrient efficacy) and environmental friendliness. While these were considered important, their performance exceeded the farmers actual interest, indicating a potential overemphasis on these aspects.

According to Table 5, the CSI was calculated at 74.80% (16). Based on Table 1, CSI values between 66% and 80.99% are categorized as "Satisfied" (17). The 74.80% CSI score reflects the importance and strong performance of attributes in quadrant II, while attributes in quadrants I and III contributed to the score falling short of 100%.

Factor analysis

To assess the adequacy of the sample for factor analysis, the KMO (Kaiser Meyer Olkin) and Bartlett's test were performed. The results in Table 6 indicated that the sample was adequate, with a KMO value of 0.617, exceeded the threshold of 0.5. Table 7 shows the percentage of total variance explained by each factor, while Fig. 3 displays a scree plot indicating 5 factors with eigen values greater than 1. As shown in Table 8, factor 1 has 3 variables, factor 2 has 3, factor 3 has 2, factor 4 has 3 and factor 5 has 2, out of 13 variables influencing farmers purchasing behaviour.

Table 4. Attributes based on quadrants

S. No.	Quadrants	Variables
1.	I	A2 (consistency of quality)
2.	II	A1 (soil health performance), A5 (availability and supply consistency)
3.	III	A3 (price), A4 (easy to use)
4.	IV	A6 (yield), A7 (environment Friendly)

Table 5. Performance conformity and interest

S. No.	Attributes	MIS	WF (%)	MSS	WS
1.	Soil health performance (A1)	4.6	16.08	3.8	0.61
2.	Consistency of quality (A2)	4.4	15.38	3.5	0.53
3.	Price (A3)	3.9	13.63	3.3	0.44
4.	Easy to use (A4)	3.5	12.23	3.6	0.44
5.	Availability and supply consistency (A5)	4.8	16.78	4	0.67
6.	Yield (A6)	3.4	11.88	3.8	0.45
7.	Environment friendly (A7)	4	13.98	4.3	0.6
	Total	28.6	100	26.3	3.74
	CSI		74.80%		

MIS= Mean importance score, WF= Weight factors, MSS= Mean satisfaction score, WS= Weight score

Table 6. KMO and Bartlett's test of sample adequacy

Kaiser-Meyer-Olkin measure of sampling adequacy		0.617
Bartlett's test of sphericity	Approximately Chi-Square	409.248
	Degree of freedom	78
	Significance	0.000

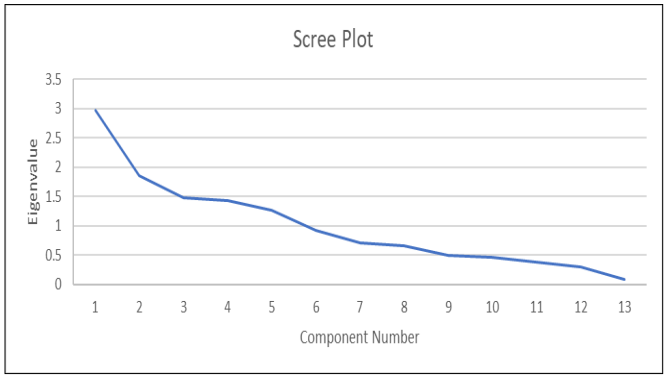

Fig. 3. Scree plot of variables in factor analysis.

Table 7. Percent of variance of the factors

Factors	Total	Percent of variance	Cumulative percent
1	2.97	22.843	22.843
2	1.85	14.232	37.075
3	1.481	11.389	48.464
4	1.436	11.045	59.509
5	1.259	9.686	69.196

Table 8. Rotated component matrix

Rotated component matrix						
S. No.	Variables	Component				
		1	2	3	4	5
1.	Price	0.927	0.195	-0.072	-0.003	-0.058
2.	Quality	0.913	0.161	-0.134	0.062	-0.032
3.	Timely availability	0.804	0.021	0.293	0.017	0.017
4.	Recommendations from dealer	0.12	0.866	-0.007	-0.015	0.001
5.	Recommendations from farmers	0.098	0.742	0.19	-0.063	-0.263
6.	Past experience	0.217	0.696	-0.051	0.01	0.463
7.	Discount	-0.089	0.002	0.764	0.06	0.152
8.	Income	0.169	0.135	0.732	-0.172	0.006
9.	Knowledge	-0.06	-0.082	0.334	0.766	-0.105
10.	Distance from shop	0.069	-0.117	-0.182	0.714	-0.109
11.	Quantity	0.073	0.24	-0.347	0.565	0.146
12.	Easy to use	-0.056	0.195	0.048	0.232	-0.781
13.	Brand Image	-0.153	0.123	0.239	0.086	0.659

Extraction method: Principal component analysis (5 factors extracted)

Factor 1: Price, quality and timely availability

Factor 1, the 'prime factor' includes price, quality and timely availability of the organic product, with factors loadings of 0.927, 0.913 and 0.804, respectively. Among these, price (18) was the most influential variable, followed by quality (18) and timely availability (19).

Factor 2: Recommendations from dealers, recommendations from farmers, and past experience

Factor 2 includes recommendations from dealers, recommendations from farmers and past experience (20). Dealer recommendations had the highest factor loading (0.866), followed by recommendations from farmers (0.742) and past experience (0.696).

Factor 3: Discount and income

Factor 3 includes two variables: discount and income, with factor loadings of 0.764 and 0.732, respectively. Both variables significantly influenced the farmers' purchasing behaviour (21).

Factor 4: Knowledge, distance from shop and quantity

This factor includes knowledge, distance from the shop and quantity, with loadings of 0.766, 0.714 and 0.565, respectively. Knowledge (19) and distance from the shop (20) were significant due to their higher loadings.

Factor 5: Easy to use and brand image

This factor comprises ease of use and brand image, with factor loadings of 0.781 and 0.659, respectively. Ease of use (22) emerged as the most influential variable within this factor.

Conclusion

The studies conducted in Navsari district reveal that a significant proportion of farmers are familiar with the use of organic fertilizers. The strong correlation between education and awareness of nano urea underscores the critical role of education in increasing knowledge about advanced agricultural inputs. The satisfaction index score indicates that farmers were generally satisfied with the performance of organic fertilizers. Key determinants influencing their purchasing decisions include price, quality, timely availability and dealer recommendations.

These insights highlight strategies to improve the adoption of organic fertilizers by emphasizing targeted educational initiatives and addressing key purchasing factors to effectively meet farmers needs. Future challenges in adoption include scalability, consistent quality and meeting rising demand, all of which underscore the importance of innovation in the production and formulation of organic fertilizers.

Expanding educational programs can help further bridge knowledge gaps and support informed decision-making among farmers. Addressing these areas holistically can enhance adoption rates and long-term satisfaction among farmers.

Authors' contributions

S, CM and GSR participated in conceptualization, investigation, methodology, validation, preparation and editing of original draft of the manuscript. MP carried out the formal analysis. AR participated in investigation and editing, reviewed the original draft of the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

References

1. Chen JH. The combined use of chemical and organic fertilizers and/or biofertilizer for crop growth and soil fertility. International workshop on sustained management of the soil-rhizosphere system for efficient crop production and fertilizer use. Citeseer; 2006.
2. Panday D, Bhusal N, Das S, Ghalehgolabbehbahani A. Rooted in nature: The rise, challenges and potential of organic farming and fertilizers in agroecosystems. Sustain. 2024;16(4):1530. https://doi.org/10.3390/su16041530
3. De Schutter O, Vanloqueren G. The new green revolution: How twenty-first-century science can feed the world. Solutions. 2011;2(4):33-44.
4. Monastersky R. The human age. Nature. 2015;519(7542):144. https://doi.org/10.1038/519144a
5. Agegnehu G, Srivastava AK, Bird MI. The role of biochar and biochar-compost in improving soil quality and crop performance: A review. Appl Soil Ecol. 2017;119:156-70. https://doi.org/10.1016/j.apsoil.2017.06.008
6. Quintarelli V, Radicetti E, Allevato E, Stazi SR, Haider G, Abideen Z, et al. Cover crops for sustainable cropping systems: A review. Agriculture. 2022;12(12):2076. https://doi.org/10.3390/agriculture12122076
7. Liu E, Yan C, Mei X, He W, Bing SH, Ding L, et al. Long-term effect of

chemical fertilizer, straw and manure on soil chemical and biological properties in northwest China. Geoderma. 2010;158(3-4):173-80. https://doi.org/10.1016/j.geoderma.2010.04.029

8. Verheijen FG, Zhuravel A, Silva FC, Amaro A, Ben-Hur M, Keizer JJ. The influence of biochar particle size and concentration on bulk density and maximum water holding capacity of sandy vs sandy loam soil in a column experiment. Geoderma. 2019;347:194-202. https://doi.org/10.1016/j.geoderma.2019.03.044
9. Jote CA. The impacts of using inorganic chemical fertilizers on the environment and human health. OMCIJ. 2023;13(3):555864.
10. Awazi NP, Tchamba N. Enhancing agricultural sustainability and productivity under changing climate conditions through improved agroforestry practices in smallholder farming systems in sub-Saharan Africa. Afr J Agric Res. 2019;14(7):379-88. https://doi.org/10.5897/AJAR2018.12972
11. Aeron MN, Mehta P. Analysis and interpretation of data on percentage basis. IJRSSH. 2013;3(2):8-16.
12. Krishna K. Study of productiveness of subject theses in Agriculture Research: A Chi Sqyare Test Analysis., S. K. N. Agriculture University, Jobner (Jaipur). p. 116-19.
13. Supranto J. Pengukuran tingkat kepuasan pelanggan: Untuk menaikkan pangsa pasar/oleh J. Supranto. 2011.
14. Yola M, Budianto D. Analisis kepuasan konsumen terhadap kualitas pelayanan dan harga produk pada supermarket dengan menggunakan metode importance performance analysis (IPA). JOSI. 2013;12(1):301-09. https://doi.org/10.25077/josi.v12.n1.p301-309.2013
15. Paul J, Sierra J, Causeret F, Guindé L, Blazy J-M. Factors affecting the adoption of compost use by farmers in small tropical Caribbean islands. J Clean Prod. 2017;142:1387-96. https://doi.org/10.1016/j.jclepro.2016.11.168
16. Pratama TA, Rahman T, Rahman N. Analisis kepuasan konsumen food bar kabupaten subang. Prosiding SNaPP2011 Sains, Teknologi, dan Kesehatan; 2011.
17. Retnanti MAC, Anindita R. analysis of paddy farmerâ€™ s satisfaction on insecticide x in pendem village, junrejo sub-district, batu city. Agric Soc Econ J. 2018;18(1):7-12. https://doi.org/10.21776/ub.agrise.2018.018.1.2
18. Omotesho A, Fakayode S, Tariya Y. Curtailing fertilizer scarcity and climate change; an appraisal of factors affecting organic materials use option in Nigeria's agriculture. EJESM. 2012;5(3):281-90. https://doi.org/10.4314/ejesm.v5i3.10
19. Sarker MA, Itohara Y. Factors influencing the extent of practice of organic farming technologies: A case study of Tangail district in Bangladesh. Am J Agric Biol Sci. 2008;3(3):584-90. https://doi.org/10.3844/ajabssp.2008.584.590
20. Ajewole O. Farmer's response to adoption of commercially available organic fertilizers in Oyo state, Nigeria. Afr J Agric Res. 2010;5(18):2497-503.
21. Lavison RK. Factors influencing the adoption of organic fertilizers in vegetable production in Accra: University of Ghana; 2013.
22. Ullah A, Shah SNM, Ali A, Naz R, Mahar A, Kalhoro SA. Factors affecting the adoption of organic farming in Peshawar-Pakistan. Agric Sci. 2015;6(06):587. https://doi.org/10.4236/as.2015.66057