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Consumer Preference of Plastic Packaging as Green Packaging Prediction with Hebbian Neural Network Analysis

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The use of plastic waste can no longer be dammed both in shopping at traditional markets, supermarkets, and in shipping goods. This has an impact on the environment because plastic waste takes 10 - 1000 years to decompose. One effort to tackle plastic waste is making green packaging or environmentally friendly packaging. Green Packaging certainly will not eliminate plastic waste, but will at least reduce the use of plastic waste. Data were taken by random sampling of 255 consumer respondents who purchased dried mango with plastic packaging in Bandung. The study was conducted from May to July 2019. Data were analyzed with the Hebbian Neural Network. The purpose of this study is to analyze how many consumers use plastic packaging to predict consumer preferences and the reason for the choice of plastic packaging. The results revealed that, 75.36% of consumers were interested in plastic packaging. The Hebbian Neural Network can predict consumer preferences for dried mango plastic packaging with a precision reaching 98.74%. Thus, it can be predicted which plastic packaging is the most preferred. There are two types of plastic packaging that consumers like the most because they are interesting, safe, and easy to carry. The dried mango plastic packaging succeeded in creating innovation so the buyer decided to buy the dried mango product with plastic packaging. Thus, green packaging must be an eye catching, safe, and easy to carry.

Key words: *Prediction, consumer preferences, plastic packaging, Hebbian NN Analysis.*

Introduction

It is known that there is a lot of pollution on this earth. One reason for this is the disposal of rubbish with an average of 8 million tons per year with 3 percent of the total plastic waste ending up at sea (Jambeck et al, 2015). The head of the 4th United Nations Environment Assembly (UNEA), in his speech beginning in March 2019 in Nairobi, called on all countries to make changes to secure a clean environment. Dirty environment is caused by pollution of air and garbage, especially plastic waste, that cannot be decomposed in the soil. The percentage of the composition of plastic waste compared to other types of waste increases every year. In 2019 plastic waste is estimated at 20.8 million tons and there will be an estimated 28.50 million tons in 2025.

To overcome plastic waste, the Government of Indonesia has issued Presidential Regulation No. 83 of 2018 and, specifically in Bandung, Regional Regulation No. 17 of 2018 to reduce the use of plastic bags. A number of strategies have been carried out but until now the implementation has not run optimally. It is interesting to look at why consumers prefer plastic packaging compared to other packaging even though this plastic packaging is polluting the environment. Knowing the important points of consumer interest in using plastic packaging can be used as a reference in making green packaging. Dry mango products are a case in point in the selection by consumers because dried mango comes in a variety of plastic packaging ranging from packaging that is already on the market to dried mango packaging that is designed by itself.

In addition, the results of previous studies revealed that dried mango is preferred by consumers because it tastes good and can substitute mangoes when they are not in season. The purpose of this research is to analyze why plastic packaging is the main attraction of consumers in buying dried mango, what is the plastic packaging that consumers like and the reasons why consumers choose the particular type of plastic packaging. The results of this study provide important information about plastic packaging that can be used as a reference in making green packaging or environmentally friendly packaging. In addition, it can provide input for the government, stakeholders, and other communities relating to the prevention of plastic waste.

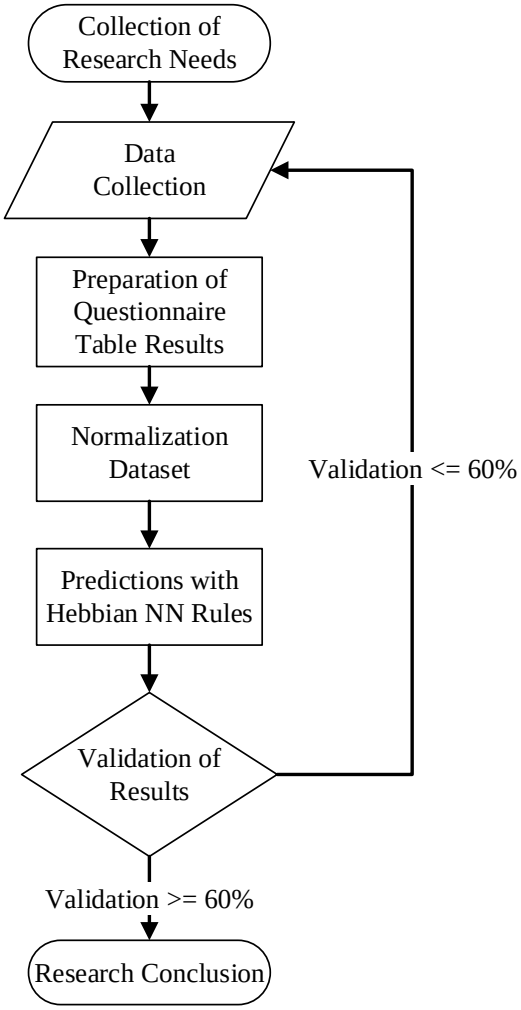
Method

Research Design

According to Glinskiy et al., (2016) environmental safety is a complex system object for study that makes it difficult to develop an effective mechanism for assessing social and economic systems according to the environmental safety level. The most powerful tool here

is the classification using fuzzy neural networks. The research conducted is to arrive at a conclusion that becomes the method used to solve a research problem. The method used in this research can be seen in Figure 1 below.

Figure 1. Research Flow



The flow of research conducted as shown in Figure 1 above, with the steps carried out at each stage are now discussed. The first stage is gathering research needs. This stage involves preparing a series of questions as outlined in the form of a questionnaire. This stage also determines the object or place of research to be carried out. The outcome of this stage are questionnaires and research objects which are evidence based.

The second stage involves collecting data by distributing questionnaires to various respondents. These respondents can behave as buyers of dried mango products or who have a desire for dried mango products. The intended output of this stage are the respondent answers

to the questionnaire regarding Dried Mango Products using various types of plastic packaging. These answers revolve around the shape of the packaging of dried mango plastic products, the ranking of plastic packaging, and the reasons for the respondent interest in the plastic packaging of dried mango products.

The third stage of this research flow is the preparation of the results of the questionnaire into tabulation form. This tabulation is presented by noting the respondent name, class, form of dried mango product plastic packaging, determining the ranking of plastic packaging, and reasons for interest in plastic packaging. The output of this third stage is a table arranged into a dataset.

The fourth stage is the normalization of the dataset. The definition of normalization is to rearrange the results of the questionnaire into a ready-to-use form. Doubtful answers to the questionnaire will be reformed so that the results avoid doubt. Normalization is also carried out by observing qualitative and quantitative data in the answers to the questionnaire.

Both data types are normalized by determining the number of possible answers to qualitative data and quantitative values. The purpose of normalizing this data is to get an arrangement of data values that have authentic references in analyzing the results. Determination of the lower and upper limits, as a reference value is very important to know. The output from this stage is the form of data values that have been normal, so that they are ready to predict buyer preferences using the results analysis tool. The result analysis tool uses the Hebbian Neural Network (NN) rule method. Normalization rules that are used according to the formulation are

$$\text{Normalizations} = \frac{\text{minRange} + [(x - \text{MinValue})(\text{MaxRange} - \text{MinRange})]}{\text{MaxValue} - \text{MinValue}} \quad (1)$$

MinRange and MaxRange are normal result values that are between 0 and 1. While MaxVaue and MinValue are respondent's answer values that are at 0 to 5.

The next stage is the fifth stage. This stage involves conducting data analysis using a tool known as the Hebbian Rules NN. In the analysis conducted by Hebbian Rules, validation of the results of the process is 60% the level of truth. The value of 60% is taken as a limit on the validity of the tool against the data used. If the results do not obtain a validation value > 60%, then the test will be repeated at stage two. This repetition is conducted to obtain the actual data validation value by reviewing the results of the respondent answers.

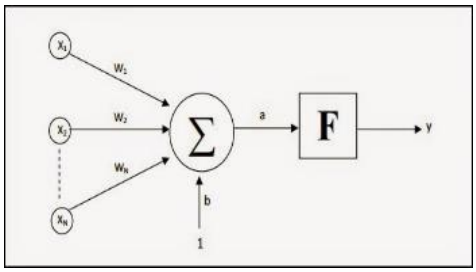
The sixth step is drawing conclusions. This stage establishes a conclusion regarding the prediction of buyer preferences for dried mango plastic packaging for purchasing decisions. This stage will explain the relationship between buyer preferences, dried manggo plastic packaging, and purchasing decisions.

Hebbian Rules Neural Network

The main property of a Neural Network (NN) processor is the learning ability of the environment it receives, as well as improving performance throughout learning. The learning process in NN is known as supervised learning or active learning. This supervised learning carries out the learning process with the help of a supervisor who shows a test on the NN. Another process is known as Unsupervised Learning. Unsupervised Learning or self-organized learning does not need the assistance of a supervisor. In this unsupervised process, NN receives a number of different inputs then finds significant features in a pattern/ data and learns how to classify input data into an appropriate category. Saleema & Amarunnishad (2015) recently further developed their research using Fuzzy Logic (FL), Rough Sets (RS), Adaptive Neural Networks (ANN), Genetic Algorithms (GA) Support Vector Machine (SVM), Ant Colony, and Practical Swarm Optimizer (PSO) etc. as the various components of soft computing and each of these offers specific attributes. Based on the mental activity of the user and the control commands of the wheelchair, the design of classification system based on fuzzy neural networks (FNN) is considered. The design of FNN based algorithm is used for brainactuated control (Abiyev *et al*. 2016; Lakhani, 2017, Kulkani, 2018)

Accordingly, the extension of the Hebbian Learning rule suggesting nonlinear units drew the attention of researchers that employ the Hebbian rule, may lead to robust principal component analysis. In 1949, Donald Hebb proposed a key idea in the study of biology (Hama, 2014). This idea is known as Hebb's Rule. Hebb's rule states that if a neuron i is adjacent to a recognized neuron j and repeats participation in its activation, then the synaptic connections that occur in these two neurons become stronger so that the neuron j becomes more sensitive to actively stimulating neurons i. In Figure 2 below, an example of Hebbian Learning NN is illustrated with graphs.

Figure 2. Architectural Research Problems, drawn with Hebb Rules NN



x_1, x_2,..., x_n are the input variables in this research problem including the reasons, ranking, and target output variables namely image preferences. Whereas b is the bias value in an NN processing, W_1, w_2,..., w_n are synaptic weights with random values between 0 to 1. The result of processing Hebb Rules NN is a linear equation with many parameters in the form of y =

$F(x) = b + x_1w_1 + x_2w_2 + ... + x_nw_n$. x_1 is the reason respondents choose packaging, x_2 to x_5 is the rating given by the respondent, whereas the preference is F (x) or the output of the Hebb Rules NN process.

The work stages of the Hebb Rules are as follows:

Step 1: Initialization
Setting synaptic weights and thresholds for a random value at intervals of 0 to 1.

Step 2: Activation
Calculates the output neuron at iteration p.

$$y_j\,(p) = \sum_{i=1}^{n} x_i\,(p)\,w_{ij} - \theta_j \quad (2)$$

Where, n is a number of input neurons, θ_j is the threshold value of the neuron j.

Step 3: Learning
Update the existing weight on the network by using:

$$W_{ij}(p+1) = W_{ij}(p) + \Delta W_{ij}(p) \quad (3)$$

Where $\Delta W_{ij}(P)$ is the improvement of the weight on the repetition of P. The weight improvement is determined by generating the product activity rules with the following equation:

$$\Delta W_{ij}\,(p+1) = \varphi y_j\,(p)[\,\lambda X_i(p) - W_{ij}\,(p)] \quad (4)$$

Step 4: Iteration
Adding repetitions with p + 1, then return to the second step. When it is finished, it will form a function:

$$y = F(x) = b + \sum_{i=1}^{n} x_i w_i \quad (5)$$

The next function is to convert it into a value between 0 - 1. The value 0-1 is the normalization of the dried mango plastic packaging option. Results from eq. (5) is normalized again to get a value between 0 -1. The following conversion function is used:

$$Preference\ value\ (x) = \frac{1 - e^{-ax}}{1 + e^{-ax}} \quad (6)$$

Step 5 : Prediction
In step five, the tool used for testing the questionnaire is the Hebbian Rules NN. The application of Hebbian Rules NN is to obtain a prediction of dried mango plastic packaging preferences. This is also used to see the suitability between the choice of plastic packaging and the decision to purchase dried mango products. So that the neural network architecture for this study is as shown in Figure 2 below.

Validation Method

The results validation method as described in this research design, is intended to test whether Hebbian rules can be applied to research for the selection of dried mango plastic packaging. This validation uses testing with confusion matrix. Confusion matrix is a presentation in the form of a table that is usually used to describe the performance of a classification model on a dataset for known true values. An explanation of how the confusion matrix works is presented in Table 1 below.

Table 1: Example of presenting the Confusion Matrix

N = 165	Prediction: No	Prediction: Yes	
Actual : No	TN = 50	FP = 10	60
Actual : Yes	FN = 5	TP = 100	105
	55	110	

In the confusion matrix presentation table able, it can be seen that there are two possible predictions, "yes" or "no" for a sample number (N) of 165. The statement Yes is a statement that the conditions in the real condition are true, while "No" is the opposite. The results presented in the confusion matrix table above show that the prediction of "Yes" is 110 and the prediction of "No" is 55. While the actual condition of "Yes" in accordance with reality is 105 and 60 people do not correspond to the state of "No". The table above includes TP (True Positive), TN (True Negative), FP (False Negative), and FN (False Negative) data values. The understanding of the unit is as follows:

- **True positives (TP):** the result of the prediction is "yes" in accordance with its actual state of "yes".

- **True negatives (TN):** the result of the prediction is "no" and in accordance with the actual stating "no".

- **False positives (FP):** the result of the prediction is "yes" but the actual condition does not occur, often known as the first prediction term.

- **False negatives (FN):** the result of the prediction is "no" but in the actual condition is "yes", recognized by the second prediction term.

Validation was conducted using a confusion matrix table as a measurement of the value of accuracy, Misclassification Rate, True Positive Rate, False Positive Rate, True Negative Rate, Precision, Prevalence, Cohen Kappa, F score, and ROC curve.

- **Accuracy:** states how many predictions are true. As many as the predicted conditions are true for "yes" and "no". If referring to the confusion matrix table, it can be calculated as (TP + TN) / total = (100 + 50) / 165 = 0.91

- **Misclassification Rate:** states how many predictions are wrong and can be calculated by (FP + FN) / total = (10 + 5) / 165 = 0.09, similarly the 1-Accuracy formula is known as the average error.

- **True Positive Rate:** see the results predicted in accordance with the actual situation on the condition of "yes", calculated with: TP / actual yes = 100/105 = 0.95 and also known as sensitivity or Recall.

- **False Positive Rate**: see the prediction results as "yes" but actually is a "no", calculated using: FP / actual no = 10/60 = 0.17.

- **True Negative Rate**: see the predicted result of "no" and in actuality is "no", meaning that it has a predictive value and the actual is "no". Calculated using: TN / actual no = 50/60 = 0.83, it can also be stated by 1-False Positive Rate, also known as "Specificity".

- **Precision**: states how many predictions occur as "yes" calculated using TP / predicted yes = 100/110 = 0.91.

- **Prevalence**: states how often the actual "yes" condition occurs in the observed sample, calculated using: actual yes / total = 105/165 = 0.64.

- **Cohen's Kappa** is a measurement of how far the truth level of a prediction for changes in data. This understanding is made clear by the difference between accuracy and the average prediction error that occurs from the results of validation.

- **F Score**: is the average weight of recall and precision.

- **ROC Curve**: graphical presentation that summarizes the performance of NN Hebb rules or other methods on all possible thresholds (threshold values). This graph depiction by making a plot between the True Positive Rate (y-axis) and the False Positive Rate (x-axis) as a threshold value to harmonize observations of the given class.

Results and Discussion

Results

A product package often is the first thing that triggers consumer instant responnse before making a purchase decision in retail environments (Cardello, 1996; Deliza Macfie *et al*, 2003). As package design is an extrinsic cue that can influence consumer perception about the intrinsic attribute of the contained product (Limon *et al*, 2009; Orth & Malkewitz, 2008), marketers tend to use package colour to differentiate products. Research indicates that it is necessary to state the results that have been obtained and these results are adjusted to the research design that has been found regarding research design. The first stage in this research is drafting research needs. The respondents in this study were 255 users of dried mango products. The questionnaire interrogates the most preferred plastic packaging by displaying pictures of plastic packaging. Figure 3 below is a sample question (choice) of plastic packaging option images that are visualized for the respondent.

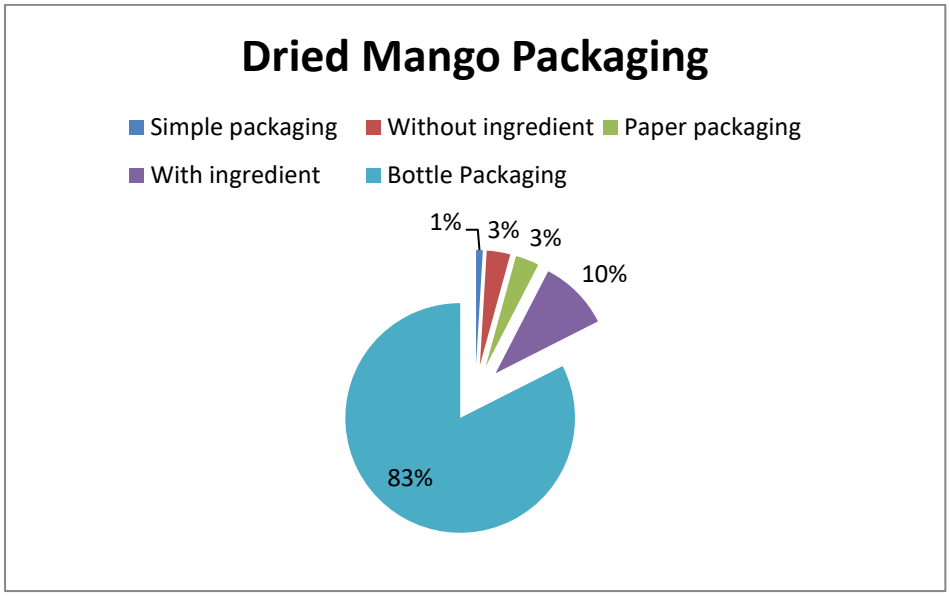
Figure 3: Examples of Plastic Packaging Submitted to Respondents

The images above relate to choices as follows: (a) transparent plastics (b) plastics packaging with ingredient and barcode, (c) paper packaging, (d) plastics packaging without ingredient and barcode (e) bottle plastics packaging. Each picture is represented in the sequence of numbers 1-5. The next questionnaire question asks respondents to rank each dried mango plastic package as presented in Figure 3 above. This ranking is also prepared using a numerical arrangement of 1-5. The last question of the questionnaire asks for the reason for

the choice made in the respondent's answer. The study comprised 255 respondents to determine the preferences of buyers who are interested in dried Mango plastic packaging.

The next step in this research is to arrange each answer so that it is easy to process using the Hebb Rules NN method. Each respondent answer is inventoried for further analysis. The results obtained are in the form of a product packaging selection number, ranking order, and the reason. The preferences consumers of dried mango plastic packaging can be seen in Figure 4 as below :

Figure 4 The Preferences Consumers of Dried Mango Packaging



In analyzing consumer reason for choosing plastic packaging over green packaging the following results were determined. The reason of respondent buying plastic packaging in sequence are easy to carry, plastic packaging can be vacuum, light in weight, interesting packaging, transparent- easy to see the product, practical packaging, simple packaging safe packaging, hygienic packaging, easy to open packaging, and neat packaging. The reason can be seen in Figure 5. These results were obtained from respondents at the designated research object. The other researcher disagreed that the factor 'easy to carry' is the important factor for choosing plastics packaging, because it is too general and lacks technical specification. The other factors that should be considered are shape, design, size, colour and graphic design (Vardham and Amulya, 2017).

Figure 5 The Reason of Consumers Buying Plastic Packaging

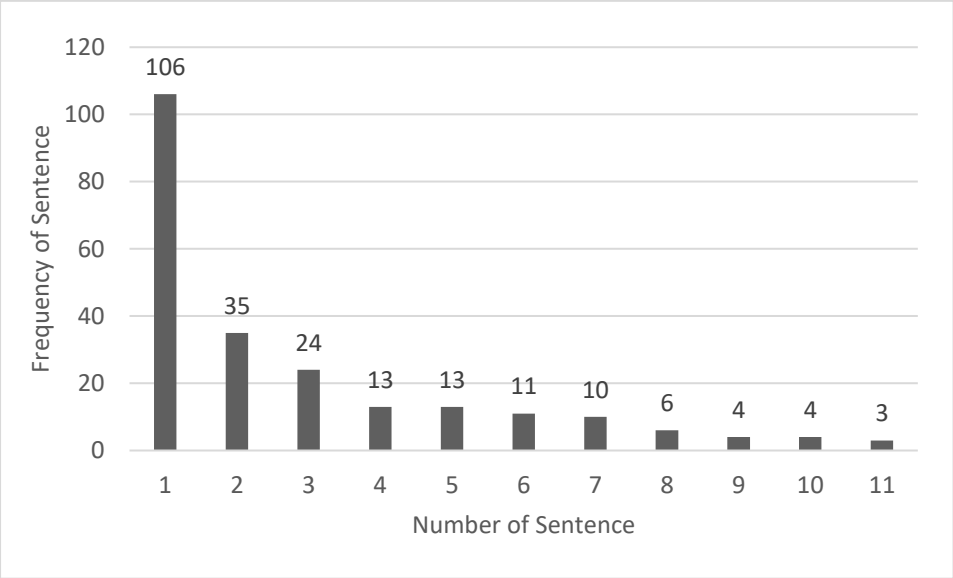


Table 2: The Crosstab of Reasoning Respondent Choose Plastic Packaging and Ranking of Packaging Preferences

No	Name	Buy/ Not Buy	Reason (A)	R_{21}	R_{22}	R_{23}	R_{24}	R_{25}	T
P1	Respondent	BUY	Interesting Packaging	5	2	3	4	5	5
P2	Respondent	BUY	Plastics Packaging	5	4	1	3	0	3
P3	Respondent	BUY	Interesting Packaging	5	3	2	4	5	5
P4	Respondent	BUY	Safe Packaging	5	4	2	3	5	5
P5	Respondent	BUY	Safe Packaging	5	2	3	4	5	5
...	...	..	...	...	...	...	...	...	...
P255	Respondent	BUY	Interesting Packaging	5	3	2	4	5	5

In Table 2. It can be seen that the next set of results obtained are the linkage of the respondent rational and the ranking of packaging preferences against plastic packaging preferences in purchasing decisions. This result is the fifth stage which is the prediction of the preference of dried mango plastic packaging based on reason, and the ranking of dried mango plastic packaging. These results are obtained using Hebb Rules NN. The following Table 3 presents

the results using Hebb Rules NN. Table 3 Results of normalization and Hebb Rule NN. F (x) is the value generated from the function $F(_x)$ = 211.2+ 59,72A + 128,9 R_{21}+ 120,5 R_{22} + 124,08 R_{23}+ 199,4 R_{24}+49,1 R_{25} , according to eq. (5)

Table 3: Normalization of Hebbian Neural Network

No	A	R_{21}	R_{22}	R_{23}	R_{24}	R_{25}	T	F(X)
P1	0.051	1	0.4	0.6	0.8	0.2	1	635.1337
P2	0.0941	1	0.8	0.2	0.6	0.4	0.6	586.9757
P3	0.051	1	0.6	0.4	0.8	0.2	1	624.7577
P4	0.0235	1	0.8	0.4	0.6	0.2	1	607.3754
P5	0.0235	1	0.4	0.6	0.8	0.2	1	623.8714
...	...	...	...	...	...	...	...	...
P255	0,051	1	0,6	0,8	0,4	0,2	1	594,6697

To determine that there is a strong relationship with the respondent's preference value, the results in Table 3 for the value F (x) are recalculated with eq. (6). Eq results. (6) are shown in Table 3. Variables A, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, while T is the preference value of plastic packaging as the support value of the function. 211.2 Value is the value of b like the function written in eq. (5). A is the respondent's rationale sentence, R_{21} is the favorite value on picture packaging 3a, R_{22} is the preferred rating on picture 3b packaging, R_{23} is the preferred rating on picture, 3b packaging, R_{24} is the preferred rating on picture 3b packaging, R25 is the preferred rating on picture 3b packaging, R_{25} is the preferred rating on picture 3b packaging.

Table 4 : The Similarity of Values given by Consumers (T), with the Results of the Hebbian Neural Network.

No	T	eq. (6)	Similarity Value
P1	1	1	True
P2	0,6	0,8	False
P3	1	1	True
P4	1	1	True
P5	1	1	True
...	...	...	...
P255	1	1	True

Using calculation as presented in Table 4 above, it can be seen that column T and eq column. (6), show the similarity value contained in the similarity value column. 255 respondents in column No, namely P1, P2, ..., P255 are respondents who have given a preference value T. The similarity value column is the result of the similarity test between the respondents' preferences and the prediction results of the Hebb Rule NN preference. If the value in column

T is the same as the value in column eq. (6), it produces TRUE value. If it is not the same it will produce a FALSE value. The value in column T is the result of normalization of the value of the plastic packaging preference in Figure 3 with numbers 1 - 5.
The value 1 represents bottle packaging (e). A value of 0.8 represents a plastic packaging with ingredient (d). The value 0.6 represents paper packaging © . Value 0.6 represents plastic packaging without ingredient (b) and value 0.2 represents simple plastic packaging. This is the interpretation of the data for the other points.

Discussion

The results of the analysis using Hebb Rules NN have been shown. Of course, from this result a validation test needs to be done. This results validation test uses a confusion matrix with regard to aspects of a buy or not buy decision**.**

Table 5: Confusion Matrix results for Hebb Rules NN

Respondent = 255	Prediction preferences: Not Buy	Prediction preferences: Buy	Total
Actual: Not Buy	TN = 42	FP = 2	44
Actual: Buy	FN = 54	TP = 157	211
Total	96	159	255

In Table 5 above, the percentage of actual data respondents for buying decisions is 211 or 82.74% (prevalence). While the actual data of respondents for the decision not to buy is as much as 44 or 17.25%. While the prediction data from Hebb Rules NN is 159 respondents predicted to buy or 62.35%, and 96 respondents predicted not to buy or 37.64%. Thus, the validation test results from predictions with Hebb Rules NN can be displayed in Table 6 below.

Table 6: Results of Hebb Rules NN Validation of Actual Data

Item of validation	Result of validation
Accuracy	0,7804
Misclassification Rate	0,2118
Recall	0,7536
False Positive Rate	0,0454
True Negative Rate	0,9545
Precision	0,9874
Prevalence	0,8274
F Score	0,8704

In Table 6, the results of the analysis with Hebb Rules NN obtained an accuracy of 78.04%. This means as many as 199 respondents or 78.04% of the sample respondents are influenced

by purchasing decisions with dried mango plastic packaging. The value of 199 is divided into 157 respondents who decided to buy, and 42 respondents who decided not to buy despite indicating preference for the dried mango plastic packaging. While the inaccuracy of predictions with Hebb Rules NN is 21.18%.

Table 6 also records the average error in classifying buying or not buying decisions is 21.18%. This means there are results that are not suitable Hebb Rule NN for as many as 54 respondents (FN) with the actual purchase decision data, and 2 respondent (FT) results of Hebb Rule NN are not in accordance with the decision not to buy.

The validation value obtained can be interpreted as the preference of respondents to buy dried mango based on plastic packaging at 75.36% (recall) of all respondents who purchased. There were 157 respondents who decided to buy because they were influenced by dried mango plastic packaging. This 75.36% value is the real value in that the respondent buys the product based on the packaging used.

If observed from the prevalence value that only focuses on respondents with a purchasing decision, then only 82.7% of respondents were obtained or around 211 respondents were interested in buying caused by dried mango plastic packaging. Receiver Operating Characteristic (ROC) Curve about comparison of NN Hebb Rules results regarding purchasing decisions to buy and not buy can be seen in Figure 6.

Figure 6. Receiver Operating Characteristic regarding Purchasing Decisions to Buy and not Buy

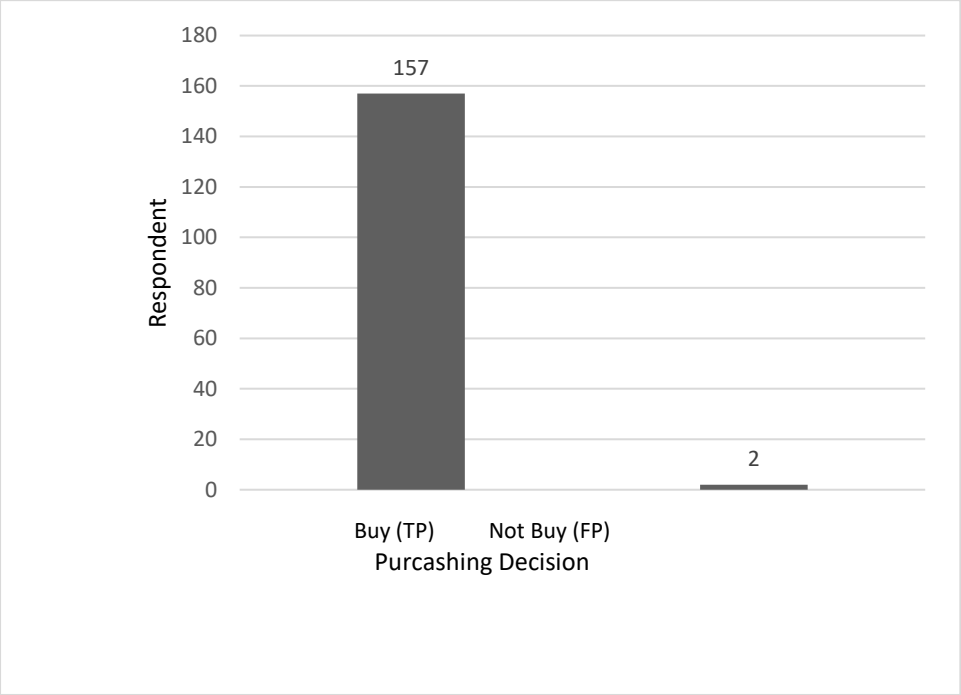
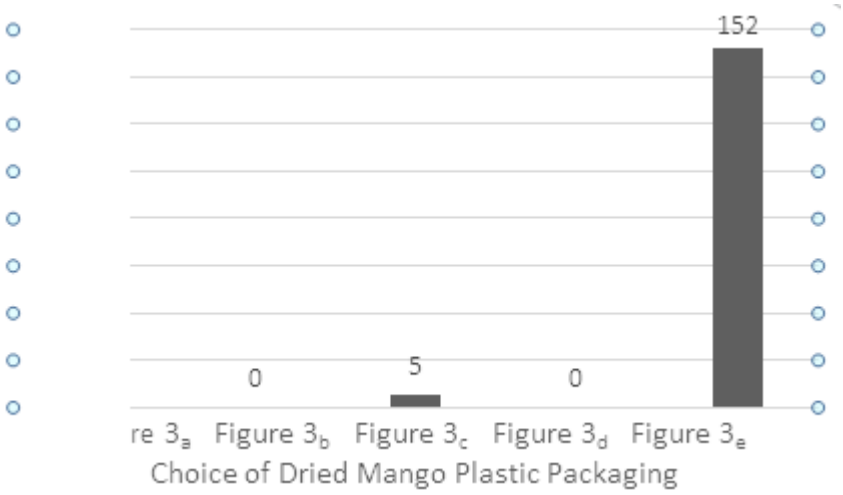


Figure 6 above explains the results of the respondents' decision to buy or not buy dried mango products based on their interest in plastic packaging. In Figure 7, respondents' data that can be said to be authentic, in that they have a high level of truth, is only around 159 respondents. In other words, respondents who are interested in dried mango plastic packaging and who decide correctly numbered only 159. These 159 respondents were divided into 157 respondents interested in buying and 2 respondents who were not interested in buying.

Figure 7. Respondents' Preferences with Buying Decisions, there is a Compatibility of the Hebb Rule NN analysis with The Actual Data.



Based on the results of the Hebb Rule NN analysis, that bottle packaging has many choices of 152 respondents for reasons of interest that the packaging is interesting, safe, and easy to carry, from the reasons stated as presented in Figure 5. On the other hand, simple packaging, , packaging with and without the packaging not chosen by the consumer. While only five respondent choosen paper packaging, its means only five respondent aware of green packaging. Packaging can influence consumer's perception of product quality, which creates new challenges for new idea for packaging (Kochanowicz Zdzislaw *et al*, 2016)

The study results show that consumers preferred using plastic bags rather than green packaging. Thus public awareness of the importance of a clean environment is still low. Therefore, no matter how good the program intending to reduce plastic waste or how stringent the government regulations, people will continue to use plastic packaging. This behavior will change when there is a public awareness of the importance of protecting the environment. The reason consumers prefer plastic packaging than green packaging is because it is interesting packaging, safe, and easy to carry. The requirement of any packaging system relates to marketing, technical performance and legal requirements (Stewart, 2012).

The implication of this research is that green packaging production must have three considerations. Currently, green packaging can be made from natural materials such as cassava, cactus plants and other ingredients whose products are labelled bioplastic, edible and biodegradable (Baldwin and Robert, 2001). Bioplastics from cassava starch have low tensile strength so they are only able to carry light goods and thus nanotechnology was developed by adding nanocellulose produced from rice straw. This addition has proven to be able to increase tensile strength while reducing bioplastic permeability. Currently only 5 % material value of plastics packaging is captured after one use cycle (Hahladakis and Eleni, 2018). The transition to increasing secondary material recovery and recycling becomes more feasible than ever (Ellen Mac Arthur Foundation, 2017; lacovidou et al, 2007).

Conclusion

The results of this research analysis have proven that there is an interest in buying dried mango products with plastic packaging. Dried mango plastic packaging is in great demand by buyers, with 211 respondents determining the buying decision. The proof is accompanied by the results of the analysis as follows:

- The accuracy of Hebb Rules has an analysis confidence level of 78.04%, meaning that there is 78.04% of the results of Hebb Rules NN that matches the actual data.
- Predictions of consumer preferences for dried mango plastic product packaging for purchasing decisions of this product (precision) reached 98.74%. This means that the Hebb rules NN method can be used in this study

- The average error of data analysis results reached 21.18%, this is the inaccuracy of respondent answers to the purchase decision. The answer to the interest in plastic packaging is not accompanied by a buying decision.
- Plastic packaging attracts consumers to make the decision to buy dried mango and this means society do not understand how to care for the environment.
- Respondents who actually bought and stated interest in packaging were 75.36%, with reasons for interest that included interesting packaging, safe, and easy to carry.
- The level of consumer preference in choosing consecutive plastic packaging as follows . The reason of respondent buying plastic packaging in sequence are easy to carry, plastic packaging can be vacuum, light in weight, interesting packaging, transparent- easy to see the product, practical packaging, simple packaging safe packaging, hygienic packaging, easy to open packaging, and neat packaging.
- Preferred packaging options are the packaging with bottle packaging and paper packaging. The preferred reason is due to interesting packaging, safe, and easy to carry. This was proven by 157 respondents choosing this package. 152 respondents chose the bottle packaging and 5 respondents chose the paper packaging.
- Dry Mango Plastic Packaging has succeeded in creating innovation, so buyers buy dried Mango Products with plastic packaging. Thus, if green packaging is to be made, the green packaging must be interesting, safe and easy to carry.

Further research must be conducted to add new variables in plastic packaging use so that the discussion is more detailed

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