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An Analysis of the Relationship between Social Protection Program Status and the Incidence of Food Insecure Households in Aceh Province

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Abstract. One of the government's targets in achieving social development is to reduce food insecurity. Limited economic access for households to obtain sufficient food can cause food insecurity. The social protection program is a policy that plays an important role in efforts to fulfil economic access for households to reduce the incidence of food insecurity. A study about the contribution of social protection programs to food insecurity events needs to be carried out. One of the machine learning methods, namely classification tree can be applied to achieve this goal. The data used in this study is from the 2020 Indonesian Social Economic Survey (SUSENAS) in Aceh Province which consists of food insecurity status as an output variable and 7 input variables; PKH, KKS, BPNT, Local Government Assistance, BPJS, Jamkesda, and PIP. The results obtained are that BPJS provides the largest contribution in determining the status of food insecurity with an AUC value of 0.60.

INTRODUCTION

Education Following the Sustainable Development Goals, one of the objectives of the Government of Indonesia in achieving social development is to eliminate hunger and achieve food security and good nutritional quality. The government's target by 2030 is to eliminate hunger and ensure access for everyone as measured by the prevalence of food insecurity[1].

Food insecurity is defined as a condition of incompetence in the fulfilment of sufficient food in quantity and quality. Food insecurity is a global problem, including in Aceh Province. Food insecurity is influenced by social and economic factors[2]. Economic limitations are one of the causes of households experiencing food insecurity. Based on data from the Central Bureau of Statistics in 2021 the poverty rate in Aceh Province reached 15.43%[3]. The increasing poverty rate makes Aceh the poorest province on the island of Sumatra. The issue of poverty in Aceh Province has the potential to cause food insecurity.

Responding to the problem of poverty, the government implemented a social protection program policy for the community to help fulfil economic access for households. Social protection policies include access to social services

in the areas of health, education, basic services such as access to water and sanitation, housing, and other services including food security[4].

Social protection programs as part of the National Food Security System are expected to reduce food insecurity[5]. The study of social protection program policy against food insecurity events is interesting to do. One of the machine learning methods that can be applied to review the problem is a classification tree. A classification tree is a method often used for classification. The advantage of this method is that the result is easy to interpret and does not take a long programming time[6]. Therefore, this paper uses the classification tree method to analyze the relationship between the status of social protection programs and food insecurity events in Aceh Province. Hopefully, this study is useful to overcome food insecurity problems in Aceh Province.

MATERIAL AND METHODS

Classification Tree

Classification and Regression Trees (CART) is one of the methods or algorithms of the decision tree technique. CART is a simple but powerful method. CART aims to obtain an accurate group of data as a characteristic of a classification, besides that CART is used to describe the relationship between the response variable (dependent variable) and one or more predictor variables (independent variable). The resulting tree model depends on the scale of the response variable, if the data response variable is continuous, the resulting tree model is regression trees, while if the response variable has a categorical scale, the resulting tree is classification trees.

Regression tree and classification tree methods are methods used to describe the relationship between a response variable and a set of predictor variables. The classification tree aims to produce an accurate classification and explain the predictions of new data in each category contained in the response. The classification tree is formed by iterating over each node into two subsets of the derived set[7]. Some of the advantages of CART are:

1. If The variables in the CART, both dependent and independent variables, don't assume the population on a certain probability distribution.
2. Independent variables or predictors in CART can be of categorical type (nominal or ordinal) without the need to create a dummy variable or can also continuous type.
3. CART is able to overcome missing values.
4. CART is not affected by the presence of outliers, collinearity and heteroscedasticity among the independent variables.
5. In CART there is no data transformation.
6. Interpretation of the classification tree generated by CART is very easy understood by its users.

Some CART works in five main steps, namely:

1. Tree building process (creating a classification tree, namely solving the parent node into two child nodes through certain splitting rules and done repeatedly (recursively).
2. Class assignment, namely the identification of the nodes formed in a class through the identification rules (assignment rules).
3. Stopping the trees building process, i.e. stopping the creation of classification trees
4. Pruning the tree is the process of pruning or cutting into a tree that smaller (T).
5. Optimal tree selection is the determination of the optimal classification tree[8].

The sorting process starts from the main node (root node) which contains the data to be sorted. Sorting is done at each node until a final node is obtained. The variable that sorts on the main node is the most important variable in determining the class of observations [7]. In addition to performing classification analysis, the classification tree is also used to see the scores of importance variables from the model. The importance variable score is used to identify the order of the influential variables and is included in the classification tree model. The first order indicates the most dominant variable and becomes the main split in the model. This score is calculated based on the sum of all possible split in one variable at each node. The score of the importance variable used is the normalized value so that the most importance variable will have a score of 100, while the other variables will be in the range of 0 to 100[9].

DATA AND VARIABLE

The data used in this research were adopted from the a 2020 aceh national socio-economic survey conducted by Central Bureau of Statistics. It was obtained 12.971 households. There are 8 variables used in this research which contain of 1 target variable that is household food insecurity status and 7 input variables which are the social protection program. Classification tree analysis used in this research. Further explanation about the variables used is shown in the table.

TABLE 1. *Variable explanation*

No	Type of Variable	Variable/ Indicator	Definition	Reference
1.	Food Insecurity Status	Target variable	A scale that can describe the inability of households or individuals to access the food they need on a regular basis. It's measured using FIES (Food Insecurity Experience Scale) with 2 categories; YES and NO.	[10]
2.	BPNT		Food aid	[11]
3.	KKS		Identity of non-welfare family	[12]
4.	BPJS		Social Health Insurance	[11]
5.	PKH	Input variable	Government assistance	[13]
6.	Jamkesda		Health insurance provided by local government	[11]
7.	Local Government Assistance		Local Government Assistance	[14]
8.	PIP		Education assistance receiver	[15]

RESULT AND DISCUSSIONS

The Overview of Food Insecurity in Aceh

Food insecurity at the individual or household level can occur in a variety of contexts. Based on the data obtained, the general picture of food-insecure household events in Aceh Province is shown as follows.
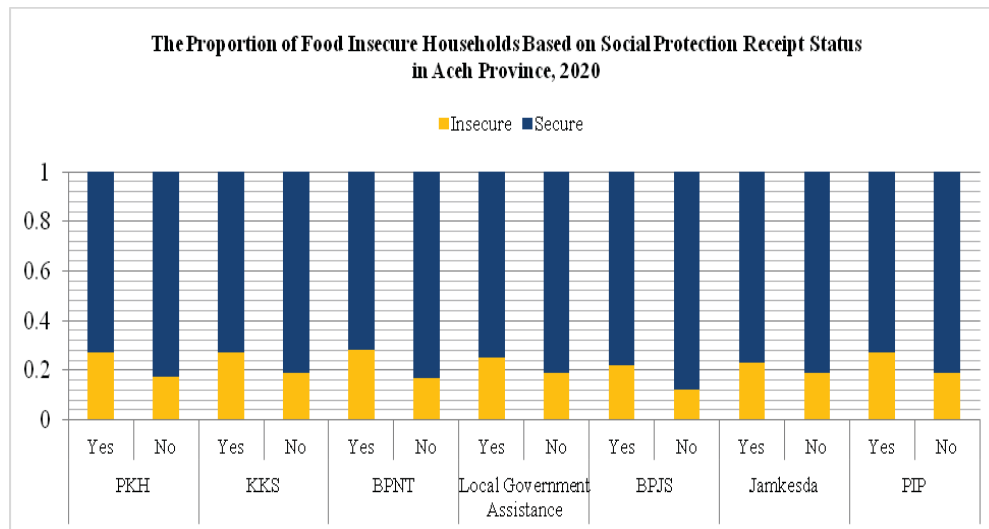

FIGURE 1. *Proportion of Food Insecure Households Based on Social Protection Receipt Status*

Figure 1 shows that the incidence of food insecurity in households receiving social protection programs tends to be higher than the incidence of food in households with the status of not receiving social protection programs.

Tunning Parameter

In this study, AUC values were used to measure the merits of the model. The maximum AUC value, the better the model produced. The parameter that was tuned is *minsplit* which is a multiple of 100 ranging from 100 to 1000. The Control Points (Cp) parameter is minimized to 0 to facilitate the interpretation of the resulting classification tree. The parameter tuning results are shown as follows.

TABLE 2. *Tuning parameter (minsplit) of Classification Tree*

Minsplit	AUC
100	0.5932792
200	0.5932792
300	0.5932792
400	0.5932792
500	0.5934321
600	0.5933856
700	0.5933856
800	0.5917543
900	0.6012589

Table 1 shows the results of tuning parameters with a value of Cp = 0. Based on the table known the maximum AUC value is obtained at *minsplit* 900. This value is used to form a classification tree.

Classification of Food-Insecure Households in Aceh Province

The amount of contribution of each variable is seen based on variable importance obtained using the Rpart library from R-Studio software version 4.0.1. Here is the variable importance score of the variable used.

TABLE 3. *Variable Importance Score*

Variable	VI Score	
BPJS	132,9345	
BPNT	46,74913	
PKH	38,32289	
KKS	15,51525	
Local Government Assistance	5,355279	
PIP	3,267749	
Jamkesda	0	

Table 2 shows that the top three important variables affecting the incidence of food-insecure households in Aceh Province in 2020 based on the social protection programs are BPJS, BPNT, and PKH. Here is a classification tree that describes the incidence of food insecurity in households in Aceh province based on the status of social protection programs.
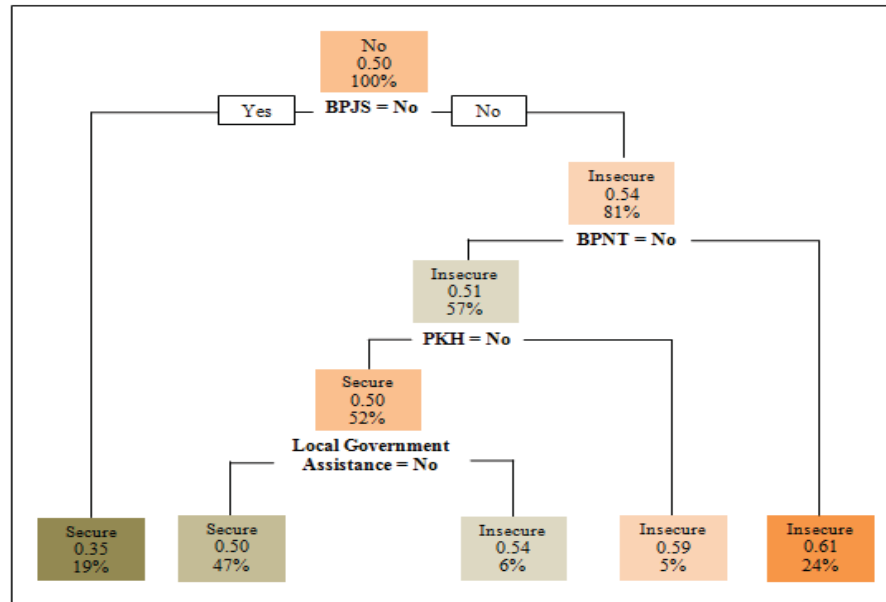
Figure 2. *Classification Tree*

Figure 2 shows the relationship between the status of social protection programs and the incidence of food insecurity in households in Aceh province. Based on the classification tree it is known that when households receive BPJS, do not receive BPNT, and receive PKH then it will be insecure by 5%. BPJS is the indicator that contributes the most to food insecurity in Aceh Province in 2020 based on the status of social protection programs.

CONCLUSION

Based on the analysis that has been done, the conclusions obtained are as follows:
1. The AUC value used for the classification of food insecurity events in Aceh Province in 2020 amounted to 0.6012589 with *minsplit* of 900 and Cp = 0.
2. The top three important variables affecting the incidence of food-insecure households in Aceh Province in 2020 are BPJS, BPNT, and PKH.
3. BPJS is the indicator that contributes the most to food insecurity in Aceh Province in 2020 based on the status of social protection programs.

ACKNOWLEDGMENTS

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