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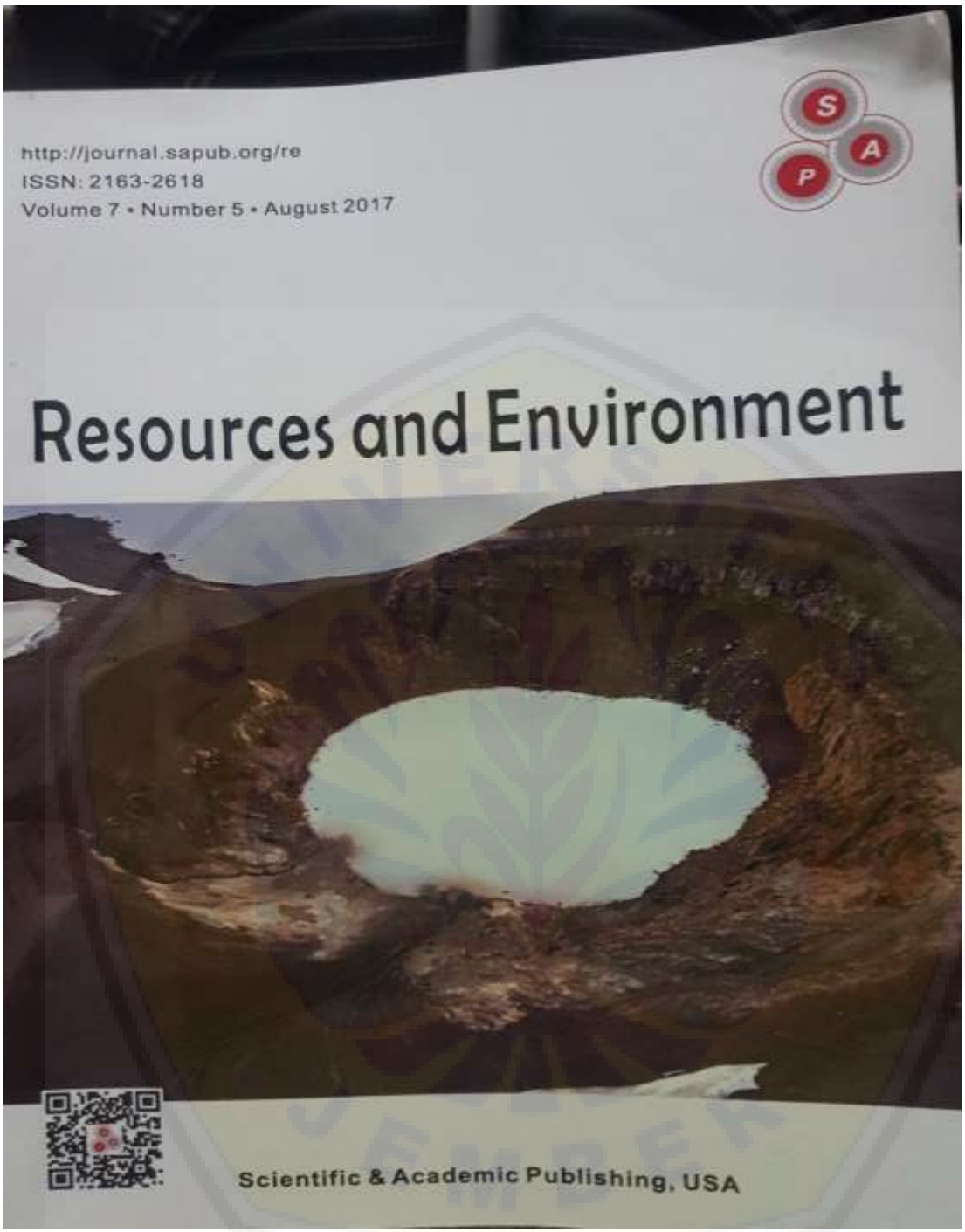

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Volume 7, Number 5, August 2017

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p-ISSN: 2163-2618
e-ISSN: 2163-2634
http://journal.sapub.org/re

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Purpose

Resources and Environment focuses on introducing the current situation of resources and environment to make the broad masses of the people know the meaning and value of sustainable development as a kind of public academic journal. The current policies and related management measures designed for sustainable development will be mentioned in this journal.

Range of Topics

The journal features original research articles as well as review articles in all areas of resources and environment. Subject areas include (but are not limited to) the following fields:

Air Pollution and Climate Change Interactions, Aquatic Biology and Ecology, Atmospheric Chemistry, Climatology, Earth Science, Environmental Analyses and Monitoring, Environmental Change, Environmental Economics & Politics, Environmental Engineering, Environmental Ethics, Environmental Impact, Environmental Microbiology, Economics of Environmental Management, Environmental Science, Environmental Studies, Indoor/Urban Air Pollution and Control, Pollution and Waste Management, Air Resources, Agriculture Resources, Conserve Resources and Reduce Pollution, Fishery Resources, Forest Resources, Human Resources, Management of Resources, Non-renewable Resources, Non-renewable Resources, Renewable Resources, Resource Extraction and Waste Generation, Water Resources, Soil.

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Resources and Environment 2017, 7(5): 115-123
DOI: 10.5923/j.re.20170705.01

Analysis of Sustainable Groundwater Resources Management in Jember District (Study in Sumberjati Village, Silo Sub-District)

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Abstract The results of research in Sumberjati village found 15 different type of ground to water resources, out of that 11 ground water used as a source of clean water that is distributed by pipeline to households, and 4 water resources are not distributed to households. Potential water supply in Sumberjati village per hamlet is as follows: Sepuran hamlet 61.65%; Kajar hamlet 27,79%, Kajar hamlet 9.34% and the smallest potential is in Krajan hamlet 1,29%. The ground water of Sepuran hamlet is utilized by Krajan hamlet, Kajar, Karang Kebun, Garahanjati hamlet, Garahandan Village, Sempolan Village. The average of clean water consumption in Sumberjati Village is higher than the survey result of Directorate of Drinking Water Development, Ditjen Cipta Karya, it is 144 liters per day per person, standart of Indonesia and UNESCO is 60 liters / capita / day. Estimated clean water needs of entire population in Sumber Jati Village using weighted average is 2,909,41 m^3 / day or 2,909,414.63 liters / day. Data analysis used Sustainability Livelihood Approach (SLA) by using factor analysis, by first describing the research data using descriptive analysis. Data obtained from the survey using the instrument in the form of questionnaires, validity test and reliability instrument, all are significant. The highest capital resource strength in Sumberjati Village is natural and social resources while the lowest is financial resources. The management model of sustainable water resource in Sumberjati Village, Silo Sub-district, Jember District is in the form of Village Owned Enterprise (BUMDesa), with the strength is in sustainability of water resources and social capital supported by community approval. While the weakness in sustainability management is on financial and physical capital that can be solved by doing financing cooperation, both from the budget of the Village Government together with business and from banking.

Keywords Management Model, Groundwater Resources and Sustainability

1. Introduction

Water resources management basically consists of three aspects: too much water, lack of water and water pollution. This is due to the increasing need for water has caused excessive exploitation of water resources resulting in a decrease in environmental carrying capacity. (Directorate General of Water Resources, 2014). The results of the global declaration of water conditions in the world presented at World Water Forum II in Denhaag 2013, projected that by 2025 there will be water crises in some countries. Although Indonesia includes in 10 water-rich countries but water crisis is also expected to occur, as a result of water management errors reflected by the high levels of water pollution, inefficient water use, enormous fluctuations in river flow,

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weak institutions and Inadequate legislation.

The water problem in Indonesia is also marked by the increasingly unfavorable condition of the environment, thus accelerating the water scarcity. With the increase in water demand and the scarcity of water availability, people are beginning to think and view water as an economic goods. As stated in the Dublin Priciples (2012) Water has an economic value in all its competing uses and should be recognized as an economic good. Water scarcity is considered an economic opportunity and therefore water scarcity must be solved by usage efficiency, followed by restrictions on water consumption by raising the economic value of water so that people will be cautious in using water because it is expensive. The agreed principles are also in line with the results of the study (Brown and Field, 2013).

The scarcity perspective of natural resources according to Paul A. Samuelson (1973) is due to human rationality in meeting their relatively unlimited needs. This is in contrast to that described by Malthusian Theory, where Malthus states that scarcity is caused by human growth not being matched

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by increasing food availability. According to him human growth is according to geometrical progression while the availability of food is according to arithmetic. So that in a time will happen food scarcity. Another opinion from Ricardian Theory, introduced by David Ricardo who argued that the scarcity is due to the decline in soil quality and fertility so that more input is needed. Land degradation causes the resulting output to decrease and the profit decreases. Another theory of John Struatmill says that scarcity occurs because of weak institutional and inhospitable systems. Scarcity according to the perspective of institutional theory described by T.I Gizelis, (2012) and A.E Wooden (2013) is caused by the government's inability to control its natural resources (scarcity) influenced by institutional existence.

Implementation of sustainablility related to water resources in the concept of public interest is regulated by the state. The role of the state can be realized through the constitution and regulation of natural water resources management actually has been contained in Article 33 paragraph (3) of the 1945 Constitution. In the provision of Article 33 paragraph (3) of the 1945 Constitution stated "Earth, water, and natural resources contained therein controlled by the state and in use for the greatest prosperity of the people ". In Law no. 7 of 2004 Article 6 paragraph (1) water resources are controlled by the state and used for the greatest prosperity of the people. The substance of the provisions above are: (1) Earth, water and natural wealth contained therein include objects contained in the earth and water is controlled by the state and (2). The purpose of state control over the earth, water and natural resources contained therein is to the greatest prosperity of the people.

The scarcity phenomenon of water resources in Jember District encourages behavior or policies that can support the balance between ecological and economic conditions in natural and environment resource management as an instrument that regulates allocation of natural resources rationally (Steer, 2006). Therefore, human behavior greatly affects the supply and demand for water. Human behavior is reflected in the implementation of religious norms and ethics in the utilization of water. It is motivated that economic activity also must be imbued by religion.

Implementation of sustainable water resources will be easier if based on religious values, because in religion there is ethics, morals and law. This is in line with the thought of Will Durant (1933), Auguste Comte (1798-1857) and J.S. Suriasumantri (2009) that there is a close relationship between science, ethics and religion. In addition Plato (1934) argues that science without religion (moral guidance) is blind. The moral blindness of science may bring humanity to the brink of catastrophe.

From 281 water resources located in Jember District, according to the information from people around water resources location can be seen that the decrease of water debit is 53.55% compared to previous years. Related to the condition of water resource, it is known that there are 55.05% of physical buildings which include a water container and waterways from that water resource of and there are no management at 71.56% of water resources. Related to the condition of land cover, it can be seen through visual observation that 17,79% in critical condition (42 water resources) and critical (8 water resources), while 82,21% (231 water resources) in a good condition (Jember District Planning Agency, 2015).

The scarcity phenomenon requires sustainable management of water resources both downstream and upstream. Scarcity of water resources will cause the increase of economic value of water, without good management will cause social problems in society. This social problem has occurred in the area of Sumberjati village, Silo sub-district, Jember district.

Sumberjati Village, Silo sub-district, is a villages with 33264 Ha and 4 sub-villages, namely: Krajan hamlet, Karang Kebon hamlet, Kajar hamlet and Sepuran hamlet. Sumberjati village has several water resources that are utilized by the community, not only for agriculture but also for other economic activities, family needs and drinking water needs. There are several water resources that are managed to meet the needs of the community, one of the sources is "Sepuran". This water resources is relatively abundant, but has decreased water debit. By HIPPAM (Water User Association) this water resource is used to fulfill the needs of the community which is channeled through pipeline, there are some people (Krajan hamlet) that utilize well, but there are some people (Sepuran hamlet) who do not get the benefits properly. This is related to the poor management and understanding of the village's assets. So that this low understanding is what causes the utilization of water becomes not optimal and cause social problems.

2. Research Methods

The SLA (Sustainable Livelihood Approach) method is used to find the answers of sustainable livelihood strategies for water resource management in Sumberjati Village, Silo Sub-district, Jember District. In SLA (Sustainable Livelihood Approach) analysis, there are two methods of data analysis namely descriptive analysis and factor analysis as implementation of SLA usage. First the research instrument, validity and reliability is tested.

1. Validity and Reliability Test

The validity test is about the precision of measuring instrument to the concept measured so that it actually measures what should be measured. According to Riduwan and Kuncoro (2007), validity is a measure that indicates the level of reliability or validity of a measuring instrument. A less valid measuring instrument means lower validity. Formula of Pearson Produck Moment is used to measure the validity with the following formula:

$$r_{count} = \frac{nn\sum XXXXXXXX-(\sum XXXX)(\sum XXXX)}{\sqrt{\{NN\sum XXXXxx^{22}-(\sum XXXX)xx^{22}\}\{nn\sum XXXXxx^{22}-(\sum XXXX)xx^{22}\}}}$$

(Riduwan and Kuncoro, 2007)

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Description:
r_{count} = correlation coefficient
n = number of respondents
$\sum XXXX$ = Total score of items
$\sum YYXX$ = Total score (of all items)

If the instrument is valid, then the interpretation criteria about its correlation index (r_{count}) if the correlation value > 0.30 then the instrument is valid.

Reliability test is performed to obtain the level of accuracy (reliability) of data collection tool (instrument) used. Instrument reliability test is done by Alpha Method (Riduwan and Kuncoro, 2007: 22):

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum S_{XX}}{S_{SS}}\right)$$

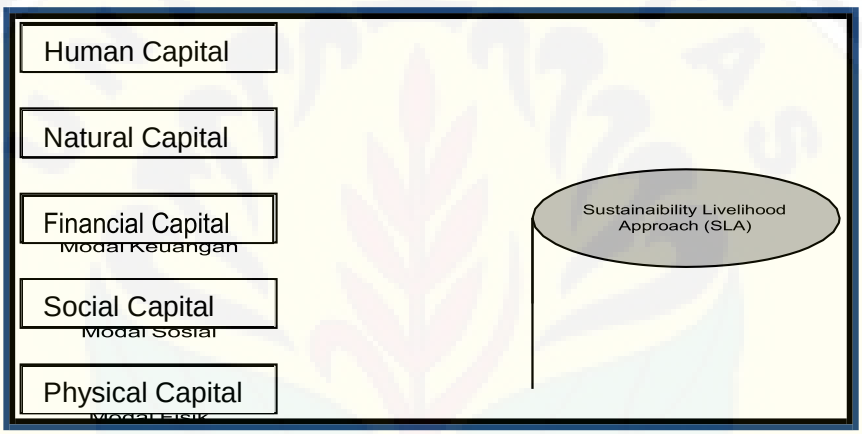
Description:
r_{11}: Value of reliability (alpha coefficient)
Σ_{Si} : Value of reliability (coefficient alpha)
S_i : total variance
K : number of items
Decision rule : If r_{11} > 0.6 decision rule
: If r_{11} < 0.6 means not reliable

2. Factor Analysis

The procedures undertaken in this factors analysis are as follows: formulating the problem, making the correlation matrix, determining the number of factors, factor rotation, factor interpretation, and determining the accuracy of the model (Malhotra 1993: 622).

a. Formulating the Problem

The problem formulation in this factor analysis is in the form of determination of research indicators based on previous research so briefly presented as follows:



Source: Malhotra, 1993

Figure 1. Problem Formulation in Factor Analysis

b. Making the Correlation Matrix

All data of the incoming independent variables calculated its correlation matrix with the aim to identify the interrelated indicators. Indicators that are not interconnected with other indicators will be excluded from further factor analysis.

The statistical test used is calculation of Kaiser-Mayer-Olkin (KMO) measure of sampling adequacy, Barlett's Test Sphericity test, and Measure of Sampling Adequacy (MSA) test. Calculation of KMO value is performed to know the level of sufficiency of sample size, if the value of KMO > 0.5 then sample size is considered quite feasible to ber processed in factor analysis, and vice versa (Malhotra 1993: 623). Barlett's Sphericity test is performed to test H_0 which states that the indicators are not interrelated to each other with a significance level of 0.05. If the significance value is < 0.05 then H_0 is rejected which means there is a significant dependency relationship between the indicator (Santoso, 2002). The MSA test is performed to measure how far an indicator of bias is predicted by other indicators, the MSA adequacy requirement is > 0.5. If the MSA value of an indicator > 0.5 then the indicator can be used in factor analysis, otherwise if the value of MSA < 0.5 then the indicator must be issued.

c. Determining the Number of Factors

The method used in this factor analysis is Principal Component Analysis (PCA) technique, where the determination of the number of factors eligible to represent the above indicator is analyzed based on the criteria, ie the eigen value > 1 (Malhotra 1993: 626). Only factors that have an eigen value equal or greater than 1 are retained in the factor analysis model, while others are excluded from the model.

d. Factor Rotation

The result of matrix factor simplification through factor extraction process with principal component analysis method shows the relation between factor and indicator, but that correlation is still difficult to interpret, so it is necessary to do matrix rotation through varimax method to form a simpler and easier to interpret matrix structure. This rotation factor identifies the loading factor or relationship value

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between factor and individual variable in the matrix factor. The result of grouping by varimax rotation technique will be orthogonal, ie one factor is not correlated with other factors (Malhotra 1993: 627).

e. Factor Interpretation

Factor interpretation is done by grouping the variable that have the loading factor ≥ 0.5 in the new factor, then naming the new factors formed, variable with the loading factor ≥ 0.5 out of the model. This is followed by identifying its relationships with the variables incorporated in one factor with that factor itself, including ranking based on the strength of the relationship between variables and factors and giving meaning to the relationship, and providing a review of the relationship (Malhotra 1993: 628).

f. Factor Score Determination

Since the main purpose of using factor analysis in this study is to reduce the number of original variables into the combined number of fewer variables (called factors) then proceed with the multivariate analysis, it is necessary to calculate the factor scores for each new factor formed through the principal component analysis technique, where the factor score will be used as input on the following multivariate analysis (Malhotra 1993: 629). Multivariate analysis used in this research is path analysis.

g. Determination of Model Accuracy

The final step in the factor analysis is measuring the accuracy of the model through Principal Component Analysis technique which calculates the percentage of residuals (difference) between the observed initial correlation value and the correlation value reproduced with the deviation rate <0.05 (Malhotra 1993: 630). The smaller the percentage of residuals the more appropriate the model of factor analysis used.

Location of the study can be seen in the map below.

Figure 2. Research Location Map

3. Empirical Result

1. Data Analisys

The sustainable livelihood approach (SLA) data analysis phase is done by using factor analysis approach. Before factor analysis is interpreted, good testing (assumption) of factor analysis model that includes KMO, Sig, and MSA values is done. The first measure is the size of Kaiser Meyer Olkin Measure of Sampling (KMO). Kaiser Meyer Olkin Measure of Sampling (KMO) is the comparison index of the distance between the coefficient correlation with its partial coefficient correlation. If the sum of partial correlation coefficients squares among all pairs of variables is small when compared to the total of correlation coefficients squares, then it will produce KMO values close to 1. KMO values are considered sufficient if more than 0.5. Second, the value of Bartlett Test of Sphericity. This indication is the sperity measure of the factor analysis, where the spercity requirements are met if the Sig value is less than 0.05. Third, is the calculation of Measures of Sampling Adequacy (MSA) or indicator of goodness in sample size. If the MSA value is more than 0.5, then it qualifies the factor analysis, otherwise if the MSA value is less than 0.5, then the indicator is not

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included in the factor analysis.

The following table presents the feasibility test of factor analysis on the SLA model in Kajar Hamlet, Karang Kebon Hamlet, Kajar Hamlet and Sepuran Hamlet. From the table it shows that the KMO value > 0.6, Sig Bartlett < 0.05, and MSA > 0.5, so the model obtained has been feasible.

From the eigen value there is only one value greater than one, it is 2.693 of eigen value 1. This indicates that the five capital: natural, financial, human, physical and social of residents in Sumberjati Village are interrelated to form one sustainability. The percentage magnitude of data diversity that can be explained from formed factors analysis is 53.85%. This means that 53.85% of the five capital can explain the Sustainable Livelihood Approach. SLA testing of residents in Sumberjati Village can be explained on the concept of loading factor. The highest loading factor value indicates the high capital in forming the Sustainable Livelihood Approach. Here is the pentagon form of SLA analysis in Desa Sumberjati.

Based on the pentagon form, it can be seen that in general, the strongest capital in Sumberjati Village is natural capital. It can be concluded based on the loading value of natural capital factor of 0, 839. It indicates that Sumberjati Village has natural resources, which in this case is the source of the water resource, which have large water debit and a lot of water resources. The second strongest capital is social capital with a loading value of 0.698. Next is human capital with loading value of 0.642, physical capital with loading value of 0.338, and the weakest capital is financial capital with loading value of 0.323.

Table 1. Feasibility of SLA Model Factor Analysis

Variable	KMO value	Sig Bartlett	MSA value	Description
SLA in Kajar Hamlet				
Natural	0.763	0.000	0.712	Feasible
Financial			0.848	
Human			0.760	
Physical			0.846	
Social			0.716	
SLA in Karang Kebon Hamlet				
Natural	0.774	0.000	0.725	Feasible
Financial			0.879	
Human			0.743	
Physical			0.762	
Social			0.853	
SLA in Kajar Hamlet				
Natural	0.772	0.000	0.721	Feasible
Financial			0.931	
Human			0.757	
Physical			0.782	
Social			0.791	
SLA in Sepuran Hamlet				
Natural	0.760	0.000	0.708	Feasible
Financial			0.901	
Human			0.762	
Physical			0.753	
Social			0.765	
SLA in Sumberjati Village				
Natural	0.817	0.000	0.809	Feasible
Financial			0.843	
Human			0.816	
Physical			0.799	
Social			0.822	

Source: Primary Data Processed, 2017

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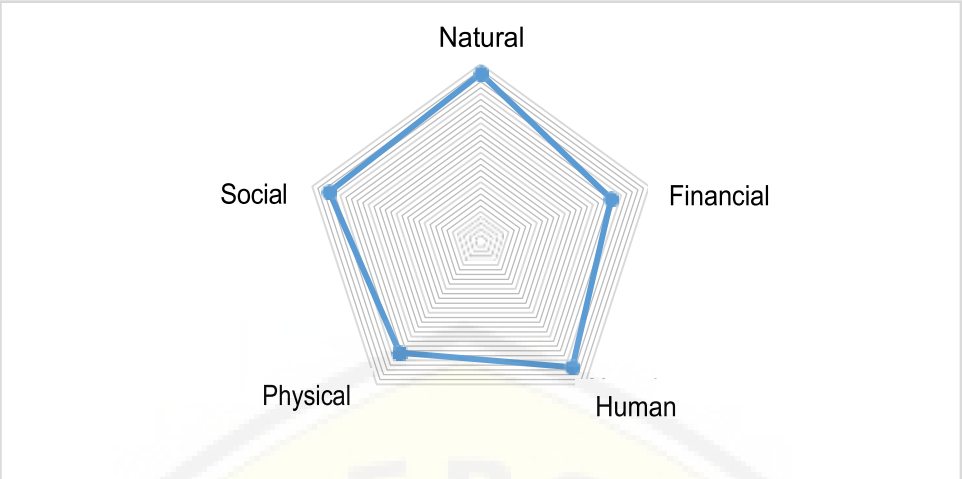

Figure 3. Pentagon of SLA Sumberjati Village Result

4. Discussion and Results

Sumberjati village, Silo Sub District, is 427,1470 Ha divided into 4 hamlets, namely: Krajan hamlet, Karang Kebon hamlet, Kajar hamlet and Sepuran hamlet. Sumberjati Village has 15 identified water resources and has been utilized by the community to meet household needs. There are 11 water resources that are managed by pipeline to the community and 4 unmanaged water resources through pipeline to the community. Sepuran hamlet is the hamlet that has the most water resources, consist of 8 water resources with supply potential reach 61.65% from Sumberjati Village water resource, the rest of 38.35% is distributed in 3 other hamlets.

Water resources supply are relatively abundant, but not infinite. Under certain conditions water supply will decrease, for example by the reduction / absence of standing trees in the upstream area or water catchment areas. Therefore, the water supply must be maintained continuously and the water needs must be controlled and efficient, it must be managed. So far, the manager is HIPPAM (Water User Association) both using water meter system (controlled usage) and monthly (free usage) and individual manager. By the manager, this water source is used to fulfill the society needs which channeled through pipelines. In addition, there are 4 sources of water that its utilization is to meet household needs in the form of washing and bathing in the absence of pipeline.

Interesting phenomenon is that most of the need for water fulfillment in Sumberjati Village comes from the water resource in Sepuran hamlet, meaning that in the concept of riparian right, the people of Sepuran hamlet who have the right to utilize. But in reality, the biggest users are not Sepuran societies, but other hamlet societies and even other villages. This is because the geographical location of some societies settlements in Sepuran hamlet are at higher elevation than the source of water. Technology and social factors in togetherness should be able to be a solution to such constraints. Technological and social factors will be driven when done in an institutional. This institution will manage the water resources by meeting the supply aspect (water resources supply) with the demand aspect (the need for water resources). Appropriate management model in the water resources management in Sumberjati Village is a Village Owned Enterprise (BUMDesa). The basic considerations are:

1. Community Approval

All respondents interviewed based on the questionnaire stated their approval to the water management is from BUMDesa, regardless of whether the BUMDesa directly manage the water or the BUMDesa still used HIPPAM as a business unit.

2. Regulation

a. Law no. 23 of 2014 on Regional Government Part fifth, Article 285 about Village Funds and 294 that Village Funds as set in Article 285 paragraph (2) letter a number 4, are allocated by the Central Government to among others the number 4 allocated by the Central Government to fund the administration, Implementation of development, community development, and empowerment of village communities based on the authority and needs of the village in accordance with the provisions of the law about Village.

b. The Republic of Indonesia Law no. 6 of 2014 about Village stat that. Sustainable water resource management is one aspect of rural development, as mentioned in the Republic of Indonesia Law no. 6 of 2014 about Village.

Article 78:

Paragraph (1) Village Development aims to improve the welfare of the village community and the quality of human life and poverty alleviation through the fulfillment of basic needs, development of Village facilities and infrastructure, development of potential local economic, and use of

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sustainable natural resources and environment.

Water resources in Sumberjati village is a local economic potential and which its utilization must be sustainable by involving the community in mutual assistance and utilizing local wisdom, as set in Article 81:

Paragraph (1) Village Development is carried out in accordance with the Village Government Work Plan.

Paragraph (2) The Village Development as referred in paragraph (1) shall be implemented by the Village Government by involving all villagers in a spirit of mutual assistance.

Paragraph (3) The Implementation of Village Development as referred in paragraph (1) shall be conducted by utilizing the local wisdom and natural resources of the Village.

As explained in Articles 78 and 81, Water is a natural resource in Sumberjati village and its potential is to be developed into village economic activities, therefore it need village development planning. Village development by utilizing the potency of well-managed water resources will be able to allocate water among users well, able to distribute water amongst consumers fairly, able to maintain water quality well, able to maintain the sustainability of water resources, water supply sustainability and able to realize economic independence of the village.

Village Owned Enterprise (BUMDesa) is the right solution in order to optimize the potential of natural resources of water in Sumber Jati Village. The establishment of BUMDesa will streamline the use of water resources and reduce the potential conflicts for ownership among citizens. Income generated by BUMDesa in the framework of water governance is used for, improving water infrastructure, improving services to the community and can be used as a medium for the growth of productive economic activities in the village that are based on local potential and trying to avoid environmental damage. BUMDesa is set in Articles 87, 88, 89 and 90, as follows:

Article 87:

Paragraph (1) The village can establish a Village Owned Enterprise called BUMDesa

Paragraph (2) BUMDesa is managed with the spirit of kinship and mutual cooperation.

Paragraph (3) BUMDesa can run business in economy and / or public service in accordance with the provisions of legislation.

Article 88:

Paragraph (1) Establishment of BUMDesa agreed through Village Deliberation.

Paragraph (2) Establishment of BUMDesa as referred in paragraph (1) shall be stipulated by Village Regulation.

In Article 89, the results of BUMDesa's efforts can be utilized for business development; and

Article 90

Governments, Provincial Governments, District / Municipal Governments, and Village Governments encourage the development of BUM Desa by:

a. Provide grants and / or access to capital;
b. Perform technical assistance and access to markets; and
c. Prioritize BUM Desa in managing natural resources in the village.

c. Regulation of the Village Minister, Development of Disadvantaged Regions and Transmigration in Republic of Indonesia Number 4 of 2015 on Establishment, Handling, Management and Dissolution of Village Owned Enterprises.

Article 2 states that BUMDesa is intended as an effort to accommodate all economy activities and / or public services managed by the Village and / or inter-village cooperation. Whereas in Article 8 it is stated that BUM Desa may establish business units covering: a) Limited Liability Company as a capital partnership, and b) Micro Finance Institution with a share of BUM Desa of 60%, in accordance with laws and regulations concerning micro finance institutions.

d. Regulation of the Republic of Indonesia Government Number 43 of 2014 about the Implementation of Law Number 6 of 2014 about Villages, Article 1 point 7: Village Owned Enterprises, hereinafter referred to as BUM Desa, is a business entity wholly or partly owned by the Village through participation directly derived from the wealth of the Village separated to manage assets, services and other businesses for the greatest welfare of the village community.

3. SLA Analysis

The strengthening of BUM Desa as a model of sustainable groundwater resource management rests on the strength of natural and social capital which in the analysis of Sustainable Livelihood Approach has the highest number in Sumberjati Village. This strength is supported by a relatively equal value at the hamlet level with variations occurring in the Krajan Hamlet based on the strength of human and financial capital, Karang Kebun hamlet is based on the strength of natural, human and social capital. While that must be developed is the financial and physical capital has the lowest value.

5. Conclusions

The research results in Sumberjati village, found 15 water resources, 11 used water resources as a source of clean water that is distributed by pipeline to households, and 4 water resources are not distributed to households. Data analysis used Sustainability Livelihood Approach (SLA) approach by using factor analysis, by first describing the research data using descriptive analysis. Data obtained from the survey

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using the instrument in the form of questionnaires, validity and reliability test, all instrument are significant. The strength of highest capital resource in Sumberjati Village is natural and social resources while the lowest is financial resources.

The management model of sustainable water resource in Sumberjati Village, Silo Sub-district, Jember District, is in the form of Village Owned Enterprise (BUMDesa), with the strength is in sustainability of water resources and social capital supported by community approval. While the weakness in sustainability management is on financial and physical capital that can be solved by doing financing cooperation, both from the budget of the Village Government together with business and from banking.

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