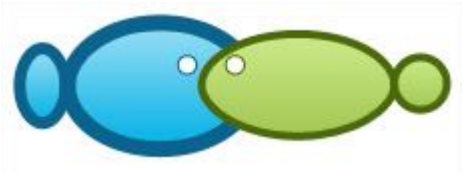

Stakeholder perception and participation in relation to success rate of water hyacinth control program in the Rawa Pening Lake

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Abstract. Water hyacinth (*Eichhornia crassipes*) population covered 50% of the Rawa Pening Lake and inflicted the negative impact on the ecology and economy of stakeholders who rely on the lake. There are several methods to control water hyacinth. However, the successful control of water hyacinth depends on stakeholder perception and participation. The present study aimed to analyze the relationship between stakeholder perceptions and participation level in controlling the water hyacinth; stakeholder perception related to the success rate of water hyacinth control program; participation level related to the success rate of water hyacinth control program. This study surveyed 173 respondents of four different sub-districts (Tuntang, Bawen, Ambarawa, Banyubiru), while data were collected and analyzed using questionnaires and Structural Equation Model (SEM) with AMOS software. The result showed the model was acceptable, where there was conformity between model with the data used (chi-square 78.035, probability 0.082 > 0.05, RMSEA 0.039 < 0.08, GFI 0.931 > 0.90 and CMIN/DF 1.259 < 2). The implication of good perception (48%) and enough participation (56%) contributed to the bad result of water hyacinth control program in the lake. The perception did not significantly influence participation of the stakeholder (p 0.202 > 0.05), meanwhile, the perception had significant influence to the success rate of water hyacinth control program (p 0.032 < 0.05) as well as participation (p 0.018 < 0.05). The community empowerment and welfare improvement are fundamental things that need to be pursued. Further, the environmental education of young generation using recent mobile technology is essential to support a sustainable management of the lake.

Key Words: stakeholder, perception, participation, success rate, water hyacinth control.

Introduction. Rawa Pening lake is located in the Central Java province Indonesia. The lake has a vital function for aquatic organisms and local people. The main problem of the lake is water hyacinth (*Eichhornia crassipes*) mats that covered more than 50% of the lake area (Trisakti et al 2014). Water hyacinth was originated from South America (Julien 2001). Introduction of water hyacinth in Indonesia occurred in 1884 as an accessory plant in botanical garden Bogor (Goltenboth et al 2006) and it spread into the Rawa Pening lake. The lake was categorized as a damaged lake with priority rehabilitation for the year 2015-2019, based on lake conferences in 2016 (Ministry of Environment & Forestry 2015). The excess of water hyacinth population caused degradation on quality and quantity of water such as the decrease of water volume and dissolved oxygen (DO), sedimentation, homogenization of aquatic vegetation, even death of aquatic organisms. Economic losses were perceived by the fisherman and therefore water hyacinth control needs a high cost (Villamagna & Murphy 2010).

Policy formulation has been made in 2011 by integration among government agencies to address these problems, such as GERMADAN “Gerakan Penyelamatan Danau” (lake preservation action) similar to ILBM (Integrated Lake Basin Management) (Soeprobowati 2015). Since 1998, many efforts have been made to control water

hyacinth mechanically, chemically and biologically by involving stakeholder in Rawa Pening lake (Sutarwi 2008). Local stakeholder-based water hyacinth control will support successful control of water hyacinth in the lake, as Kapler et al (2012) stated that basically, conservation and land management program can reach satisfying result if every decision making is influenced by stakeholder. Stakeholder-based control was the stakeholder's direct participation in management, from planning to evaluating the various programs undertaken in the water hyacinth control projects. Stakeholder perception is important to support invasive species management. There was much research investigating stakeholder perspective on invasive species in different countries (Bardsley & Edwards-Jones 2006; Kapler et al 2012; Lauber et al 2015) and stakeholder participation on invasive species management (Stokes at al 2006; Ford-Thompson et al 2012; Novoa et al 2018). In relation to the presence of water hyacinth in the Rawa Pening lake, there is lack of research about the community's view of water hyacinth, community participation in the control of water hyacinth and the success rate of water hyacinth control program. It is important to know the perceptions and participation of local communities to facilitate in designing water hyacinth control and acceptable strategies to local communities. Therefore, the present study aimed to analyze the influence of stakeholder perceptions related to participation level in water hyacinth control; the influence of stakeholder perceptions on the success rate of water hyacinth control program; influence the level of stakeholder participation on the success rate of water hyacinth control program in the Rawa pening lake.

Material and Method

Study design and data collection. The study was carried out in February 2017 at four sub-districts, Tuntang, Bawen, Ambarawa, and Banyubiru, which were situated around the Rawa Pening Lake (Figure 1). One hundred and seventy three (173) persons were chosen to fill out the questionnaire (±43 in each sub-district) because the range of samples required for Structural Equation Modeling (SEM) was 100 to 200 samples (Ghozali 2017). Data were collected in one session of the monthly meeting schedule of stakeholders in each sub-district, where the people met together and took their time to answer the questions.

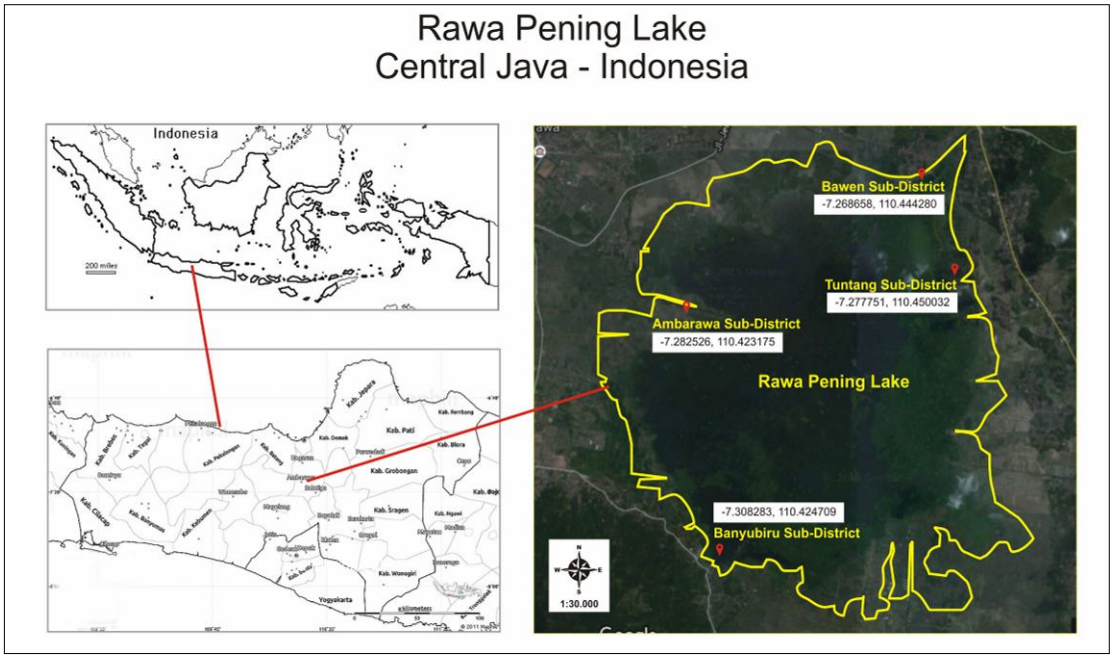

Figure 1. Map of the Rawa Pening Lake, Central Java, Indonesia.

Questionnaire organization. General information on the characteristic of the respondent was asked (the age, formal education level, and membership in an

environmental organization). The questions consisted of three groups: stakeholder perception, participation, and the success rate of water hyacinth control program. We used the Likert scale from score 1 (not important) to score 5 (very important) to determine the responses and Table 1 below was used to distinguish the response of stakeholder into 5 different intervals.

Table 1

Response of stakeholder criteria

Interval (%)	*Criteria*
84 ≤ 100	Very good
68 ≤ 84	Good
52 ≤ 68	Enough
36 ≤ 52	Bad
20 ≤ 36	Very bad

Data analysis. Data were analyzed using structural equation model (SEM) with AMOS software. In this case, the aim of using SEM was to know the validity of the model built based on theory through the pattern of dependence and multiple interdependencies between free variables (exogenous) and dependent variable (endogenous). An exogenous variable was the stakeholder perception whereas endogenous variables were the participation level and success rate control of water hyacinth. Description of the research variables is presented in Table 2. The suitability of the structural equation model built with the data can be seen after the goodness-of-fit test by looking at the Chi-square index value, the probability significance, the RMSEA, and the CFI. The model is fit, if it meets the requirements in the Table 3 (Ghozali & Fuad 2008).

Table 2

Description of research variables

No	*Latent variables*	*Observed variables*	*Instrument*
1	Stakeholder perceptions	Perception of the lake condition	Knowledge about the lake function, damage level of the lake, side effect of water hyacinth, utilization rate of the lake resources
		Perception about water hyacinth population	The water hyacinth abundance within five years, negative impact on social economy
2	Stakeholder participation	The degree of voluntary participation	The degree of participation and motivation
		Participation in biological control	Participation level in planning, actuating and monitoring
		Participation in physical/mechanical control	Participation level in planning, actuating and monitoring
		Participation in chemical control	Participation level in planning, actuating and monitoring
3	The success rate of water hyacinth control program	Public participation, frequency and success rate of the control program	Public participation, frequency of government programs in biological, physical, and chemical control and the success rate of implementation program

Table 3

Goodness of fit criteria

Goodness of fit index	*Cut-off value*
χ^2 - Chi-square statistic	expected small
χ^2 - Significance probability	≥ 0.05
GFI	≤ 0.90
AGFI	≥ 0.90
CFI	≥ 0.94
RMSEA	≤ 0.08

Results

Respondent characteristics. According to the survey, respondents were the indigenous residents of the lake area and the members of the local organizations in each sub-district. The age range was from 20 to 70 years old and the majority of respondent was employed as the fisherman. In terms of education level of respondents, 43% had the elementary school, 25% and 26% for junior and senior high school respectively, 1% and 5% had a diploma and bachelor degree respectively (Table 4).

Table 4

Respondent characteristicts

No	*Characteristics of respondent*	*Number (%)*
1	Gender	Male: 168 (97.1%) Female: 5 (2.9%)
2	Age (years old)	> 20-30 (11%) > 30-40 (29%) > 40-50 (30%) > 50-60 (20%) > 60-70 (10%)
3	Education	Elementary school (43%) Junior high school (25%) Senior high school 26%) Diploma degree (1%) Bachelor degree (5%)

Perception and participation of respondents. Based on the survey, 48% of 173 respondents have a good knowledge of the Rawa Pening lake condition and water hyacinth population, only 3% has a poor perception (Figure 2). For the participation level, 56.6% of the respondent has enough level participation in planning, actuating and monitoring of the water hyacinth control program (Figure 3). However, 56.1% of respondents stated the bad result for water hyacinth control program in the Rawa Pening lake (Figure 4).

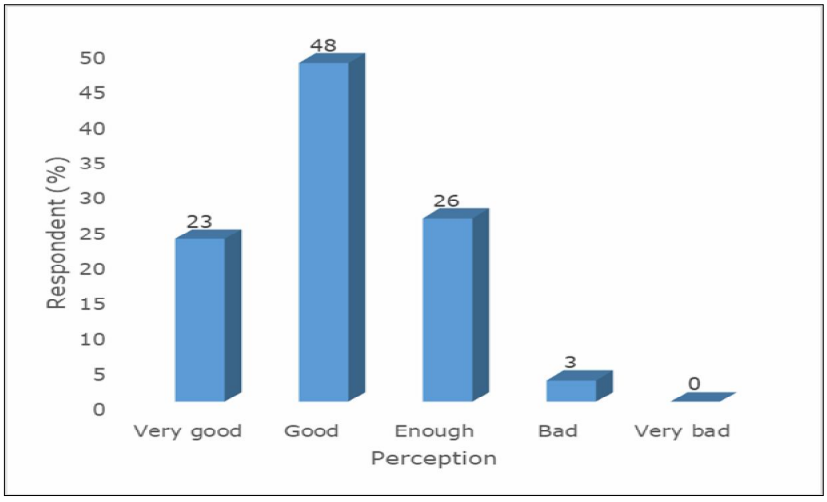

Figure 2. People knowledge about Rawa Pening condition and water hyacinth population.

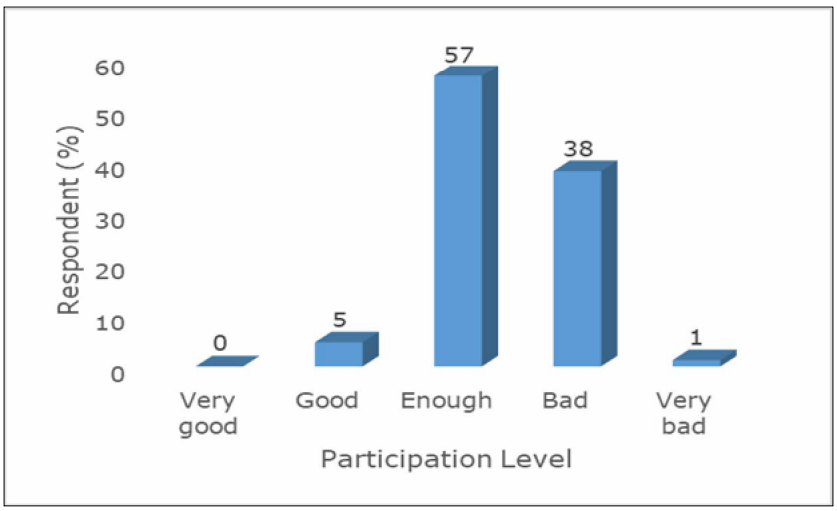

Figure 3. Stakeholder participation level in the water hyacinth control.

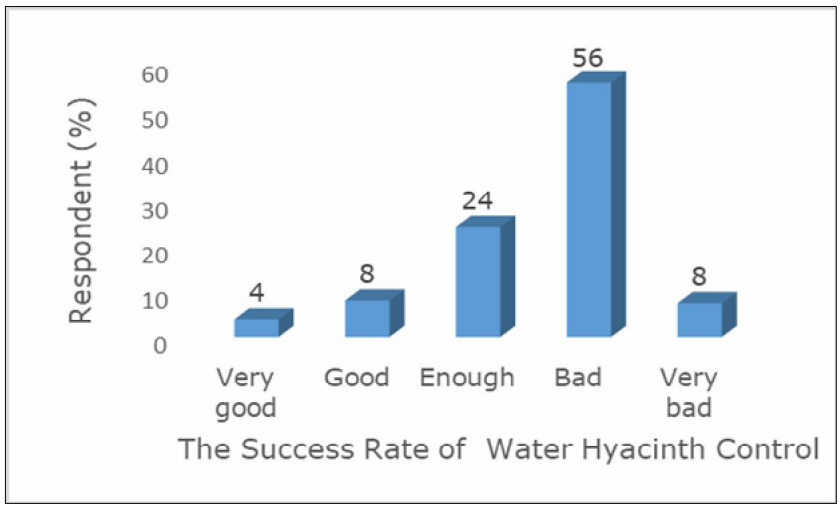

Figure 4. The success rate of water hyacinth control program.

Confirmatory analysis of variables. Confirmatory analysis was used to test the concept constructed using several measurable indicators. The confirmatory model conformity was tested using a goodness-of-fit index that included chi-square, probability, RMSEA, GFI, CFI, TLI and cmin/df.

Stakeholder perception. The confirmatory analysis of perception variable built by two indicators can be seen in the Figure 5.

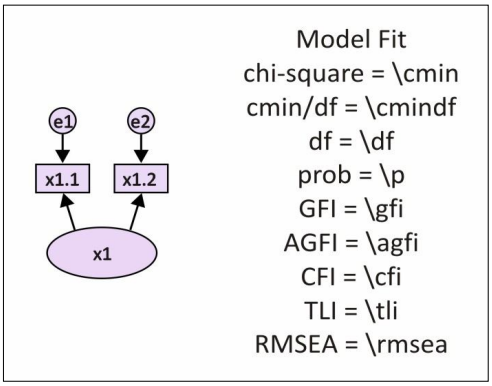

Figure 5. Confirmatory analysis of perception variable.

The result of the confirmatory analysis showed that perception indicator was feasible to be used in this research without a confirmatory test because the indicator was less than four.

Participation level. The confirmatory analysis of participation level variable in guarding Rawa Pening lake that built by four indicators can be seen in the Figure 6.

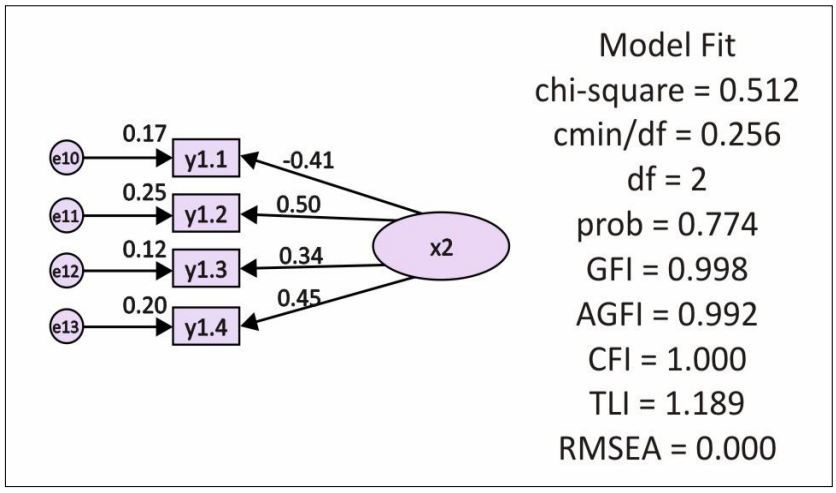

Figure 6. Confirmatory analysis of participation variable.

The result of the confirmatory analysis can be explained by the following equation:
Y1.1 = -0.41 participation + 0.17
Y1.2 = 0.5 participation + 0.25
Y1.3 = 0.34 participation + 0.12
Y1.4 = 0.45 participation + 0.20

The value of chi-square was 0.512, prob 0.774, GFI value 0.998 > 0.90, CFI value 1.000. It showed that the model conformity test performed a good acceptance. Therefore it can be concluded that the indicators were acceptable to construct the participation variable.

Succes rate of water hyacinth control program. Figure 7 was the result of the success rate of water hyacinth control confirmatory analysis that built by seven indicators.

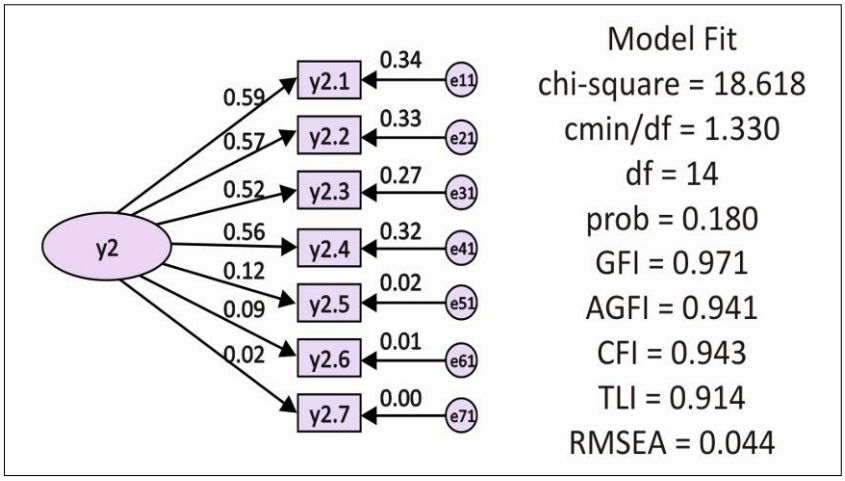

Figure 7. Confirmatory analysis of success rate of control program variable.

The following equation represented the result of the confirmatory analysis:
Y21 = 0.59 the success rate of control + 0.34
Y22 = 0.57 the success rate of control + 0.33
Y23 = 0.52 the success rate of control + 0.27
Y24 = 0.56 the success rate of control + 0.32
Y25 = 0.12 the success rate of control + 0.02
Y26 = 0.09 the success rate of control + 0.01
Y27 = 0.02 the success rate of control + 0.00

Based on the model, the value of chi-square was 18.618 with prob 1.330, GFI value 0.971 > 0.90, CFI value 0.943. It showed that the model conformity test performed a good acceptance, which the indicators constructed well variables.

Confirmation of exogenous constructs. Based on the results, it can be seen (Figure 8) that each indicator or dimension of each latent variables showed good outcomes while the value of chi-square 4.656 with probability 0.794.

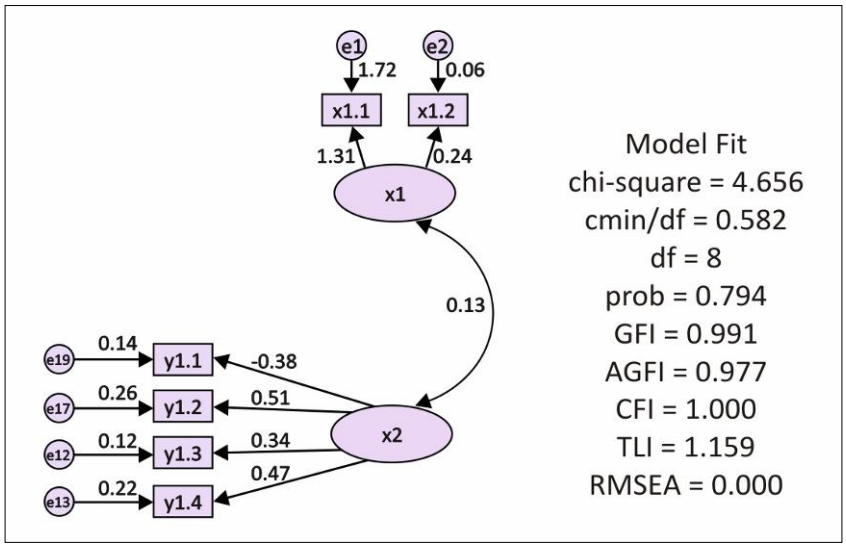

Figure 8. Confirmatory analysis of exogenous constructs.

Confirmation of endogenous constructs. Based on chi-square value 44.424 with probability 0.411, it can be concluded that each indicator or dimension of each latent variables (Figure 9) showed good results so that indicators of the latent variable have shown unidimensionality.

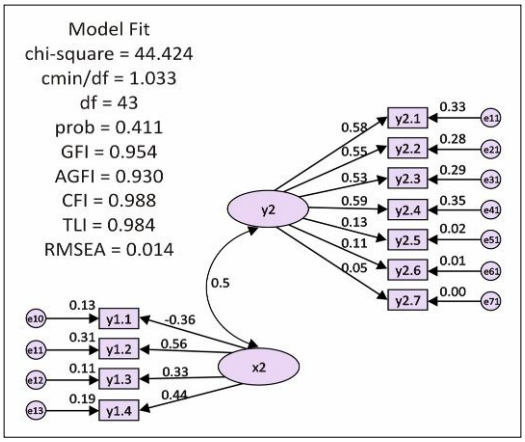

Figure 9. Confirmatory analysis of endogenous constructs.

Measurement of SEM model. The SEM fit test was one of the most influential procedures in structural equation modeling. Based on Figure 10, obtained chi-square value of 78.035 with probability 0.082 > 0.05, value of RMSEA equal to 0.039 < 0.08, value of GFI equal to 0.931 > 0.90 and value of CMIN/DF was 1.259 < 2. It indicated the model of fit test produced a good acceptance and it can be concluded that structural modeling analysis in this study can be done.

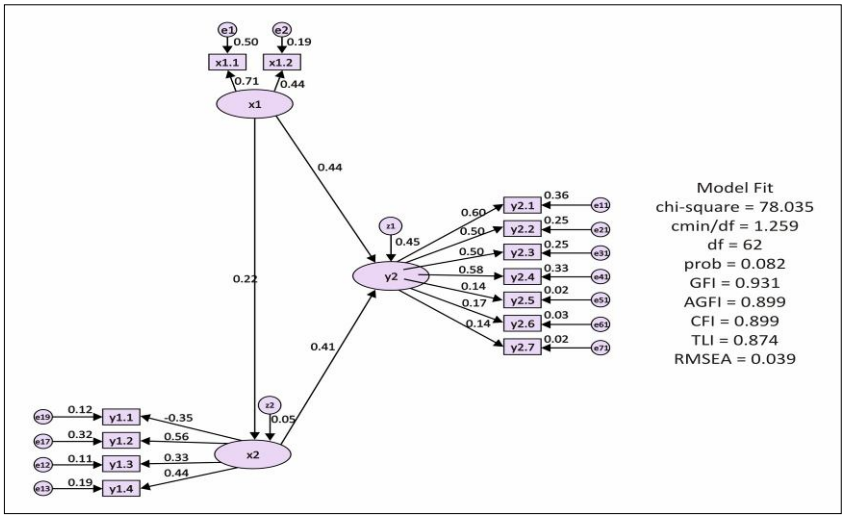

Figure 10. Interrelationship model between variables in SEM.

Normality data test. The outcomes of one-sample Kolmogorov-Smirnov test (Table 5) showed sig. value of unstandardized residual1 = 0.394 > 0.05 and sig. value of unstandardized residual2 = 0.924 > 0.05, and it can be said that the data was normally distributed.

Table 5

Normality data test by Kolmogorov-Smirnov test

Normality test	*Unstandardized residual1*	*Unstandardized residual2*
Kolmogorov-Smirnov Z	0.899	0.549
Asymp. Sig. (2-tailed)	0.394	0.924

Outlier test. The outlier test aimed to determine the Z score, if the score was bigger than 3 and less than -3, it will be categorized as an outlier. The present study showed the majority of Z score (Table 6) was not in that range, it can be concluded there was no univariate outliers data.

Table 6

Evaluation of Z-score value

Statistics	*N*	*Minimum*	*Maximum*
Zscore(X1.1)	173	-2.360	2.010
Zscore(X1.2)	173	-2.877	1.779
Zscore(Y1.1)	173	-2.456	2.553
Zscore(Y1.2)	173	-2.482	2.985
Zscore(Y1.3)	173	-2.527	3.064
Zscore(Y1.4)	173	-2.118	3.024
Zscore(Y2.1)	173	-2.583	1.673
Zscore(Y2.2)	173	-2.620	1.564
Zscore(Y2.3)	173	-2.566	1.948
Zscore(Y2.4)	173	-2.616	1.792
Zscore(Y2.5)	173	-2.243	1.333
Zscore(Y2.6)	173	-1.511	1.696
Zscore(Y2.7)	173	-1.538	1.687

Validity test. Validity test was used to measure the validity of a questionnaire. Based on the Table 7 below, it indicated that all indicators have the critical error (CR) that larger twice of the standard error (S.E), it can be concluded that the indicator variable used was valid.

Table 7

Questionnaire validity test

			Estimate	*S.E.*	*C.R.*	*P*	*Label*
Y2.2	<---	Y2	0.850	0.190	4.479	***	par_1
Y2.3	<---	Y2	0.794	0.176	4.503	***	par_2
Y2.4	<---	Y2	0.935	0.192	4.859	***	par_3
Y2.5	<---	Y2	0.372	0.249	1.492	0.136	par_4
Y2.6	<---	Y2	0.510	0.280	1.819	0.069	par_5
Y2.7	<---	Y2	0.417	0.277	1.509	0.131	par_6
x1.1	<---	x1	1.000				
x1.2	<---	x1	0.413	0.168	2.452	0.014	par_7
y1.4	<---	Y1	1.000				
y1.3	<---	Y1	0.723	0.288	2.510	0.012	par_8
y1.2	<---	Y1	1.074	0.361	2.979	0.003	par_9
y1.1	<---	Y1	-0.689	0.264	-2.608	0.009	par_10

Reliability test. Reliability test measured the internal consistency of variable indicator. The Table 8 shows the value of construct reliability was above 0.50, in consequence, the indicators were able to explain the latent variables.

Table 8

Questionnaire reliability test

Indicator	*Standard loading*	*∑ Standard loading²*	*1-Std loading²*	*(∑ Std loading)²*	*Construct reliability*
		Perception			
X1.1	0.718	0.516	0.484	1.346	0.511
X1.2	0.442	0.195	0.805		
Sum	1.160	0.711	1.289		
		Participation			
Y1.1	0.440	0.194	0.606	2.829	0.579
Y1.2	0.329	0.108	0.692		
Y1.3	0.562	0.316	0.484		
Y1.4	0.351	0.123	0.477		
Sum	1.682	0.741	2.059		
		Succes rate of water hyacinth control			
Y2.1	0.597	0.356	0.644	4.941	0.505
Y2.2	0.499	0.249	0.751		
Y2.3	0.503	0.253	0.447		
Y2.4	0.579	0.335	0.565		
Y2.5	0.140	0.020	0.980		
Y2.6	0.172	0.030	0.970		
Y2.7	0.142	0.020	0.980		
Sum	2.035	1.663	4.837		

Hypothesis test. The hypothesis test was used to determine the influence of independent variables on the dependent variable. According to the outcome of the model (Table 9), it showed that hypothesis 1 stated that perception has an influence on participation was rejected (CR value of 1.277 with Prob = 0.202 > 0.05). Hypothesis 2 was accepted, the perception affected the success rate of hyacinth control program (CR value of 2.139 with Prob = 0.032 < 0.05). The last hypothesis was accepted, the

participation level has an effect on the success rate of water hyacinth control program (CR value of 2.373 with Prob = 0.018 < 0.05).

Table 9

The result of hypothesis test

			Estimate	*S.E.*	*C.R.*	*P*	*Label*
Y1	<---	x1	0.152	0.119	1.277	0.202	par_12
Y2	<---	x1	0.079	0.037	2.139	0.032	par_11
Y2	<---	Y1	0.108	0.046	2.373	0.018	par_13

Discussion. The present study found that structural equation model was good to explaine perception and participation level of stakeholders in relation to the success rate of water hyacinth control program in Rawa Pening lake. Public perception is the simplest type of information gained from a public point of view surveys but is meaningful information for a decision maker or environmental managers (Fischer & van der Wal 2007). It was a collective view of a group of people selected randomly, who was asked directly on what they understand about special topic or issues (Dowler et al 2006). Even though this research surveyed limited respondent, the result may represent the stakeholders of Rawa Pening lake. Study of stakeholder perception of invasive alien species was an important part of the management strategies evaluation and a vital factor in the policy arrangement and procedure that was both effective and approved by stakeholders (Vanderhoeven et al 2011). Based on the research finding, there was different respondents' perception, but the majority of the respondent has a good knowledge about the Rawa Pening condition and water hyacinth impact. The hypothesis was accepted that the perception affected the success rate of water hyacinth control. The difference perception was influenced by the respondents' characteristics including gender, ages, level of education and level of responsibility (Bremner & Park 2007). The possible reasons for the good perception is because they were the indigenous resident who lived close to the lake. Therefore they well understood the lake condition and the changes that occurred every year in the lake by reason of the water hyacinth population and many negative impacts were recognized by fishermen, such as difficulties in accessing the lake by boat due to water hyacinth blocked, decreasing fish catch and waters tended to be smelling and turbid.

The result on the level of stakeholder participation was poor in planning, actuating, and monitoring of the water hyacinth control mechanically/physically, chemically and biologically. Hypothesis test proved that the people knowledge of lake condition and water hyacinth impact has no significant influence on participation level. It was similar with Nishimura's (2014) finding that the people knowledge did not influence the participation level to eradicate aquatic weed, but the willingness to eradicate can increase the motivation level. The different result of Niemiec et al (2016) found that the factors that influence the resident motivation to control invasive species were social norms, knowledge and understanding of control methods and the risk of invasive species. The lower participation level imposed by the majority of stakeholder worked as the fisherman with low living standard who still oriented to meet their economic needs and low level of trust in government. A long time ago, some community groups were involved in various government programs in the water hyacinth control of the Rawa Pening such as "Rembug Rawa Pening Forum" in the year 1998. However, there was often a conflict of interest between several groups of people due to economic motives, so the program run ineffectively and thus the government tended to be less transparent on the running program. This is in accordance with the opinion of Bagherian et al (2009) which mentioned the five factors that influence community participation in environmental management: the level of public's satisfaction with previous programs, public's mindset, public's knowledge, the monthly salary and the expectations of a government program. In general, the people used the lake water resources continuously, such as tidal agriculture in the lake area, take water hyacinth for handicrafts, set a floating net cage cultivation, etc. However, the irony fact that they were not too involved in the control of

water hyacinth and most of them blame the government for continuing the control of water hyacinth program, but the results were insignificant. Their motivation to participate in the water hyacinth control was mostly because of the duty as a member of fisherfolk association, which required to participate, both in the fisherman association and government project. The sustainability of the lake should not only be the government duty but also the stakeholder contribution. For that reason, the success of aquatic weed control needs more than static public support. Warner (2011) stated that people participation in biological control from various perspectives during a sustained period of control can be guided by common goals and codes of ethics for success weed control program. Improving the welfare and empowerment of the community are an effort that can be done, based on Suwondo's research (2003) that civil society in the region was influenced by the stable economic conditions, functional local political system, local elite leadership exemplary and tradition of villagers' participation. Caplat & Coutts (2011) stated that to be effective, the control of aquatic weed needs active engagement of stakeholder, public commitment to organizing the greater social responsive of the obstacle; generate greater social concord on the demand of weed control and the conditions in which the control method was desirable approach; and an increase of public belief that government agencies enforce public interest through proper review of legislation.

According to the survey, respondent stated there was the bad result of the implementation of water hyacinth control mechanically/physically, chemically and biologically. It was agreed with the hypothesis result that the participation level has a significant effect on the success rate of water hyacinth control. Sutarwi (2008) stated that in dealing with Rawa Pening lake problems, the government was at the stage of formulating policy, but the implementation of the policy that has been made was not real, and law enforcement tended to be discriminatory in some places around the Rawa Pening lake. To deal with the problem in the lake, the value of community life was very important to be adopted, in the language of Java "wening" which means it should not be greedy in utilizing lake resources and "ngepen" which means it must be sincere in the management or conservation of the lake. Furthermore, implementation of appropriate mixed media such as mobile technology to improve the knowledge and insight of young generation related to invasive species should be done to increase awareness and motivation level of the young people to eradicate the worst invasive weed in the lake. It was agreed with previous research that mentioned multimedia sources as mobile technology can be used to educate young generation (Oxley et al 2006; Anderson et al 2015). Moreover, environmental educators should show the goodness of control when preparing people to participate as the responsible stakeholder for environmental issues (Krasny & Lee 2002; Ferkany & Whyte 2012). To get satisfied eradication of weed, biologists and social scientists must work together to arrange guideline with functioning resolution-making tools (Daab & Flint 2010). If the attempt is successful, it can enhance knowledge and increase active participation of the younger generation to support water hyacinth control program and reach sustainable management of the lake.

Conclusions. The structural equation model showed a good model in this study. The result showed that the perception has no influence toward participation level of the respondent. However, the perception influenced the success rate of water hyacinth control program. Moreover, the participation level influenced the success rate of water hyacinth control program. The high perception of the respondent because they lived as the indigenous resident and suffered the negative impact of the presence of water hyacinth. Community participation was low because of their poverty, they more stressed to meet their economic needs than to think about environmental sustainability. The bad result of the implementation of the water hyacinth control program correlated to a poor participation level of the respondent. The government's possible role is to improve the economy living standard through stakeholder empowerment and the policies implementation must be transparent, as well as the integration between upstream and downstream. The education of young generation by using methods that are in harmony with the times is another way to support sustainable management of the lake.

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