A FRAMEWORK SOFT COMPUTING IN DSS FOR ALLEVIATION OF POVERTY OPTIMALIZATION IN INDONESIA

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Abstract

According to BPS (Statitics Indonesia), the number of poor citizens – citizens whose monthly per capita income is lower than the poverty line - in Indonesia in March 2016 was reaching 28,01 million of people or equivalent to 10,86 percent of the total population in Indonesia. The problem must be resolved by a systematic and structured immediately. By innovation in information technology systems so the poverty reduction can be measured with good response. This research attempts to provide a framework soft computing that can optimize decision support system (DSS) to reduce poverty. Fuzzy inference by Tsukamoto method can be an alternative method to identificate and clustering poverty alleviation fund from government or private parties. This framework is integrated with spatial data poor families, with the location input and mapping as a feature for public audit. The result of this framework has been used by the government in Bantul District, Indonesia, for assisting distribution of poverty alleviation fund to the right people..

Keywords: DSS, Fuzzy Inference, Poverty alleviation fund, Tsukamoto method.

1 INTRODUCTION

Most of the world's extreme and moderate income poor, and most of the world's multidimensional poor, now live in lower middle-income countries (LMICs), and in countries such as Indonesia and Viet Nam which recently have transitioned from low income to middle-income status relatively (although Indonesia had previously attained LMIC status in the 1990s) [1]. In formulating poverty alleviation policies, it is often necessary to distinguish people who are poor occasionally (i.e., transiently poor) from those who are poor most of the time (i.e., chronically poor), as the types of policy measures that are relevant for dealing with chronic and transient poverty would likely be different [2][3]. When poverty is essentially a transient phenomenon, policies should focus mainly on social safety nets that help people to alleviate their present deprivation, return to a non-poor category and reduce vulnerability [4] [5].

Poverty, discrepancy and imprecision of poverty alleviation program's targets is one of the problems which becomes the priority for Indonesian government in developing the nation. According to BPS (Statistics Indonesia), the number of poor citizens – citizens whose monthly per capita income is lower than the poverty line - in Indonesia in March 2016 was reaching 28,01 million of people or equivalent to 10,86 percent of the total population in Indonesia. Figure 1 shows a graph of poor people in urban and rural areas in 2016 [6]. Poverty is a multidimensional problem and sectors that are influenced by a variety of interrelated factors, among others: the level of income, health, education, access to goods and services, location, geography, gender, and environmental conditions [7].

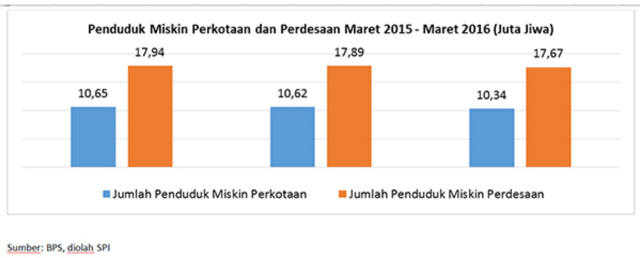

Figure 1. Graph of the Poor Population

The variety of measurements and indicators from some departments in determining the state of poverty is one of the problems causing the poverty programs are not optimal. Indicators which are used in the national level are often unable to capture the social and cultural realities at the local level, even it can be ascertained in certain situations that surveys conducted also will only become numbers without meaning [8]. The government has sought to reduce the level of poverty in each region. This is indicated by a decrease in the poverty rate in each province. Many things affect the lack of success of poverty alleviation programs, one of which is the lack of monitoring and evaluation process on programs provided to poor families [9].

Information and communication technology can improve economic policy and facilitate the policy-making process. An array of ICT tools is available to the policymaker and decision-maker. Foremost in this list of tools are poverty maps, which are made possible by geographic information systems (GIS) [10]. GIS is used to perform resettlement analysis of the poor [11]. Poverty mapping combines geographically-referenced survey and census data to generate poverty and inequality profiles at low levels of aggregation. Additionally, poverty maps based on highly disaggregated data, serve benchmarking, as well as monitoring and evaluation purposes [10][12].

Fuzzy sets theory has successfully accommodated the lack of clear-cut boundaries of poverty and its gradual nature. On the other hand, uncertainties related to lack of knowledge and imprecision in poverty data need also to be accounted for. The accuracy of poverty analysis is highly subject to how well these features are adequately addressed [13][14]. Fuzzy Hard C-Means is capable to perform the grouping of poverty pattern by analyzing the influential attributes. [15].

This study aims to provide a framework of integration between the soft computing and geographic information system on DSS for optimization of poverty alleviation in Indonesia. This framework will be tested in one of the areas in Indonesia, namely Bantul which is in the province of Yogyakarta.

METHODOLOGY

The subsequent framework is the result of a research conducted in over three years with funding from Ristek Dikti with poor people in the DIY Province, represented by the districts of Bantul, as the object of research. The subsequent framework has an architecture as shown in Figure 2.

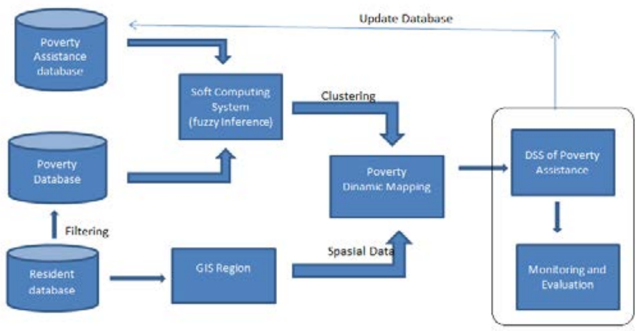

Figure 2. Framework Architecture of Poverty of Alleviation Optimalization

The system in this framework is supported by the three databases, namely poverty alleviation fund database, poverty database, and resident database. Poverty filtering database is obtained from resident data from the database (population database). The filtering process is completed using Bantul's classification mechanism consisting of eleven indicators of poverty. The number of parameters for classification was composed from eleven indicators as presented on Table 1.

Table 1. Indicators of Poverty

No	Indicator	Indicator Score
1	Food	(0,12)
2	Clothing	(0,9)
3	Shelter	(0,9)
4	Income	(0,35)
5	Health	(0,6)
6	Education	(0,6)
7	Wealth (Rupiah)	(0,5)
8	Property (Land)	(0,6)
9	Water	(0,4)
10	Electricity	(0,3)
11	Number of Familly members	(0,5)

Poverty classification has been done by [16] by means of a Naive Bayes classifier using eleven indicators which can be classified into three classes, namely very poor, poor and vulnerable poor with 93 percent accuracy. Poverty alleviation fund database contains data of poverty funding given by some units (the civil service) within the district/province. Poverty alleviation fund database and poverty database become the input for the fuzzy inference system (soft computing). The fuzzy inference used in the soft computing system is Tsukamoto method.

Fuzzy logic generally has the following stages of processing [17]:
1. Determining the linguistic variables.
2. Forming the membership function.
3. Establishing a rule base.
4. Transforming crisp data into a fuzzy value using membership function.
5. Performing rule evaluation in the rule base.
6. Combining the results obtained in each rule.
7. Changing the output data into a non-fuzzy value.

Fuzzy Inference is used to provide poverty alleviation clustering recommendations. The block diagram for soft computing (fuzzy inference) used in this study is shown in Figure 2.

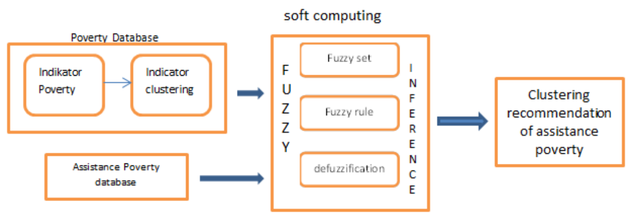

Figure 3. Block Diagram of Soft Computing

The steps performed to Tsukamoto fuzzy inference include:
1. Designing the membership function for three groups of criteria namely: determinant variables, cause variables and supporting variables.
2. Designing the membership function of poverty alleviation fund consisting of *Raskin, BLT* and *KUR*.
3. Designing a Tsukamoto fuzzy rule made by combining poverty alleviation fund variables and group criteria variable. The number of rules in the design are eight rules.

RESULT AND DISCUSSION

All of the eleven indicators that exist in the poverty database can be classified into three criteria to construct the fuzzy inference. The results of the fuzzy inference is used to provide poverty alleviation grouping recommendations. The poverty alleviation recommendation group consists of KUR (small loans), rice for the poor (Raskin) and direct cash funding (BLT). The membership function graph for the 11 indicators that are made in to three criteria are shown in Figure 3, Figure 4 and Figure 5.

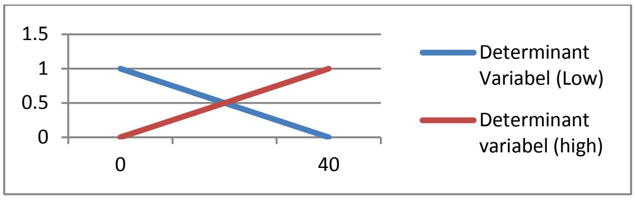

Figure 4. Membership function of Determinant Variable

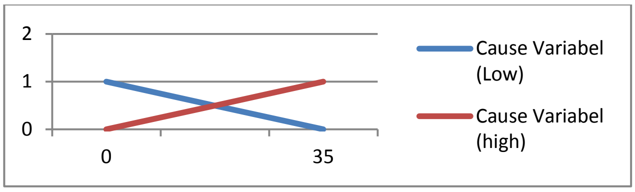

Figure 5. Membership Function of Cause variable

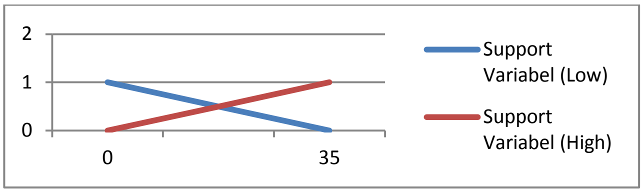

Figure 6. Membership function of Support Variable

There are 8 rules used in the Tsukamoto fuzzy inference shown in table 2.

Table 2. Rule Fuzzy Tsukamoto

No	Rule Fuzzy Inference of Tsukamoto Method
1	If Determinants Increase, Cause Increase, Support Increase Then KUR
2	If Determinants Increase, Cause Increase, Support Decrease Then BLT
3	If Determinants Increase, Causes Decrease, Support Increase Then BLT
4	If Determinants Increase, Cause Decrease, Support Decrease Then Raskin.
5	If Determinants Decrease, Cause Increase, Support Increase Then BLT
6	If Determinants Decrease, Cause Increase, Support Decrease Then Raskin
7	If Determinants Decrease, Cause Decrease, Support Decrease Then Raskin.
8	If Determinants Decrease, Cause Decrease, Support Decrease Then Raskin

The results of poverty alleviation fund grouping recommendation, which consists of 3 groups, have poverty alleviation fund membership function which can be seen in figure 6.

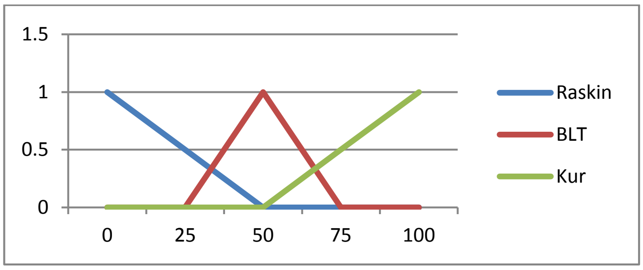

Figure 7. Poverty Alleviation Fund Membership Function

The next step is making the eight rules for both poverty alleviation fund membership function and criteria membership function combination of the poverty indicators.

Table 3. Implications of Each Rule

No	Annual Implication Value							
	R1	R2	R3	R4	R5	R6	R7	R8
1	0.3	0.3	0.0	0.0	0.3	0.7	0.0	0.0
2	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
3	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
4	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0
5	0.2	0.3	0.0	0.0	0.2	0.7	0.0	0.0
6	0.1	0.3	0.0	0.0	0.1	0.7	0.0	0.0
7	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
8	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8
10	0.0	0.0	0.3	0.3	0.0	0.0	0.4	0.6
11	0.0	0.0	0.3	0.3	0.0	0.0	0.3	0.7
12	0.0	0.0	0.3	0.3	0.0	0.0	0.4	0.6
13	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
14	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
15	0.0	0.0	0.3	0.3	0.0	0.0	0.3	0.7
16	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
17	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
18	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0
19	0.1	0.3	0.0	0.0	0.1	0.7	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
21	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6
22	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
23	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
24	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0
25	0.0	0.0	0.3	0.3	0.0	0.0	0.3	0.7
26	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
27	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
28	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
29	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.0
30	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
31	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0
32	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
33	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0
34	0.3	0.3	0.0	0.0	0.4	0.6	0.0	0.0
35	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
36	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
37	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6
39	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.7
40	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7
42	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0
43	0.3	0.3	0.0	0.0	0.3	0.7	0.0	0.0
44	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.4
46	0.0	0.0	0.3	0.3	0.0	0.0	0.5	0.5
47	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6
48	0.3	0.3	0.0	0.0	0.4	0.6	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.1	0.9	0.0	0.0

The value of table 3 will be used to calculate the defuzzification which becomes a significant value for poverty aid grouping recommendation. The results of this aid grouping re-commendation will become one of the inputs to do a poverty mapping specifically the mapping of poverty aid beneficiaries. It is possible to be done because there is spatial position data of poor family data which is shown in figure 7. The spatial data of poor family's location will become the reference for poverty alleviation aid mapping as seen in figure 8.

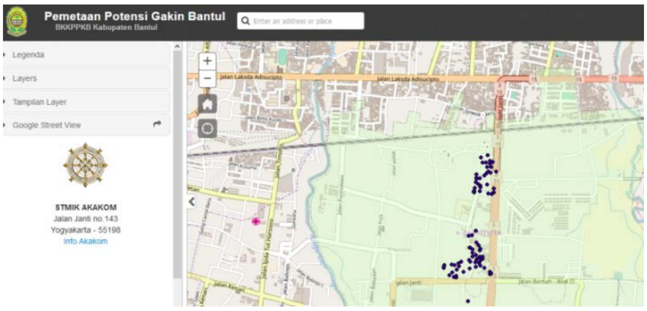

Figure 8. The position of poor families

The result of poverty alleviation grouping recommendations will be one of the inputs for poverty mapping especially in the mapping of poverty alleviation program beneficiaries. This can be completed because there are spatial data of the data position of poor families. The prototype of poverty mapping alleviation funding program can be seen in Figure 8. The spatial data as shown in Figure 8 is obtained from real time input by using a mobile-based application. This application will update population database in real time with additional fields namely the position of poor families and poor families location photo.

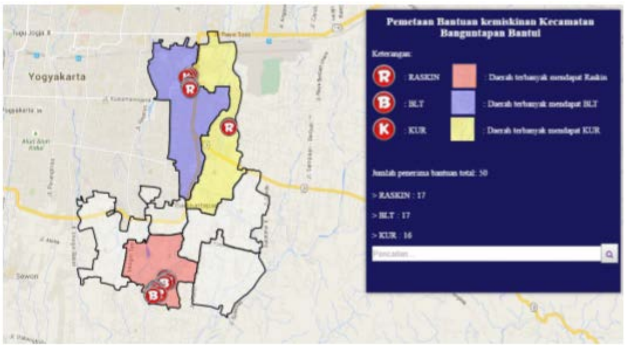

Figure 9. Poverty Alleviation Fund mapping

The mapping in Figure 9 will be dynamic if the existing data on poverty aid database is updated. These results will be used to support the making of poverty alleviation fund decision which is given to poor families by the parties concerned so as to minimize the errors on aid distribution.

In order to optimize the distribution of poverty in the framework, a monitoring and evaluation system is provided so that poverty alleviation goals can be achieved.

CONCLUSION AND FUTURE WORK

From the framework proposed in the study above, it is expected that it can help Indonesian government, especially in Yogyakarta province, in assisting poverty alleviation programs. This framework will provide a result of DSS information in real time so that it will easily be monitored at any time regarding poverty alleviation programs. The thing that needs to be considered in this framework is the large capacity of the server for both poverty database and poverty alleviation fund database. This is because it manages to store poor family data in detail. The modeling used in the soft computing may use other methods of fuzzy inference or neural network. Further research is required to optimize the soft computing modeling results.

The determination of poverty alleviation aid to poor families still becomes the authority of the government but with this framework application, it is expected to minimize the direct role of the government or poverty aid benefactors so the process can be more effective and transparent.

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