Study on Impact of Relocating Settlement as a Post-Disaster Mitigation
-Case Study: Permanent Relocated Settlement after Mt. Merapi Eruption in 2010 in
Sleman District, Daerah Istimewa Yogyakarta, Indonesia-

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Abstract

Relocating a settlement often becomes a post-disaster solution in cases when a disaster strikes and leaves people homeless. One of the disasters which can bring such kind of impact is a volcanic eruption. The study case on the relocated settlement in Merapi volcano area, Daerah Istimewa Yogyakarta, is considered as one of best practices for a relocation project in Indonesia which was driven by the massive losses incurred from the large eruption in 2010. The project was facilitated by the Rehabilitation and Reconstruction Program Community-based society (REKOMPAK) which had the community play a central role at every decision and action. However, even as the best practices in Indonesia, this project was also obstructed by a major issue which usually occurs in the relocation project, that being project deniers. There were 656 households insisted on returning to their previous house. Moreover, until the end of the second year after the project finished, about 100 additional households also decided to go back from the relocated settlement to their previous settlement.

The objective of this study is to identify the impact of relocating the settlement by comparing the satisfaction of the inhabitants in the relocated settlement with the satisfaction of the inhabitants who declined the project and persisted in building houses on their own. A questionnaire survey was conducted in September-October 2016 to the inhabitants of the both types of settlements consisting of 62 respondents which were the representatives of each local neighborhood. There were 49 respondents from the relocated settlement and 13 respondents from the in-situ reconstruction settlement.

Based on a principal component analysis (PCA) result, the project impact can be observed on six variables which are (1) community participation, (2) new settlement satisfaction, (3) project satisfaction, (4) community empowerment, (5) infrastructure satisfaction, and (6) public facility satisfaction. Built from the value of these variables, the inhabitants of both settlements were classified into five clusters. The interpretation of these clusters shows that the relocation also gave different impacts among the inhabitants within the same relocation project. Even though they moved together to the same relocated settlement, they perceived the different impacts. Furthermore, detailed by the cluster distribution and reconstruction process, the result implied that the location aspect, demography structure, inhabitant's distribution in the new dwellings, the bonds between neighbors, and community's participation to the development program are the main problems that occurred inside these settlements. Thus, based on this finding, the result can be used as a consideration for constructing further improvement program.

Keywords: Impact of Relocation, Relocated Settlement, Post-Disaster Mitigation, Eruption

1. Introduction

Resettlement of population is a complex process with many possibilities for different impacts, and if not conducted properly can create serious problems for the people involved¹⁾. In some cases, poorly designed and managed displacement is often known to be associated with

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social disarticulation and increased deprivation²⁾. As one of the parts of the reconstruction and rehabilitation step in the disaster management cycle, relocating a settlement often becomes a solution when disaster hits and leaves people homeless. According to The World Bank, relocation can be the best option after disaster for some conditions such as when people have already been displaced by the disaster and their current location is judged to be uninhabitable, or when relocation is considered to reduce vulnerability to the risk of future disaster³⁾.

Relocation settlement as a combination of housing planning and disaster management has many aspects that need to be considered. The contribution to long term disaster mitigation which is aiming at minimizing damage to people's lives and assets before a catastrophe strikes made the relocation program, as part of house planning, considered to be an important part of integrated disaster risk management⁵⁾. However, Unsuitable new sites also can lead to other issue such as lost livelihoods, a lost sense of community and social capital, cultural alienation, poverty, and people abandoning the new sites and returning to the location of their original community⁴⁾.

One of the best relocation projects in Indonesia was undertaken after the Merapi volcanic eruption in 2010 in Sleman, Daerah Istimewa Yogyakarta. As one of the most active volcanoes in Indonesia, there have been seven eruptions over the last quarter century and the eruption in 2010 is recorded as the biggest among them. The losses did not only happen in terms of material loss but also in the loss of human lives. In those times 346 people died, 121 were injured, and five were missing. 3,470 houses were found destroyed and heavily damaged. Total losses from this disaster reached 3.62 trillion rupiahs (about 290 million USD)⁶⁾.

Figure-1 Abandoned House after Merapi Volcano Eruption

The relocation project, which commenced in 2011 and continued until 2014, was facilitated by the Rehabilitation and Reconstruction Program Community-based society (REKOMPAK). Among three districts which struck by the eruption, In the Sleman district, there were 12 new villages formed by this project which were built on village-owned land. More than 2,000 unit of permanent houses was built included the infrastructure such as road, electricity and clean water. This project received an award from the Indonesian government as the biggest and fastest relocation project until 2014.

Despite its title as one of the best practices, there is no denying the fact that relocation project in Merapi still has a major problem which is project deniers. Actually, this condition has been discussed in general cases that the main threat of every relocation project is due to rejection and abandonment⁹⁾. In Merapi case, there were 656 households that insisted on returning to their previous house. Moreover, since the project finished in 2014, the recorded data shows that a further 100 households decided to return to their previous settlement⁸⁾. Despite a condition for no support from the government, they succeed to rebuild their village and insisted to stay there until now.

Hence, aside of the scale and the completion speed achievement, the quality of the project itself also need to be considered. Inhabitant as the main object needs to be the fundamental concern of the assessment in order to understand the range of the project capability to recover the inhabitant's post disaster condition. By assessing the impact of the project through the inhabitant satisfaction level, this research is aiming to analyze the effect of the project to the life condition of the relocated settlement inhabitant. Furthermore, in order to get a whole vision, the

analysis also included the inhabitant form the in-situ reconstruction settlement for the comparison. The correlation of the both inhabitant's perspective after the reconstruction process assumed to be able to show how far the project can make differences in their life.

2. Methodology and approach

Figure-2 The Map of Relocated and In-situ Reconstruction Settlements in Cangkringan

The targets of this research are the inhabitants of 12 villages which facilitated by REKOMPAK and 3 in-situ reconstruction villages. Administratively, all those villages located on Cangkringan subdistrict with its 27,421 population in a total area of about 48 square kilometers¹⁰⁾. This research focuses on the relocated settlements which are built on the village-owned land. Figure-2 shows the name and specific location of all settlements from both village types.

Referring to purposive random sampling method, questioner data addressed to all neighborhood which was represented by one household for each. Conducted during September until October 2016, there are 49 respondents from the relocated settlement and 13 respondents as the representatives from the in-situ reconstruction settlement.

In order to amplify the statistical data, primary data also collected through case study by doing in-depth interview to the REKOMPAK key person and 5 village elders. Following up these interviews, investigation in far more detail expected can be drawn to understand the correlation of the analytical result to the current condition¹²⁾.

3. Context

3.1 Permanent hazard exposure in Cangkringan subdistrict

Being the subdistrict, which located closest to the volcano crater, Cangkringan subdistrict often became the most damage area every time the volcano erupts. More than half of the area determined as the disaster-prone area. The settlement with the highest elevation located 1,150 meters above the sea level, only about four kilometers from the volcano crater. These potential hazards are combined with the insufficient understanding of the impacts of disasters and lack of effective early warning systems related to extreme weather events. This exposure leads to the condition where the inhabitants became more and more vulnerable.

3.2 Relocation Settlement by REKOMPAK after Merapi Eruption

In this project, the community has a role at the core of every decision and action. REKOMPAK implements a philosophical method which is "from, by, and for society." This method is an essential way to empower the residents. Therefore, they can fulfill their needs⁷⁾ [REKOMPAK, 2012].

In the process, REKOMPAK facilitated the inhabitants during the initial planning until the implementation of their new settlements. Every household was trained as to how to make a site plan from the provided land, for not only the house position but also the infrastructure and the necessary facility. In the implementation, the government, through REKOMPAK, provided the budget and the house model list in which the inhabitant was able to choose. REKOMPAK granted every family a 36 m² wide house which cost equal to Rp 30,000,000 (2,200 USD) in

Figure-3 Length of Settlements Reconstruction

the house reconstruction process Figure-3 shows the variation length of reconstruction process of all respondents. The entire reconstruction project initiated by REKOMPAK were scheduled to finish in a maximum of two years and shown on the recorded data that almost 75% of the settlement being completed within the first year. In the other hand the in-situ reconstruction settlement, because of the uncertain materials and budgets, some inhabitants took a longer time to rebuild their homes. Moreover, the worst case shows the longest process even took four years for its completion.

4. Impact Assessment of Relocation Settlement

The analysis focus for assessing the impact is the components of the relocation project itself and the settlement condition as the output of the project (Table-1), which is became the base for constructing the questionnaire and interview questions. Questionnaire point was divided into two different kinds of data, the ordinal type about the satisfaction level with five ranks Likert scale of answer and the ratio type that shows the exact number answer. These exact number data is used to check compatibility within the respondent satisfaction level and the existing condition. However, this analysis requires a positives relation between each variable as an isotonic requirement. Hence, from the questionnaire result, correlation analysis conducted and discovered there are 24 genuine variables verified positively associated with a significant value. Then, the principal component analysis (PCA) was used to find the interrelationship between the variables which are independent from each other, so those variables can be concluded into new variables in a less number than the initial variable set. The new set of variables is named by a new label that reflects the characteristics of the rounded genuine variables¹¹⁾.

Table-1 Questionnaire Variables

Project Assessment	Output Assessment
1. Reconstruction process	1. House condition
2. Damage compensation	2. Infrastructure availability
3. Mitigation plan	3. Childcare and Amenity facility availability
4. Community participatory	4. Health and education facility accessibility
5. Stakeholder role	5. Local community empowerment

4.1 Variable of Impact Assessment

As part of defining the impact of the relocation, 24 genuine variables used to measure how far the reconstruction process and the new settlement environment affected their life (Table-3). These variables were compressed using principal component analysis (PCA). Firstly, the entire variable was selected through its appropriateness before being used for further analysis. This step used to check the tendency of each variable to be grouped and built into factors by sorting the variables which only have a high correlation. Then, the appropriate variable will be a base for the factoring analysis. Table-2 shows the result of the analysis, which in this research uses a cumulative initial eigenvalues percentage to decide the number of the new factors. Total variance used in this study is about 70%, this is used on purpose to keep the bond strength of

100 m² certificated land. People would get their property rights and land tax free privilege with a condition that they unable to sell to other people. In the in-situ reconstruction settlement case, reconstruction was undertaken by the inhabitants themselves. They built using material donated from the non-government organizations. After hit by the disaster, their houses were not utterly destroyed and could still be recognized.

According to the time spent to finish

each variable in one factor based on their characteristics.

Table-2 The Variance of Principal Component Analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8,029	33,453	33,453	8,029	33,453	33,453	3,657	15,238	15,238
2	2,504	10,434	43,887	2,504	10,434	43,887	2,967	12,364	27,601
3	2,252	9,382	53,269	2,252	9,382	53,269	2,897	12,071	39,673
4	1,535	6,395	59,664	1,535	6,395	59,664	2,808	11,701	51,373
5	1,313	5,472	65,136	1,313	5,472	65,136	2,603	10,844	62,217
6	1,096	4,567	69,703	1,096	4,567	69,703	1,797	7,486	69,703

Table-3 The Variables to Construct The New Factors

No	Variable	Avg. Score	Factor					
			1	2	3	4	5	6
1	The community satisfied with the settlement refunctioning.	4.18	0,07498	0,66629	0,13328	-0,05221	0,20096	0,24232
2	The community got enough support and compensation	4.32	0,07330	-0,12704	0,63121	0,27435	0,46860	0,08834
3	The relocation and mitigation assistance really helped improving the community live.	4.18	0,23054	0,07561	0,77939	0,08911	0,06709	0,10622
4	The community was gaining a knowledge about planning and reconstruction process	4.27	0,26982	0,09179	0,52207	0,57110	0,14698	-0,02915
5	The community involved in the planning process	4.45	0,76303	0,10717	0,16205	0,28486	0,16134	0,18256
6	The community involved in the implementation process	4.56	0,72626	0,05671	0,29311	0,34116	0,18261	0,04300
7	The community involved in the maintenance process.	4.60	0,35669	0,04071	0,50863	0,51034	0,41231	0,00900
8	The community involved in the evaluation process	4.39	0,62834	0,26369	0,17682	0,40721	0,20825	0,09389
9	The community has a good awareness of the disaster	4.45	0,68638	0,16662	0,12479	0,05868	0,02627	0,04840
10	The mitigation planning implemented perfectly	4.16	0,61909	0,15321	0,61435	-0,09794	0,01250	-0,10465
11	The community satisfied with the mitigation planning	4.23	0,52061	0,21214	0,59360	0,20272	-0,00975	-0,19942
12	The community satisfied with the replacement payment	3.85	0,09125	0,38488	0,45680	0,01813	0,38059	0,22161
13	The community satisfied with the new sites	4.10	0,19936	0,82415	-0,01086	0,05308	0,00404	0,14939
14	The community satisfied with the house design and construction	4.34	0,24937	0,71150	0,12640	0,16190	0,19519	0,13412
15	The community has a good relation with each other	4.69	0,44095	-0,02087	-0,00775	0,63741	0,12648	-0,08139
16	The community helped each other when one of the member got a personal problem	4.66	0,26463	0,13822	0,07575	0,71030	-0,17980	-0,10095
17	The community satisfied with the education facility services	3.69	-0,03068	0,09317	0,18816	0,00300	0,10998	0,78860
18	The community decided anything related to public dealings through forum discussion	4.63	0,00203	-0,00718	0,11109	0,79733	0,11561	0,15218
19	The community feel safe live in the area	4.42	0,44260	0,31268	0,07842	0,33078	0,20304	-0,34160
20	The community feel pleasant to live in the area	3.90	0,02021	0,76218	0,03781	0,04639	-0,10530	-0,51125
21	The community satisfied with the health facility services	3.84	0,23353	0,34376	-0,15971	0,06202	0,12979	0,68692
22	The community satisfied with the served infrastructure	3.69	-0,13677	0,28396	0,36742	0,13691	0,70744	0,04232
23	The community satisfied with the accesibility to the settlement	3.77	0,13741	0,24249	0,08341	-0,03144	0,73441	0,09973
24	The settlement has a good internal system street	4.18	0,31443	-0,11306	-0,00679	0,08421	0,82283	0,08877
New Factor			Community Participation	New Settlement Satisfaction	Project satisfaction	Community Empowerment	Infrastructure Satisfaction	Public Facility Satisfaction

Based on the correlation value in the table above, each variable is grouped into the factor which has the highest correlation with them. The bigger the number is, the stronger relation between those variables has with the new factor. Positive value describes the directly proportional ratio. Meanwhile, minus shows the inverse. After being grouped, these groups will be named by how the original variables described it. The result of this process defines the six new main variables for assessing the relocation impact named; community participation, new settlement satisfaction, project satisfaction, community empowerment, infrastructure satisfaction and public facility satisfaction. After the method was applied, according to the new factors, the next analysis uses the regression score of the previous variable value to determine how strong the impact of relocation affected the inhabitant's life.

4.2 Cluster Analysis

The new variable of the impact assessment from the principal component analysis result became the material for the next cluster analysis. This method is used for grouping the respondents by their new factor's regression score tendency. The respondents are clustered by the high homogeneity between each member within the cluster, and each cluster has a high heterogeneity between one and another. After being clustered, each group is named based on their characteristic and strengthen by confirming it to the existing condition data

According to the new factor's regression score, the respondents were categorized into five clusters. Table-4 shows the average regression score of each cluster. The number shows the characteristics of the clusters and how strong the relocation impact was to the inhabitant's lives. The cut point of this correlation is 0.5 which mean the factor above 0.5 has a strong impact. Meanwhile, the positive and negative score shows how the impacts affect their life in either a positive or negative way. All clusters are named due to the different characteristics of each impact, which are; (1) Stable community, (2) Good community in the unsatisfying settlement, (3) Improved community with lack of infrastructure, (4) Normal community with a lack of empowerment, and (5) Maladaptive community in the undeveloped settlement.

Table-4 The Characteristic of Each Cluster

Cluster	Community Participation (1)	New Settlement Satisfaction (2)	Project Satisfaction (3)	Community Empowerment (4)	Infrastructure Satisfaction (5)	Public Facility Satisfaction (6)
1	-0.0814622	0.5365504	0.0985784	0.5409273	0.7527741	-0.4697255
2	0.6858808	-0.9402643	0.0328064	0.4084471	0.2491969	0.7135061
3	-0.3834609	0.1471131	0.9185376	0.7116925	-1.5268199	-0.0011784
4	-0.5322291	-0.0774563	-0.0456706	-1.2919868	0.0412587	0.2352397
5	0.7057608	0.6063274	-1.7899701	-0.2035260	-1.2474089	-0.9637417

The next step of this analysis is verifying the cluster characteristics using the existing condition data got from the questionnaire (Table-5). This comparison indicates that the impact assessment variable and the cluster analysis's result are in line with the real condition. However, one point needs to be considered is this result shows the current condition just after the project finished.

Analysis of the cluster composition in figure-4 shows that actually the impact did not particularly divide the inhabitants into relocated and in-situ reconstruction settlements only, but among the same settlement type itself also can be differentiated into more specific cluster. Even though they involved in the same program, throughout the process, every respondent felt different impact. The negative impacts in the relocated settlements lead people to abandon their homes and go back to their previous village. In some specific case, the interview survey also found the inhabitant with a partially relocate. As the administrative status, they were moved to

Figure-4 Cluster Composition

and cluster 5. Some respondents already satisfied enough with their previous life condition, even without any improvement as long as they can build their house and they do not have any problem with live normally like their previous life. Meanwhile, some other respondents feel

the relocated settlement, however over the following two or three years, because of the difficulty with livelihoods and the limited natural resources, they choose to go back to their previous house to take care of the livestock and mine the sand from the eruption. In this situation, they will back to village again on weekend or when they want to take holiday.

The cluster differentiation does not only occur on the relocated settlement but also as for the in-situ reconstruction settlement generally divided into cluster 4

their new life is much better than before, they gained new experienced from the reconstruction process. The condition where the government excludes the entire infrastructure and facilities made them adapt to the situation by undertaking self-improvement and made the shortage became acceptable. This adaptation makes them felt much better and improved, also after a few years after the eruption, they stated the environment around the settlement is much better with all the minerals which makes the soil more fertile and provides abundant grass for livestock. However, this condition does not change the reality that it still does not lead to a state where they can avoid the risk of disaster in the future. Hence, it is rather difficult to judge as to which cluster is good or bad because each of it has different strength and weakness points.

Table-5 Cluster Characteristics Comparison

			Cluster				
			1	2	3	4	5
Average Score of Each Variable	Project Satisfaction	How long did the reconstruction process take? (months)	11,6	9,6	6,3	21,3	11,8
		How many percent of the compensation has been disbursed? (%)	100	94,3	100	95,6	86
		How much did the the community get for compensation of housing and associated assets? (million rupiah)	30	30	26,25	14,31	5,8
	Community Empowerment	How many households has running a home industry bussiness? (units)	1,84	1	2,13	1,88	1,8
		How many group exist in the community? (units)	3,53	3,21	3,25	2,88	3,2
	Community Participation	How many percent of the people in RT that actively participate in reconstruction process? (%)	91,8	90	78,8	92,5	100
	New Settlement Satisfaction	How many percent of the settlement area allocate for green space? (%)	14	18,4	20	28,1	40
		How far is the settlement to the river? (km)	1,6	0,9	0,9	0,9	1,3
		How big the average expandable area in each house? (m ²)	36,21	36	59,5	63,56	120
		How many time did "Dengue Fever" happen last year? (cases)	0,6	4,5	0,6	0,8	0,6
		How many time did "Typhoid" happen last year? (cases)	0,5	1	0	0,4	0
	Infrastructure Satisfaction	How far is the nearest place to get public transportation services? (km)	15,2	5,8	14,6	14,1	21
		How many percent of house already facilitated with clean water pipe? (%)	100	99,4	100	99,4	98,9
		How many percent of house already facilitated with septic tank or communal wastewater treatment plant? (%)	100	100	100	99,1	98
		How many percent of house already facilitated with sewerage system? (%)	100	100	86,9	63,8	39,5
		How many meters is the wide of the road in the settlement? (m)	4,1	3,6	3,5	3,4	3,7
	Public Facility Satisfaction	How far is the settlement to the market? (km)	4,9	1,6	3,8	6,3	6,4
		How far is the settlement to the nearest playground? (km)	0,7	0,1	0,6	0,4	6,1
		How far is the settlement to the nearest kindergarten? (km)	0,8	0,5	0,6	1	1,1
		How far is the settlement to the nearest elementary school? (km)	1,7	0,6	2	1,8	1,9
		How far is the settlement to the nearest <i>puskesmas</i> (health facility in neighborhood scale)? (km)	2,2	2,5	2,6	2,4	2,4
		How far is the settlement to the nearest governments office? (km)	4	3,5	4,6	10,6	15,2
		How far is the settlement to the nearest social and culture hall? (km)	1,8	1	1,9	4,7	5
		How far is the settlement to the nearest police office? (km)	3,7	3,5	4,4	10,1	17,2
※Cluster Name		Cluster 3 Improved Community with Lack of Infrastructure					
Cluster 1 Stable Community		Cluster 4 Normal Community with Lack of Empowerment					
Cluster 2 Good Community in The Underdeveloped Settlement		Cluster 5 Maladaptive Community in The Underdeveloped Settlement					

4.3 Cluster Interpretation

Cluster 1 Stable Community

The respondents classified in this cluster are satisfied with the condition of the new settlement after they moved into the relocated settlement. Most of the respondent from this cluster are economically good. There is no change in their jobs compared to before the eruption which are farmer, miner, and cattleman. The infrastructure variable from this cluster has a good score that can be seen in the existing condition where the road is already using a concrete material, and after almost five years, no problems have occurred about the infrastructure. Empowerment in the community has been maintained by the government and the local university through the training of new farming strategies and entrepreneurship. Meanwhile for the impact of the project and community participation, the inhabitants gave an average impression. Some problems also occurred like under budgeting for the house constructors which had responsibility for building

the house. The participation of people also decreases because of different opinions between neighbors and disputes between them. This condition makes this cluster have an outstanding satisfaction at the beginning of the project but has decreased gradually until now.

Cluster 2 Good Community in The Underdeveloped Settlement

This cluster has a good regression score in public facility and community participation. Relocating to the new settlement makes the distance to public facilities like schools and markets closer. The people felt the benefit of being closer to the market as an essential public facility together with the health and education facilities. In the participation aspect, "*gotong-royong*" culture, which is the conception of reciprocity or mutual aid, is really strong between each inhabitant. The full application of this principal helped to improve settlement quality from the previous condition when problems often occurred. In the early days, this cluster had a bad score for new settlement satisfaction because people still could not adapt to the narrow space which restricted them to expand their house. Moreover, the open style drainage sometimes created small accidents because the inhabitants were not used to that drainage type. Building a mutualistic situation between neighborhoods makes them overcome these problems and improve their quality of life.

Cluster 3 Improved Community with Lack of Infrastructure

The project process and community empowerment are the main positive impacts felt by the respondents in this cluster. At the beginning of the project, the biggest problem for these communities was the condition that they had to stay together in the same place when previously they originally came from different villages. Each community had a high ego that led to the condition making a mutual relationship hard to build. However, in 2014, they started to surpass those problem by independently making a local's organization called "*paguyuban*" as a place for everyone to build communication and discuss the improvement needed for their settlement such public spaces, clean water, power supply, and waste management. The early condition indicates a result of the principal component and cluster analysis having a bad score in infrastructure satisfaction, but in the next step of the in-depth interview, after several years the case study subjects admitted that they have been improving and getting better over time.

Cluster 4 Normal Community with Lack of Empowerment

The respondents included in this cluster tend to have normal life exactly just like before the disaster hit. The low score in the community participation and empowerment is caused by a demographic problem and a majority of elderly population. They felt satisfied enough with the previous condition and did not have any desire to make a vast improvement. Neither physical nor social condition shows an improvement or decline. Some of the inhabitants, due to the lack of funds to reconstruct their house were forced to use the only compensation money they received, which was supposed to be for livestock compensation, to restore their house. After several years, the existing condition shows the recovery of the environmental condition which leads to an improvement in providing livestock feed and creates a new job opportunity which is managing the destroyed area for heritage tourism. This situation presents an opportunity for them to recover their economic condition.

Cluster 5 Maladaptive Community in The Underdeveloped Settlement

The entire respondents of this cluster are the inhabitants who insist on staying in their previous house. The further understanding of the cluster's name, maladaptive, based on Soemarwoto¹³⁾ defined as the condition when the people show the adaptation of the behavior of society to the problems that exist. Instead of solving the problem, the maladaptive tend to get used to the problem and live in harmony with the disaster. The reason for the rejection is because it is their culture to live in the place where they were born, and retain the land that they inherited from their ancestor. The government did not support the community's decision and decided not to offer any compensation. They live in a significant distance from the market, school, and hospital. Moreover, the government also cut the power and clean water supply. This decision made the inhabitants present a negative impact on the project, infrastructure, and public facility

satisfaction variable. Meanwhile, as the result of defending their desire to stay in their previous house makes them satisfied with the new settlement condition, and also the condition where they have to build everything by themselves raised participation from all the inhabitants. They even created their own mitigation system, and then using NGO help they learnt how to be an entrepreneur and maximize the natural resources around them.

5. Discussion

5.1 Cluster Distribution

Further analysis applied to figure out the correlation of the location factor with the cluster distribution. Based on the cluster domination, the settlements arrange themselves into three groups, dominated by cluster 1, dominated by cluster 2, and dominated by cluster 4 and 5 (Figure-5). This naming process was made based on the cluster domination, which means there is still other cluster existence but only as the minor member.

The area dominated by cluster 1 is located on the west side of the Cangkringan subdistrict. The inhabitants of those villages came from the adjacent area before being relocated to the existing settlement. They suffered the biggest loss from the disaster, and their settlements were completely destroyed by the eruption and lava flood. Facing a condition where they did not have any choice as to where they live as well as being traumatized by the disaster, made them accept the relocation project with pleasure. This condition is a much better option than being homeless. The government assured their safety and future life by providing settlements, jobs, and mitigation solution. The relocation and reconstruction project had a positive impact on their community and life, with which result clustered them in cluster one.

Figure-5 The Map of Cluster Distributions

Relocated settlements Banjarsari and Jetisumur are grouped in the area which is dominated by cluster 2. This cluster has good points in community participation and public facilities. Located close to the main street to access the school, the hospital and the evacuation center

made these villages score well in the public facility aspect. These locations also made distances to public facilities such as the market, school or government office closer.

The rest of the relocated settlements are grouped together with the in-situ reconstruction settlement in area dominated by cluster 4 and 5. Located still near the prone area and a little bit kept away from the main from presumed became the reason of this arrangement. These reason made the inhabitant feels everything just recover as before, rather than being improved. Moreover, the demographical condition from this cluster dominated by elderly, and as the reconstruction judgment they decided to follow the decision of a younger family member. Some of them returned to the previous house and the rest moved separately to the relocated settlements depending on where they were evacuated to after the disaster. With a quite large composition of elderly people, they are not demanding much of any new initiatives, as long they can live as they had before.

The interpretation from this section is location and the accessibility to the public facility became the main reason of this distribution pattern. The distance from the settlement to some key location such as a public facility, workplace, even to the prone disaster area made a domination of a certain cluster. This factor is classified as the external factor which means the inhabitant actually does not have direct authority to adjust it.

5.2 Settlements Characteristic

Physically, the big difference between the settlements site map in the relocated and in-situ reconstruction settlements is about how the houses are spread. In the relocated settlement, the site accurately follows the block layout pattern, which is divided by firm lined road. Meanwhile, in the in-situ reconstruction settlements, the houses are dispersed and connected by a narrow local road. Aside from being differentiated directly into relocated and in-situ reconstruction, in one settlement, the neighborhood can be differentiated into more clusters. To understand the further reasons behind the cluster dispersion, this research took one sitemap sample from each of the relocated and in-situ reconstruction settlements. Referring to the cluster distribution map, the site map sample was taken from the settlement which has most cluster types in it. In figure-6 and figure-7, the Pagerjurang settlement represents a relocated settlement which has four cluster varieties, and Kalitengah Lor represents an in-situ reconstruction settlement with two cluster types.

In Pagerjurang, more than 50% neighborhood classified in cluster one. Even after receiving an identical house and compensation, different neighborhood giving a different response about how the project impacts their life. Three of the 11 neighborhood in Pagerjurang classified to cluster three which has problems with infrastructure aspects. A condition where their house often suffered a power outage is a reason behind their bad score. However, unlike the electricity infrastructure, the clean water supply serves the settlement without any problem. Another neighborhood in this settlement also classified in clusters two that had an issue in new settlement satisfaction. For a big family with many members, the 100 m² of land provided by the government was insufficient. Furthermore, small houses with a very small gap between them also created a social problem among the inhabitants and made illness easily spread. Another problem stated about the communal cattle pen which can only accommodate one cow for each family. People found it difficult to expand their cattle pen because they do not have enough money to buy additional land after they suffer from the disaster. This condition makes some of them decide to go back to their initial house which has a larger area. The rest neighborhood in this village is categorized as cluster four. Being separated with the other families from the previous neighborhood, made these respondents felt neutral about the reconstruction process without any meaningful improvement. To join community activities, these inhabitants have to go to their previous village. Unlike the other houses in the previous village, their houses are the only houses damaged by the disaster and located in the prone disaster area. The government decides to move them partially to a safer area which is in this relocated settlement.

In the in-situ reconstruction settlements, Kalitengah Lor villages consist of four neighborhoods, one of them is cluster five, and the rest are in cluster four. Instead of being in the

same cluster with the others, the one located on the south part of village has better satisfaction in their new settlements. Located next to another district from another province makes them get access to buy electricity supply from the other region private company, when the Sleman district decide to cut the supply for them as a disincentive. This condition makes them more actively improve their area and triggers them do something more in order to survive.

The explanation shows even government has an authority to provide the inhabitants need, soon or later it will stop in the certain level. In other words, from that step the inhabitants must grow by themselves. This factor come from the internal of the community which means the more they proactively contribute on the settlement development the more they will satisfied with it.

Figure-6 Site Map of Pagerjurang Settlement

Figure-7 Site Map of Kalitengah Lor Settlement

5.3 Reconstruction Process

As explained in the cluster characteristics, the result of principal component and cluster analysis was based on the satisfaction level of inhabitants just after the project finished. Whereas, to get an understanding of the whole situation, all steps in the reconstruction process need to be valued before the eruption until the present. In order to observe the detailed history, a case study conducted to each cluster representatives. Figure-8 shows the life satisfaction for each case study by time and activity that occurred since before the eruption up until the present. Life satisfaction was scaled from 0 as the lowest to 100 as the highest state. The respondents were asked to illustrate the fluctuation of their life satisfaction into that scale. For each dynamic movement, the respondents were also requested to enclose the reasons behind it.

The interview result shows that each cluster gives a different valuation as to how each step affected their satisfaction in life. Generally, the inhabitant satisfaction was on 90 before and dropped to around 10-20 after the eruption occurred. The score gradually increased after they moved to the evacuation center and kept going up after they had a stable condition in the temporary shelter. Among the five clusters, cluster four seems to have found a difficulty living in the temporary shelters. Based on previous research, because there was no specific standard used for building the shelters, each shelter was of different quality. The result also showed that only 87 % of the reference of the UNHCR standard was actually applied as a reference to the implementation process of building temporary shelters 2010, particularly in the area of the government program¹⁴⁾. This condition made some inhabitants dissatisfied with living in the temporary shelter with their living conditions.

Figure-8 Inhabitants Post Disaster Life Satisfaction

When the compensation was disbursed, the relocated settlement inhabitant's satisfaction increased. Meanwhile, for the in-situ reconstruction settlement, it was decreased because they did not receive any compensation except for their livestock. After several months planning and preparing, the housing reconstruction started at the end of 2011. At the same time when other clusters satisfaction increased, cluster one and two decreased. In the reconstruction process, they were assisted by the constructor to build the house and all facilities. However, for large-scale settlements, the provided budget was insufficient, and reconstruction delayed during a certain period. This condition left the case study respondent unsatisfied with the reconstruction process. In the end, this problem was solved by the inhabitants themselves by seeking an alternative construction company. The reconstruction process was continued until basic building was finished and the finishing was completed by each house's owner.

Cluster one and cluster five, reach the highest score when the reconstruction was completed and when they moved to their new settlement, but for different reasons. Cluster one was really satisfied with their new house and all the facilities which they had planned by themselves and implemented in partnership with the government. Meanwhile, cluster five was really pleased because they were able to go back to their previous house. In other cases, clusters two and three undertook a beautification of their settlement which affected the enhancement of their satisfaction of life.

After two years of adaptation and living in the new settlement, all clusters started being stable until the present existing condition. Between those periods, the satisfaction from cluster one dropped to 50 and did not increase until recently. This problem was caused by the inhabitant's social-economic situation. Just as was mentioned before, inadequate house space and a difficulty to expand cattle pens made the inhabitants return to their previous homes. This problem majorly occurred in the Pagerjurang and Karangkendal settlements. At the same time, cluster three, which consists of Banjarsari and Jetisumur settlements, also had a problem in constructing harmony between new neighborhoods until in the middle of 2013 when they initiated to create "*Paguyuban*" and increased their score sharply.

Through explanation from this section, the relocation impact stated by the respondent now is not a static result. It was the derivation of the long process since the evacuation started until they moved to the existing permanent settlement. Hence, as the time by the community grows and how the stakeholder reacts to the existing problem, those actions will determine on which direction the settlement going to develop in future.

6. Conclusion

The impact of the relocation can be asserted into six variables, which are community participation, new settlement satisfaction, project satisfaction, community empowerment, infrastructure satisfaction, and public facility satisfaction. After looking into the detail of these variables, the impacts cannot be clearly split between relocated and in-situ reconstruction. In this respect, the inhabitants are classified into five clusters. Based on the case study, there is no completely perfect cluster model for inhabitants because each cluster has different strength points and problems.

The major problems occurred in the settlements after the Merapi eruption generally specified into two types, external problem such as location aspect, public facility accessibility, demography structure, and the internal problems from the bonds between neighbors, and the inhabitants' participation to the development process.

Regarding to the current condition, as the time by the community will grow naturally and affect the satisfaction level itself as to whether it will have improved or become worse. Upgrading the in-situ reconstruction settlement is rather hard to achieve because the problems of that settlement are the outcome of the government's disincentive regulations. Meanwhile, on the subject of the improving the relocation program, understanding on each area problem and making different improvement program, considered able to make the program more precisely solve the existing dilemma.

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