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# Model of Community Empowerment of Springs Preservation in Arjuna Mountains

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**Abstract.** The research objectives were (1) to examine the determinants of community empowerment towards the revegetation of Arjuna mount forests; (2) assessing the influence of geography and soil conditions on the revegetation of Arjuna mount forests; (3) reviewing the effect of Arjuna mount forest revegetation on the preservation of spring water sources and (4) formulating a model for empowering communities around the forest towards sustainable conservation of springs. The research method was descriptive quantitative, with research populations around the forest and springs, namely Leduk, Jatiarjo and Dayurejo Village, Prigen District, Pasuruan Regency, East Java. The research sample was determined by cluster sampling and data analysis using SEM (structural equation modeling). The results showed that (1) the variable of community empowerment with factors human resources, economic, social, local institutions, facilities and infrastructure have a very significant effect on revegetation of Gunung Arjuna forest; (2) geographic and soil variables have a very significant effect on forest revegetation; (3) forest revegetation variables have a very significant effect on the preservation of spring resources; and (4) the local institutional factors, facilities and infrastructure have a higher influence than other factors. The institutional and facilities and infrastructure factors of the forest community can be a model of empowering the community around the forest towards the success of revegetation and preservation of the area around the source of the spring, and was the novelty of this dissertation research.

Keywords: community empowerment, springs

## 1. Introduction

The achievement of the forest sustainability function was characterized by the ability of the forest to support human life and the environment, in other words, a sustainable forest was a forest that was able to function all its functions. There were two functions of a healthy and sustainable forest, namely: (1) ecological function, meaning that the forest was able to guarantee the sustainability of a sustainable forest, a balanced interaction between all components in the forest; (2) economic function, meaning that forests that were damaged with a level of risk are still below the threshold of loss [12].

Rehabilitation of tropical forests by communities in a sustainable manner was important for forests as a function of the hydrological system, especially the effect of the sponge being able to hold rainwater

and regulate its drainage, thereby reducing the occurrence of floods and maintaining the flow of water in the dry season. However, with the decrease in agricultural land, the increasing number of people living around the forest, the change in the management of protected forests into production forests and tourist destinations, the expansion of industrial investment areas, and the increasing needs of the community, these conditions result in uncontrolled harvesting. Forest resources include water, flora and fauna by human activities.

The monitoring results of United States Agency for International Development showed that over the past 20 years there has been a rate of forest destruction on Arjuna mount, some areas of sub-watersheds have decreased springs discharge, this was allegedly related to forest damage in recharge areas continue to increase. The number of sources of dry or dead springs was 30 springs, out of a total of 41 springs. The main cause of the dry springs was damage to protected forests and production on Arjuna mount. Thousands of hectares of Arjuna mount forest are critical, due to fires and illegal logging. The forest area of Arjuna mount in the area of Pasuruan Regency reaches 12,000 hectares. About 1,500 hectares of them were damaged by fire in 2012. Of the 1,500 hectares burned, only 300 hectares were rehabilitated. According to the study from the Clinton Foundation, USA in 2011-2012, the rate of forest destruction on Arjuna mount reached 0.24%, equivalent to 68 ha/year. If this condition continues, it will threaten clean water supplies for almost 2 million people in Pasuruan Regency, 4.7 thousand Ha of irrigated rice fields and around 500 industries in Pasuruan Regency [16].

Some of the efforts to conserve forests and springs include: the availability of funding sources for forest revegetation and rehabilitation, the existence of community institutions that serve as a platform for community aspirations and capacity for awareness and concern for forest conservation and springs, positive socio-cultural habits of the community in forest management and springs, such as community service and mutual cooperation, community knowledge of the importance of water for life [3]. This was clarified by [1], that the empowerment of forest communities regarding the rehabilitation, rehabilitation and conservation of forests has a significant influence on the contribution of damage to forest ecosystems.

The existence of forest communities was a component of the community that directly interacts with the surrounding forests, which provides an effective function for the success of forest conservation to save springs and biodiversity contained therein. The need for stages of empowering the surrounding community as a whole to achieve independence with the stages of awareness through counseling and training, capacity building and empowerment [7]. Development of communities around forests, with a condition based on human resource, socio-cultural, economic, community institutional structure, natural resources, environmental tourism, harmonization between institutions and community capabilities are appropriate strategies for the conservation of forest biodiversity [10]. Based on some of the facts and problems mentioned above, it was necessary to study the model of community empowerment of preservation of springs at Arjuna mount.

## 2. Method

The research method used was quantitative descriptive, with the population of this study was forest-dependent communities and springs, which were domiciled in three villages, namely Leduk Village, Jatiarjo and Dayurejo, Prigen District, Pasuruan Regency, East Java. The data obtained from respondents were analyzed using SEM (structural equation modeling).

There were two variables in this research, namely exogenous and endogenous. Exogenous variables 1 were community empowerment (as indicators of human resources, economy, social, local institutions, facilities and infrastructure) and exogenous variables 2 were geography and land (as indicators of land slope and effective soil depth). While endogenous variables 1 were forest revegetation (as indicators of plant species, nursery, fertilization, planting, care), endogenous variables 2 were vegetation and forest fauna profiles (as indicators of vegetation stratification, bird wealth, taxonomic wealth, plant density), endogenous variable 3 were conservation source of water (as an indicator of water discharge in the rainy season, water discharge in the dry season, erosion, economic value of water)

Some requirements that must be met in the SEM (structural equation modeling) analysis include requirements for sample size, normality requirements and requirements for the absence of multicollinearity in the model.

### 2.1. Adequacy of sample amounts

The minimum sample size for SEM (structural equation modeling) analysis with the maximum likelihood estimation method was 100 to 200 [8]. The number of samples used in this study was 210 samples, which means the number of samples has exceeded the adequacy requirement of the sample size in SEM (structural equation modeling) analysis.

### 2.2. Normality test

Normality test in SEM (structural equation modeling) analysis was intended to determine the normal or not distribution of the research of each variable. Normality evaluation was done by using *critical ration skewness value*, the data was said to be normally distributed if the critical ratio skewness value was below the absolute price 2.58 [8], while in [6] the multivariate CR (critical ratio) value below 8 was still acceptable and analysis can still be continued as long as all indicators have CR (critical ratio) kurtosis < in susceptible value  $-2.58 < z < 2.58$ . The results of the normality test indicate that the research data has been normally distributed because the univariate CR (critical ratio) skewness value of all variables has been in the interval  $-2.58 < z < 2.58$  so that it can be concluded that the data analyzed has fulfilled the univariate normality, then, the multivariate CR (critical ratio) value has also been was in the range of  $-2.58 < z < 2.58$  so that multivariate can be declared normal, thus it can be concluded that the research data also meets the assumptions of multivariate normality.

### 2.3. Outlier

Outliers were observations that arise with extreme values both univariate and multivariate which arise because the combination of unique characteristics that they have and looks very different from other observations. In SEM (structural equation modeling) analysis, outliers can see the mahalonobis distance value, the data was referred to as an outlier if the mahalanobis d-squared value exceeds 45.314 that was the chi square value at 20 degrees free (because there are 20 valid indicators analyzed) and a significant level of 0.001. Outlier detection results show that out of 210 data analyzed there was no data that has an mahalonobis distance at 45.314 which means 210 analyzed data does not contain outliers.

### 2.4. Multicollinearity test

Multicollinearity test was done by looking at the correlation values between endogenous variables. The model was declared free of multicollinearity if the correlation value between endogenous variables was < 0.9. The multicollienarity test results show an estimate value of 0.696, meaning that there were no endogenous variables that have a correlation > 0.9, this means there was no multicollinearity in SEM (structural equation modeling) model.

### 3. Result and discussion

Structural model testing was used to test the research hypothesis. Stages in structural model testing include structural model formation stage, structural model feasibility test and test the significance of the influence of endogenous variables on endogenous variables.

#### 3.1. Structural model specifications

By referring to the hypotheses and framework of the model constructed in this study, the specification of the structural model of SEM (structural equation modeling) analysis built in this study was figure 1.

#### 3.2. Structural model suitability test

The suitability test of the structural model in SEM (structural equation modeling) analysis was done by looking at some criteria of goodness of fit model such as chi square value, probability, df (degrees of freedom), GFI (goodness of fit indices), AGFI (adjust goodness of fit), TLI (tucker lewis index), CFI (comparative fit index), RMSEA (root mean square error of approximation) and SRMR (standardized root mean squared). In this test, the structural model was stated to have fulfilled the goodness of fit model criteria if the model meets one of the assumptions contained in the table above. [13] states that if there were one or two goodness of fit criteria that have been fulfilled, then it can be said that the model built was good. Based on the estimation results of the structural measurement shows that the structural model has not been so good in meeting the criteria of goodness of fit model, the probability of the model was still below 0.05, which means that with the model, 210 samples have not had the same covariance matrix with the actual population covariance matrix, so it was necessary to modify the model. Modification indices to increase the goodness of fit model, then add paths between error e1 and e2, e4 and e5, e7 and e9, e9 and e10, e17 and e20, and in the path between e14 and e15. The results of the goodness of fit model test after the three lines were added presented in figure 1. shows that after the modification of the model, the model has a probability above 0.05, thus, the model has been used to test the hypothesis in this study.

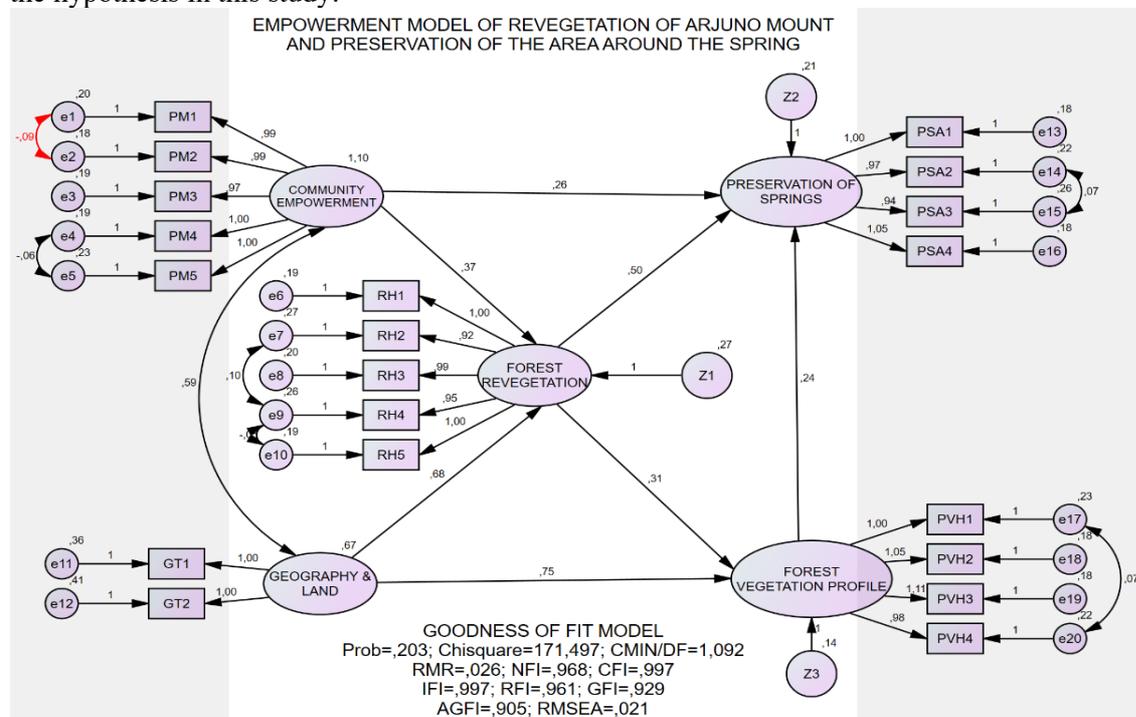


Figure 1. Results of estimation of structural model modifications

### 3.3. Significance test

The significance test aims to examine whether there was a significant influence of exogenous variables on endogenous variables. The hypothesis built in this test was as:

H0: There was no significant effect of exogenous variables on endogenous variables

H1: There was a significant effect of exogenous variables on endogenous variables, with a significant level of 0.05, H0 will be rejected if significant values P (probability) < 0.05 and CR (critical ratio) > 1.96, while if the significant value P (probability) > 0.05 and CR (critical ratio) < 1.96 then H0 was not rejected.

**Table 1.** Test results of signifikansi regression weights

			Estimate	S.E.	C.R.	P	Label
forest revegetation	<---	community empowerment	0.374	0.075	5.005	***	par_15
forest revegetation	<---	geography and land	0.679	0.108	6.273	***	par_16
forest vegetation profile	<---	forest revegetation	0.312	0.101	3.084	0.002	par_18
forest vegetation profile	<---	geography and land	0.750	0.141	5.299	***	par_20
preservation of spring water	<---	forest revegetation	0.503	0.087	5.760	***	par_17
preservation of spring water	<---	community empowerment	0.256	0.059	4.344	***	par_19
preservation of spring water	<---	forest vegetation profile	0.241	0.083	2.914	0.004	par_21

Based on the results of SEM (structural equation modeling) analysis in table 1. and the research objectives, obtained the following results:

- (1) The variable of community empowerment has a very significant effect on revegetation of Gunung Arjuna forest (probability value < 0.05 and critical ratio = 5.005 > 1.96). The better community empowerment, the better the forest revegetation will be, and vice versa. [14], explains that there are positive and significant influences of empowerment factors such as profiles, institutions, economics and policies on the productivity of forest rehabilitation. [9], explained that sustainable community development based on the alternative income approach that was environmentally friendly was very important in supporting forest sustainability globally. While [5], states that community empowerment has a positive influence on forest conservation and preventing illegal logging which includes 3 aspects, namely: (1) increased income and the growth of the economy of rural communities with environmental insight; (2) provision of facilities and infrastructure; (3) creation and positive behavior in environmental conservation.
- (2) Geographic and soil variables have a very significant effect on forest revegetation (probability values < 0.05 and critical ratio = 6.273 > 1.96). The better the conditions of geographic and soil characteristics, the better the revegetation of the forest, and vice versa. Geographic and land elements that affect forest revegetation are land slope and soil depth. The slope factor or slope affects the erosion that occurs, the greater the percentage of slope on a slope will provide erosivity in increasingly heavy rain, and damage to forest vegetation. While the depth of soil determines the amount of water that can be absorbed by the soil thus affecting the amount of surface flow [2].

- (3) Forest revegetation variables have a very significant effect on the preservation of spring resources (probability values  $< 0.05$  and critical ratio  $= 5.760 > 1.96$ ). The better the forest revegetation, the better the preservation of springs, and vice versa. Vegetation closure plays an important role in regulating the hydrological system, especially the "sponge effect" which can hold rainwater and regulate the flow so as to reduce the tendency of flooding and maintain the flow of water in the dry season. This function will be lost if the vegetation in the higher watershed was lost or damaged. Throughout the tropics, 90% of farmers in the lowlands depend on the activities of 10% of the people living in the upper reaches of the river [10]. In an effort to conserve springs, one method that can be used was by vegetation methods, through programmed rehabilitation in water catchment areas, to support hydrological balance in the area of the springs [4]. [11] explained that one of the efforts to protect and preserve the recharge area was among others: conducting agronomic conservation activities, carrying out mechanical conservation activities and regulation of the border of the water source.
- (4) The results of the squared analysis of multiple correlation squared forest revegetation variables indicate that the contribution of the influence of community empowerment and geography and land variables on forest revegetation was 73.7%, while the remaining 26.3% forest revegetation variance was influenced by other factors beyond community empowerment and geography and soil. The analysis of squared multiple correlation squared variable preservation of spring sources shows that the contribution of the variable community empowerment and geography and soil to the preservation of springs was equal to 80.9%, while the remaining 19.1% variance in conserving springs was influenced by other factors in outside community empowerment and geography and land. Based on the results of the analysis of squared multiple correlation squared, it was stated that the empowerment of communities around the forest can be a model in sustainable revegetation and conservation of springs. [1] in research entitled conserving and preserving forest and forest resources in rural Nigerian communities: implications for community education, explained that the development of rural communities regarding forest conservation has a significant influence on preventing damage to forest ecosystems. Estimation of regression weights for each indicator of empowerment of communities around the forest for revegetation and preservation of the area around the spring at Arjuna Mount Figure 1. states the value of human resources 0.99, economy 0.99, social 0.97, local institution 1.00 and infrastructure 1.00. This condition shows that according to respondents the local institutional factors, facilities and infrastructure have a higher influence than other factors. This illustrates that the institutional factors and facilities and infrastructure of the forest community can be a model of the community empowering around the forest towards the success of revegetation and preservation of the area around the source of the spring, and was the novelty of this dissertation research. [15] with a study of the contribution of forest restoration to rural livelihoods and household income in Indonesia stating that institutional factors were indicators in determining forest use in forest restoration concessions.

#### 4. Conclusion

Conclusions of the results of the research include: (1) the variable of community empowerment with factors human resources, economic, social, local institutions, facilities and infrastructure have a very significant effect on revegetation of Gunung Arjuna forest; (2) geographic and soil variables have a very significant effect on forest revegetation; (3) forest revegetation variables have a very significant effect on the preservation of spring resources; (4) the results of the squared analysis of multiple correlation squared forest revegetation variables indicate that the contribution of the influence of community empowerment and geography and land variables on forest revegetation was 73.7%, while the remaining 26.3% forest revegetation variance was influenced by other factors beyond community empowerment and geography and soil. The analysis of squared multiple correlation squared variable preservation of spring sources shows that the contribution of the variable community empowerment and geography and soil to the preservation of springs was equal to 80.9%, while the remaining 19.1% variance in conserving

springs was influenced by other factors in outside community empowerment and geography and land. Based on the results of the analysis of squared multiple correlation squared, it was stated that the empowerment of communities around the forest can be a model in sustainable revegetation and conservation of springs.

## 5. Suggestion

Based on the results of the analysis and conclusions and the phenomenon of community empowerment areas in Leduk, Jatiarjo and Dayurejo Village as well as the Arjuna Mount forest revegetation area, it can be suggested as follows:

- Empowering forest communities in Leduk, Jatiarjo and Dayurejo Villages through the development of human, economic and socio-cultural resources of the community, capacity building of local institutions, facilities and infrastructure can provide the widest possible benefits for people living in forest areas. Improving the quality of life of the community provides benefits to ecological values, namely the maintenance of forest functions as a hydrological cycle and the sustainability of springs. Furthermore, it was suggested to interested parties, namely the community, Indonesian state forest company, the government and the private sector (companies) to coordinate comprehensively and sustainable in joint forest management
- To coordinate the implementation of forest management and springs, it was recommended to form an organizational structure of shared responsibility, which has the main tasks in empowering and revegetating forests and conserving springs

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