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Prediction of The Trend of Crisis Key Factors to Support Policy Formulation of Consumption Salt Trade System in Indonesia

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Abstract

Indonesia is a net importer country of salt (NaCl), espicially for industrial salt. As consumption salt (salt consumed by household) is polytically sensitive for the country, it is determined as a strategic commodity. Government decided for being able to self sufficiency in the consumption salt. This research is a continuation of previous work, "identification of crisis key factors using ANP method, i.e. price of salt, climate, number of salt producer (farmer), and the availability of sea salt production area". Trend of those crisis key factors has to be predicted to support the dynamic formulation of trade system policy of consumption salt as needed. A method of decompotition time series and Strategic Assumption Surfacing and Testing (SAST) were used.

The decomposition method resulted a prediction of an increase trend of salt price every year, while its production tend to decrease. The area of sea salt production is predicted to fluctuate in the next ten years. Strategic policies to prevent a crisis of consumption salt in Indonesia were identified, those are: Implementing a tight control of salt import, defining a minimal salt price at farmer level, releasing the lisence and liberating the use of land for salt production, providing appropriate technology to farmer for salt production, increasing land productivity through revitalization of infrastructure in salt production areas, preventing conversion of salt production area to other utulization, and establishing a national stock of salt.

Keywords: Prediction, SAST, Crisis Key Factors, Consumption Salt Trade System

1. INTRODUCTION

Demand of consumption salt in Indonesia is increasing as the number of population is increased. This situation tends to create a potention of crisis due to uncertain climate that determine the production of sea salt in the country. Since consumption salt is used by every household to salty the food, its availability in the market has to be maintained; its absent will be politically sensitive. Therefore, Government regulates the trade of consumption salt to maintain its availability in the market, and at the same time encourage salt producer to continue producing the salt.

A tool is needed to early predict the crisis. With early prediction, government can determine a wright policy proactively, and implement the policy before the crysis comes (Eriyatno *et al*. 2010).

Prediction was done to identify key factors of crisis, i.e. climate, price of salt, number of salt producer, and land availability for salt production. Policies to prevent a crisis were determined by weighing the assumptions of preventing each key factors of crisis using a decompotition time series method. The weighing was carried out by using the method of Strategic Assumption Surfacing and Testing (SAST). This method is used to solve interconnected and complex problems with unclearity about the objective, conflict of interest, environment uncertainty, and social obstacles.

The objective of this research was to make a prediction on identified crisis key factors in consumption salt trade system, and to determine alternative policies to prevent the crisis.

1.1 Prediction Method (Time Series Analysis)

The basic principles of time series decomposition method is to decomposize data on time series into patterns, and identify each component separately. This separation is done to increase the accuracy of prediction, and the comprehension of data series behaviour (Makridakis, Wheelwright, and McGee, 1992).

Quantitative prediction technique is varied, developed from many disciplines of knowledge for different

objectives. Each technique has a unique characteristic, accuracy, level of difficulties, and cost to consider.

Makridakis, Wheelwright, and McGee (1990) explains that quantitative prediction can generally be applied with three conditions, i.e.:

1. Information on historical data is available
2. The information can be quantified in numerical form
3. It can be assumed that there will be a continuation of some aspects to the future

By time series method the prediction of the future is to be based on past value of a variable, and/or prediction mistake in the past. The objective of time series prediction method is to find a pattern in historical data, and to extrapolate the pattern to the future.

1.2. Decomposition Method

Decomposition is a prediction technique with an objective of separating components that forms a data pattern of economic or business variables, i.e. trend, seasonal variation, cycle, and random elements (Firdaus, 2011). This technique is generally devided into two models, i.e. aditive decomposition and multiplicative decomposition technique. Basically if it is asssumed that there is no cyclical component, the procedure of this decomposition method consists of three main steps. Step one is to separate the trend component, step two is to separate the seasonal, and step three is to estimate the trend equivalent from the deseasonalized data.

Trend is a tendency of the movement, up or down, of the data in a long period of time. Seasonal variation is a periodic movement of the data. Cyclic component is a movement/change after a long period of time, such as 10 years, in the quarter of 20, etc. Random is an iregular movement that can happen suddenly, and difficult to predict. Random can be an effect of war, natural disaster, monetary crisis, etc (Nugroho, 1993).

According to Hildebrand (1991), the components of trend, cycle, seasonal, and random from the time series can be assumed in two different models, i.e. multiplicative and additive models. Multiplicative models from a decomposition method is:

$$\mathbf{Xt = It \,.\, Tt \,.\, Ct \,.Et}$$

While the additive model is:

$$\mathbf{Xt = It + Tt + Ct + Et}$$

where,

Xt = actual data in the period of t

Tt = trend component in the period of t

Ct = cyclic component in the period of t

It = seasonal component in the period of t

Et = random component in the period of t

According to Makridakis, Wheelwright, and McGee (1992), simple average decomposition method is assumed on additive model, while ratio decomposition method is assumed on mobile model (classic decomposition), and Census II method is assumed on multiplicative model.

1.3 Implementation of Strategic Assumption Surfacing and Testing (SAST) Model

This model is implemented by using a panel of expert to develop strategic assumptions. Questionaire was distributed to experts whose competencies are related to important factors in determining policies in preventing crisis of consumption salt trade system. The principal of SAST model is participative, adversarial, integrative, and managerial mind supporting (Mason & Mittrof, 1981).

Judgements or opinion of expert is positioned within 4 quadran as shown in Figure 1. According to its quadran position, these opinion is used in defining alternative of strategic policy for preventing the crisis of consumption salt in Indonesia.

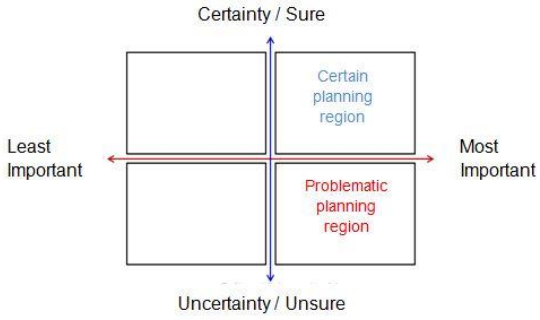

Figure 1. Illustration of SAST quadran

2. METHODOLOGY

This research is a qualitative-quantitative analysis which aims to capture views or values of consumption salt supply chain and its trade system as represented by experts. The analysis was carried out using the tools of time series decomposition and *Strategic Assumption Surfacing and Testing* (SAST). Three steps were conducted in the decomposition method, i.e:

1. Identification Model

   In this step, the right model of the observation sequence was selected. The identification of the model was done by preparing a time series plot to determine the pattern of data, and to observe the trend series. A deep knowledge of the data was used to result a model with number of parameters at fewest possible. This principle is called parsimony.

2. Estimation Model

   The best estimation model was chosen by using a least squares or maximum likelihood method.

3. Diagnosis Model

   To make sure that the resulted model was accurate for the prediction, a diagnosis was conducted by implementing the model using data those were available. Ajustment was done as needed.

SAST method was implemented to internal and external factors to determine strategic assumptions. These assumptions would be used to simplify policy formulation. Five experts were participated, those were representing industry, government, and academia. This process was aim to determine the degree of importance and certainty of the effectiveness of the defined policies. The proposed policies were graded according to its impotance and certainty of effectiveness, using judgement of experts. The Steps of this technique is shown in Figure 2.

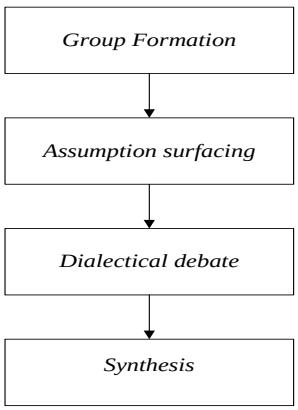

Figure 2. Steps of strategic assumptions ranking with SAST techniques

3. RESULTS

3.1 Prediction of Crisis Key Factors

3.1.1 Climate

Indonesia produces sea salt only by solar dehydration technology. Therefore the dry season of the year is one of the most important factor in determining the salt production of respected year. The crystalization process of salt needs 10 days for salt to harvest. The period of 10 days is called 1 (one) salt production period. The analysys of climate was conducted using this salt production period.

Table 1. Climate Prediction

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2011
Salt production period	11.49	7.33	8.31	9.55	8.94	5.60	6.23	7.00	6.38	3.88

Result of climate decomposition model on climate resulted an equation of Yt = 16.70 - 0.557103t. Based on this equation the climate was predicted to fluctuate with a tend to decrease each year (Table 1). Increase production for two years tends to follow by a significant decrease for another two years. For example in the year of 2016-2017 salt production was predicted about 9 – 10 periods, while in the year of 2018-2019 was predicted to drop significantly to about five periods.

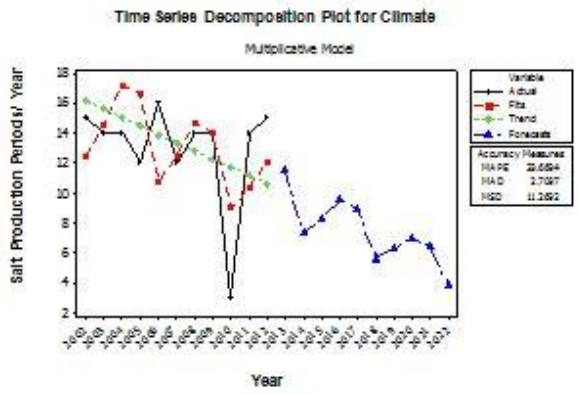

Figure 3. Time series decomposition plot for climate

3.1.2 Price of Salt

Prediction on price of salt at the site of production from the year of 2013 - 2022 tends to slightly increase (Table 2). In 2015 the price of salt was predicted at IDR 543,815.00/ton and increase to IDR 546,738.00/ton in 2016.

Table 2. Price of Salt Prediction

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2011
IDR/ ton	464,815	524,689	543,815	546,738	570,453	637,524	654,796	652,899	676,091	750,359

The price of salt follows the equation of: Yt = 152,472 + 272, 26t. The prediction chart of the salt price is shown in Figure 4.

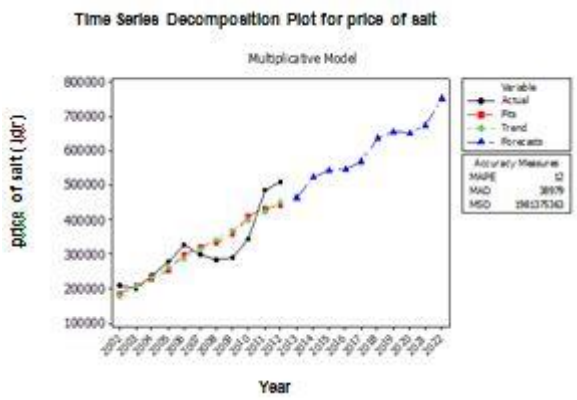

Figure 4 Time series decomposition plot for price of salt prediction

3.1.3 Salt Producer (farmer)

Salt producer in Indonesia is mainly small salt farmers with limited occupation of land. Number of salt farmer was predicted to fluctuate with a tend to decrease in the next ten years. The prediction follows an equation of: Yt = 750 532 - 26679.9t.

Table 3. Prediction on number of salt producer (farmer)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2011
Number of salt producer /farmer	495164	560978	181804	414807	256844	341682	375604	117476	256857	150981

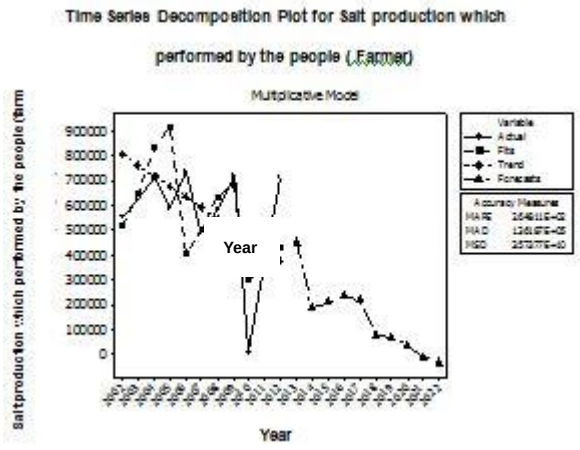

Figure 5 Time series decomposition for Salt Producer (farmer)

3.1.4 The Availability of Sea Salt Production Area/Land

The results of the decomposition method for land availability prediction is shown in Table 5 and Figure 6. The prediction for land salt production area in the next ten years follows an equations of: Yt = 19188 + 1.36t. It was predicted that availability of land for salt production is slightly decreasing in the next 10 years.

Table 4. Availability of sea salt production area/land prediction

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2011
Salt production area, ha	19304.4	19323.2	18808.5	19390.4	19309.9	19328.7	18813.8	19395.9	19315.3	19334.2

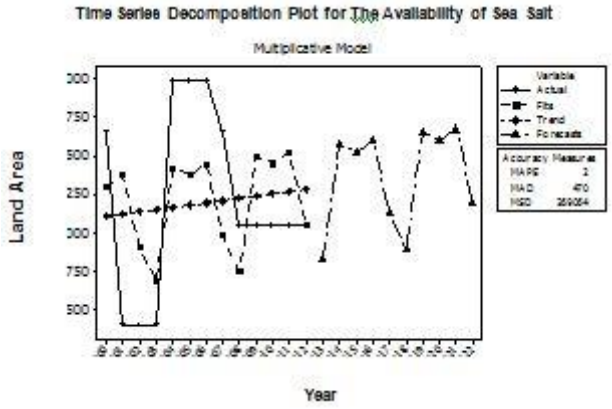

Figure 6 Time series decomposition for the availability of sea salt production area

3.2 Strategic Assumptions Exploration With SAST Approach

The SAST technique resulted grades for alternative policies those identified, explored, and judged by experts. Furthermore the policies were positioned in the 4 quadran of Cartesian according to each important and certainty in preventing the crisis. Further analysis and synthesis were carried out on the alternative policies in the second quadrant where level of important and certainty are high.

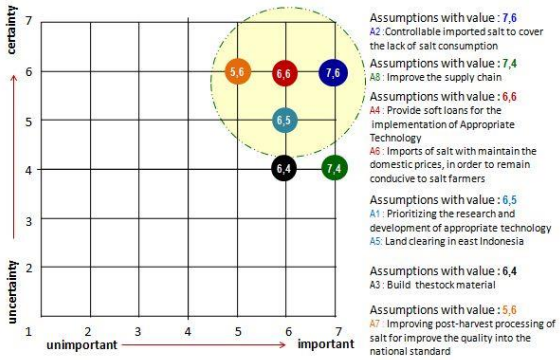

Figure 7. Strategic assumptions exploration with SAST approach for the climate factor.

The position of each strategic assumption to deal with climate is shown in Figure 7. Among the identified strategic policies, “regulation to control import of salt” considered as the most important alternative policy with highest level of certainty in its effectiveness in preventing a crisis. A tight control of import is important to secure the supply of consumption salt at any time all over the country, and at the same time is to maintain the price of salt at the level of attractive for farmers to produce the salt. Other important policies to deal with climate are: “providing appropriate technology” for salt farmers through research & development and soft loan to buy the technology, “expanding the land salt production area”, and “establishing a national stock of salt”.

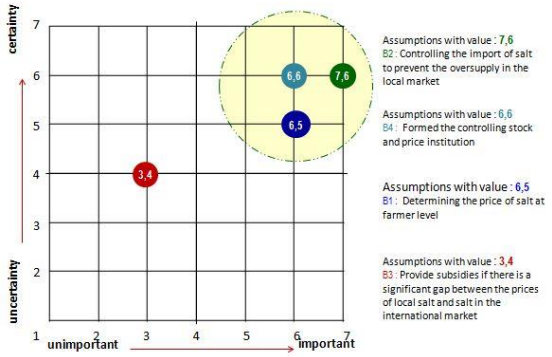

Figure 8. Strategic assumptions exploration with SAST Approach for price of salt factor.

Alternative policies to deal with price of salt is shown in Figure 8. Similar with climate factor, the most important and definite policy was "controlled import of salt", and "establishing a national stock of salt". Other alternative policy that is also considered as important was "defining minimum price of salt at farmer level".

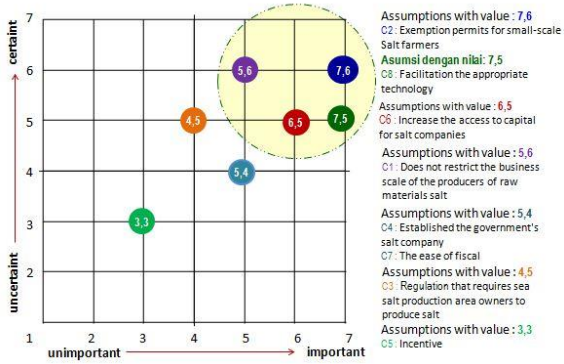

Figure 9. Strategic assumptions exploration with SAST Approach for salt producer (farmer) factor.

Figure 9 shows most important alternative policies to maintain number of salt farmers, those are: "providing farmers with appropiate technology including the soft loan for their investment", and "release farmer from getting license to produce the salt". Liberating the licensing for salt producer was considered as most important and definite policy.

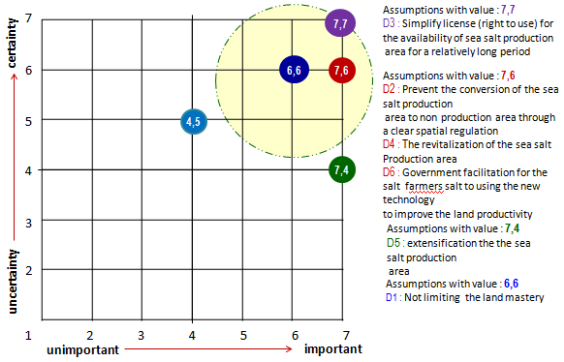

Figure 10 Strategic assumptions exploration with SAST approach for the availability of sea salt production area factor.

Since Indonesia has a limited land that is suitable for salt production, its availability should be maintained. Alternative strategic policies to deal with this issue is shown in Figure 10. The policy should be directed to

facilitating salt producers to itensify the utilization of their land through revitalization of the infrastructure, to encourage salt farmers in using appropriate technology, and to prevent conversion of salt production area/land for other utilization.

4. CONCLUSION

Decomposition method can be used to predict key factors as source of crisis. SAST was proved as effective in facilitating the policiy formulation in preventing the crisis.

The implementation of these methods on consumption salt in Indonesia resulted a prediction of the decrease of salt production which followed by the increase of salt price in the next ten years. To prevent a crisis of consumption salt in the country, alternative strategic policies were identified, those were:

- Implementing a tight control of salt import to assure the availability of consumption salt, at the same time to maintain salt price at the attractive level for salt farmers.
- Releasing small producer from getting lisence for salt production, at the same time liberating the use of land for salt production.
- Developing appropriate technology for salt production through R & D, and facilitating farmers with soft loan to buy the technology.
- Defining a minimal salt price at farmer level to assure a fair profit for salt producer
- Increasing the land productivity through revitalization of infrastructure in salt production areas.
- Maintaining the salt production land by preventing a conversion to other utulization.
- Establishing a national stock of salt.

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