



## A POST-DISASTER FORECAST ANALYSIS FOR RELOCATION SETTLEMENTS USING A COMBINED MODEL SEQUENCE

M. Garcia-Fry<sup>(1)</sup>, O. Murao<sup>(2)</sup>

<sup>(1)</sup> Master Student, Dept. of Architecture and Building Science, Tohoku University, [garcia.fry.martin.p2@dc.tohoku.ac.jp](mailto:garcia.fry.martin.p2@dc.tohoku.ac.jp)

<sup>(2)</sup> Professor, International Research Institute of Disaster Science, Tohoku University, [murao@irides.tohoku.ac.jp](mailto:murao@irides.tohoku.ac.jp)

### Abstract

This study enhances post disaster livelihood recovery by using psychographic segmentation to integrate human behaviour with business leadership to outgrow previous economic state and promote competition among neighborhood clusters. A comparative approach is used to simulate business outcomes from a calculated cluster, random cluster and Election Based Candidates from each cluster as the experimental bedrock for administrative outcome testing. With the aim of neighborhood conformation for spatio-temporal forecasting data and integral urban development planning this paper becomes the initial and foremost important step to begin a synergical model sequence that enables the possibility of retrofitting networks and addressing the overall functionality of urbanized settlements. Synergy has already been found between one model's output and the next model's input which naturally convene into a transitional guide to for urban designers. The ultimate goal is to contribute with a system based on efficiency and translate into a self-sufficient living society.

In this opportunity, a displaced population census survey is carried out after the 2010 Merapi Volcano eruption in Pagerjurang settlement, Sleman District, Yogyakarta, Indonesia to test and compare livelihood results to the actual development in September 2019. The method uses scaled data provided by the survey to form two household clusters whose businesses compete and simulate scenario outcomes. In both cases, efficiency of the administrative system is targeted to measure its functionality on a short and long range time scale since this is a common human weakness found in developing countries. By analyzing income rates, the possibility of quantitative results become feasible. Firstly, annual simulation is carried out between each segmentation group for comparative analysis. Consequently, a local business is chosen to perform a four year administrative simulation of each cluster and each segment group after a thorough risk taking behavior analysis. Findings suggest that either a group business can be administered by a voted single leadership ie. an elected candidate or a cyclical leadership ie. a rotation of segment leaders. According to the results obtained, one segment was capable of matching the cyclical outcome strategy. This group is considered high risk and represents a minority of the population. Therefore, the strategy in question becomes an attractive option to recover from and outgrow economic expectations after disaster, specially on a long term basis.

*Keywords: Recovery; Resilience; Safety; Social Planning; Livelihood; Yogyakarta; The 2010 Merapi Volcano Eruption*

## 1. Introduction

### 1.1 Background

Natural disasters have been increasing periodically and intensifying the threat of vulnerabilities in hazard prone areas resulting in tremendous tolls on humanity and infrastructure. The Internal Displacement Monitoring Centre (IDMC) has estimated that between 2008 and 2014, an annual average of at least 22.5 million people were displaced by the direct threat or impacts of floods, landslides, storms, wildfires and extreme temperatures on their safety, homes and livelihoods<sup>1</sup>. For example, in 2014, the ten largest events, all of which were related to either storms or floods in Asia, each displaced around 500,000 to 3 million in the Philippines, India, Pakistan, China, Japan and Bangladesh [1]. A direct consequence of displacement is resettlement, which begun discussions in the era of agricultural economy. There are at least six major factors

<sup>1</sup> These statistics capture displacement as a direct effect of hazard events (rather than gradual processes) in 173 countries and draw on a wide range of sources: mostly governments or official authorities, as well as UN and international organizations, NGO's and media reports. <https://public.wmo.int/en/resources/bulletin/disaster-related-displacement-changing-climate>



influencing the occurrence of resettlement according to Shi (2008): Political and religious, economic benefit, eco-environmental, engineering construction, warfare and natural disasters [2]. To rebuild communities in a new location, it takes quite a long time. This is sometimes not in accordance with expectations of people who want to get back to their previous state. However, Nolan (1979) in Dibben and Chester (1999) revealed that this kind of relocation can be successfully implemented if the population is included in the process [3]. In a social planning agenda, deemed as the first step taken in the urban planning activity for post disaster relocation and reconstruction scenarios, the question is raised; Can lifestyle, segmentation-based neighborhood clusters improve livelihood recovery rates after the 2010 Merapi Volcano eruption in Yogyakarta, Sleman District?

Following the 2010 Mount Merapi Volcano Eruption in Sleman District, Yogyakarta, Indonesia, REKOMPAK a community driven disaster reconstruction and resettlement program took over. This approach was first piloted in Banda Aceh following the 2004 Indian Ocean tsunami. On this occasion, after a request was made by the national government of Indonesia, the World Bank acted as a trustee to manage a Multi Donor Fund (MDF) which pooled together a total of \$654.5 million received from 15 country donors. These under one management provided a suitable solution for beneficiaries by putting aside individual interest. By 2006, a 5.7 M earthquake struck the island of Java and four years later in 2010 Mt. Merapi volcano erupted evacuating over 345,000 people temporarily from danger zones (areas within 20km from Mt. Merapi) [4]. REKOMPAK still had activities and facilitators on the ground in the affected area, so it was possible to mobilize a quick response and scale up support through the program mechanism. Given this ability, the Java Reconstruction Fund (JRF) was able to provide the first significant allocation for Merapi while other support was being organized [5]. By the end of 2013, the program had resulted in the construction of 2,608 houses in the affected areas with more than 75% occurring in Sleman Regency and with a majority of houses built in 15 housing resettlement sites (*huntaps*) in the 5 villages that make up the sub-district of Cangkringan [6]. The largest settlement is Pagerjurang with residents coming from five sub-villages which became object of investigation for the purpose of this study (Fig.1).

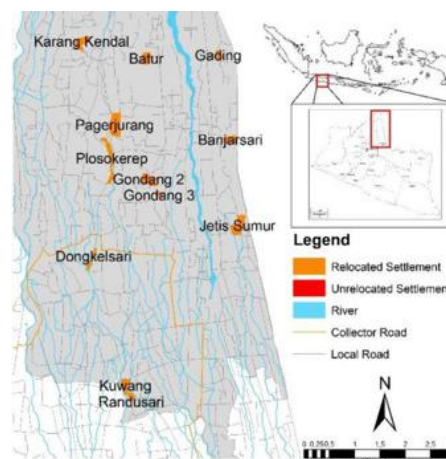


Fig. 1 - Resettlement Villages in Cangkringan Sub-District [7]

## 1.2 Case Study

On September 2019, a survey questionnaire was conducted on this settlement where 42 residents provided with necessary data to understand the aftermath scenario. The focus was based on census and segmentation data combined with activity based schedules and housing preferences within different neighborhoods. Questions gather information for household identification, future research on housing demand, population growth assessments, transportation studies and lifestyle segmentation aforementioned to analyze the possibilities implied in livelihood recovery.

Each resettlement village is subdivided into RT's, (abbreviation of *Rukun Tetangga*) defined as the neighborhood system in Indonesia which usually consists of 20-40 households for each RT. These represent



the local cluster system by which families are organized commonly increasing due to family extension and/or address change in time. On this case, Pagerjurang is composed of families that suffered the biggest loss due to their positioning near the volcano. Facing the fact of loss and psychological damage, they accepted the relocation project as opposed to the 756 households that decided to stay in their previous locations. This semi-urban settlement consists of 66,000sqm and 301 households. At first, household satisfaction begun high when people received a grant for housing, but in the long term, livelihood stagnated and reduced housing satisfaction by 50% [7]. According to the visit, each family has limited space within their home and livestock farmers own space for a single cow. Dairy farming is the main economic activity and is deemed as insufficient if families can't expand their cattle pens due to high value land prices.

Residents of this community represent what Aldrich, D.P. (2012) explains as “People in need of resources go to formal service providers, such as government welfare agencies, only as a last resort. Instead, many people prefer to use their friends, family and network connections for support during crisis” [8]. Provided that livelihood has not progressed on the long term basis as expected, this settlement fits the profile needed for this investigation.

### 1.3 Community Based Recovery

The REKOMPAK program introduces a community based planning strategy to enhance long and short term resiliency including but not limited to: psychological, economic, identity and cultural recognition. According to Erda. (2018), residents testified that the role of bonding helped to build social resilience. They also said that help from neighbors strengthened relationships between communities which increased a sense of dependence, especially when community members realized they could not live alone. “Our ancestors teach us to be kind to others, especially our neighbour, because our neighbour is our close family although we have no blood relation” [9]. To acquire such resilience, participation-based empowerment is a method that works at the community level with success dependant on: “(i) the availability of a sufficient number of skilled workers, (ii) the availability of appropriate building materials, and (iii) the motivation and capacity of communities to work together” [10]. These not only improve infrastructure planning but also help to secure the long term sustainability of community-based planning.

In order to secure possible loss of livelihoods in relocation scenarios, a joint effort is considered imperative between the community and local governments to provide with mapping, planning, technical assistance and a loan disbursement program for users considered as “non-bankable”. Technical assistance such as the GIZ Livelihood project and IOM’s activities after the 2007 Java Earthquake helped to resume and exceed user’s former businesses and incomes. More than 40% of the beneficiaries were women who stated that “before the project started, we had no idea all the things we could do with cassava, says Ibu Minten, one of the women in the group. We fed it to the animals, or used it as simple meal for ourselves”. The project started with the focus on developing snack products. Now, “they produce cassava leaf crackers, tempe soya bean crackers, peanuts in cassava batter” and other products. They also stated that “combined with their husband’s organic farming income, also supported by GIZ, their family incomes have increased by 20%”. Empowerment from economy of scales has surfaced emergent markets, business women, tourism based on recovery from disaster events, skills in anti seismic construction, and “good financial outcome which is partly attributed to fuller use of funds with less contractual and procurement-related issues than implementing large reconstruction projects through contractors” [11].

### 1.4 Smallholder Dairy Farm Business

After the 2010 eruption, most farmers did not change nor considered changing their source of income (91%). Actually, they waited until re-cultivation of salak (a species of palm trees) was possible while working in temporary job conditions and receiving government aid. The volcanic ashfall acted as a natural fertilizer after some time. The Soil Research Institute Laboratory found that soil nutrients such as calcium, potassium and iron were found after the eruption [12]. “Studies on dairy farming indicate that livestock can provide additional income and employment to households, especially in developing countries” [13]. More than 50%



of the surveyed residents lack formal education and national demand of dairy farming makes it viable for research purposes.

In order to help and support dairy farmers after Merapi disaster, GAPOKTAN Merapi Mandiri union was established as the first dairy farmer's group reinforced by the government. Merapi Mandiri became a source of farm rehabilitation and reconstruction. The local government agency of BNPB (National Agency for Disaster Management) was disbursing funds through local administration offices to the farmers to replace their livestock and purchase about 4,000 dairy cattle. "The population of dairy cows in 2000 was 4,069. Of these, 3,744 cows (92%) were located in the district of Merapi Valley area and produces 92.02% of total milk production of cows in DIY Province (DIY Provincial Livestock Office, 2009)" [14]. On the other hand, "small holder producers in the dairy industry is very significant. They produced about 90% of the total fresh milk production in the country but current local milk production contributed only 22% of the total milk supply, which justifies that Indonesia has to import the rest of 78% to fulfill the demand equal to 178.8 thousand tons of milk and milk products equivalent to USD 604 million in 2012 (DGLAHS 2013)" [15].

#### 1.4.1 Management Inefficiencies

The main four components that are crucial to enlarge revenue profits associated with managerial and technical aspects are herd profile, milk quality, good management and cow's reproduction rate. Reproduction having the highest effect on net income thus affected by land value and availability [16]. In Cangkringan district, the problems rely on low-performing lactation cows due to wasted resources (water and grass) and dry season low feed quality. Eco-efficiency scoring could decrease the wasted water and grass feeding to increase productivity. By reusing and recycling water supplies, using wet season's remaining grass for compost and harvesting grass feed on bought land instead of leased, inefficiency of the overall industry could be decreased by 30% [17]. Also, using byproducts is a common practice in Indonesia. Industrial concentrates are expensive and their material price is volatile. "Concentrates can represent up to 50-60% of milk production costs so its very expensive. We try to reduce the costs by using byproducts, reaching the lower costs but keeping good nutritional value" [18].

#### 1.4.2 Land Value Market

The land market in Indonesia is characterized by the dominance of informal markets for supplying lands, the gap between definitive land use plans and development master plans since they are a duplication of Western concepts and the increasing value of land as a result of high cost administrative processes (Sivam, 2002). Information about land market could be traced everywhere, either through regional newspapers or property trading websites; Kedaulatan Rakyat, Harian Jogja, Tribun Jogja, urbanindo.com and rumah123.com [19].

## 2. Methodology

### 2.1 Survey Questionnaire

Age, sex, occupation, marital status, household members, mobility profile, activity-based schedule, housing preferences and Rolando Arellano's *Lifestyle* questionnaire coupled with a household mapping survey is used to catalogue a sample of Pagerjurang's settlement population. Arellano's Lifestyles questionnaire is used to redefine each segmentation's behavioral attributes composed from studies in various developing countries of Latin America. This investigation relies on a questionnaire as the basis for data collection, therefore accuracy as a reliable instrument can be challenged especially when dealing with social sciences. According to (Hall, 1992) in defining urban planning, "most of the processes which need controlling are human processes, which are less well understood and work with much less certainty than laws in the physical sciences" [20]. In accordance with this statement, it was necessary to ensure that all measurements were collected accurately, therefore the internal validity could be based upon the careful use of theoretical foundation which guarantees its validity. (DeSilva and Yamao, 2007) referred to social clustering and organized shared risks as, "high levels of social capital facilitate the entrepreneurial ventures among farmers. The higher levels of trust and coordination among well integrated communities provided them with





opportunities for risk-taking and entrepreneurial ventures which could, over the long term, secure their livelihoods and increase their income” [21]. The study focuses its scientific approach on risk-taking behavior data from clustered human segmentation and independent human segmentation groups by comparing a simulated income administration for the duration of four years in a dairy farm business near Pagerjulang, Cangkringan sub-district in Merapi Valley.

With the help of local researcher and faculty member Dr. Syamsul Bachri the sample survey was conducted over the course of three days reaching a maximum amount of 42 Javanese speaking correspondents. Translation, explanations and a thorough visual assessment also took place allowing further understanding of the present situation. Soon after the information was processed, a sample data set was drafted.

## 2.2 Clustering Population Data

Firstly, in order to select sufficient households for two neighborhood clusters, a synthetic population is calculated proportionally to the 42 interviewed subjects. “Since this population only exists artificially in files on the computer, it is called synthetic. It is statistically equivalent to the real population of the study area” [22]. A 500 resident data set became available after scaling our data sample for the clustering process. Grouping is a common practice when planning socially committed households willing to acknowledge common needs and meet each others as the basis of sustainability. According to R. Chapin, “pocket neighborhoods, by our definition, are clusters of nearby neighbors around a shared commons of some sort” and “that most (but not all) co-housing communities are configured with a series of pocket neighborhood-like clusters. The larger community is an aggregate of smaller subgroups” [23]. Therefore, it would make sense to cluster groups of people that share common values and attributes. Also, “Mccamant and Durret (1994) recommend that one neighborhood of 20-25 households is the best way to create a sense of community and make decision-making manageable” [24]. In accordance with this information and considering the size of RT’s in Indonesia, clusters were defined by size and shared values. The following steps are taken to form such clusters from our synthetic population data set using three important parameters.

### 2.2.1 Adults per Cluster and Household Type Parameter

Each cluster is formed by 26 households and 50 subjects subdivided into three household types: 1-Adult, 2-Adult and 3 (or more) Adults. The amount of each household type is identified using a proportional calculation. In this case, households of one adult namely singles, households of two adults namely doubles and households of three or more adults namely triples were identified with 38%, 31%, and 31% respectively in our sample data. This proportion for a 26 household cluster is resumed to 10 Singles, 8 doubles and 8 triples resulting in 50 adults in total per cluster.

### 2.2.2 Segmentation Weight Parameter

Once the household proportion of adults is assigned, each segment group is represented by a proportional percentage available from the survey and used to calculate the corresponding weights of a cluster. The following Table 1 demonstrates how each percentage is used as a proportional ratio for cluster formation.

Table 1 - Sample Data Segment Extrapolation

Segment Acronym	Progressist	Modern	Austere	Conservative	Formalist	Total Persons
Survey Sample (%)	36%	31%	19%	2%	12%	42
Clusters	18	15	10	1	6	50

On the following Table 2, the attributes that catalogue each of the segmentation lifestyles are observed (LATIR Latin American lifestyles based on attitudes, social trends, interests and resources) [25]. Lifestyle segmentation are categories found within markets as a function of real statistical data from demographic, socioeconomic, psychological and diverse product use sources [26]. It is also important to state that social behaviour is constantly changing thanks to the ever progressive state of the human mind and therefore constant research and perpetual data renovations are deemed necessary [27].



Table 2 – Lifestyles LATIR found in Pagerjurang Settlement

Progressists (36%)	Moderns (31%)	Austers (19%)	Conservatives (1%)	Formalists (12%)
People in search of permanent progress. Always looking for opportunities trying to reverse their position. Tend to be practical and modern, studying short careers to start labour and produce. Savings are important, seek promotions. Trace ambitious goals and like to take risks. Relate success to time and effort.	Women that work or study and seek personal realization as mothers. Seek acknowledgement from society and care about looks. Display of self confidence, provide with hard work. Search for quality and brands. Money is important and take measured risks. Defined by economic independence, true love and family.	Low resource people, low skilled workers. Dont like changes and dont take risks. Take many sacrifices and feel excluded from society. Feel distant from city living, prefer to live in rural areas. Perceive "new" as risky and fail to educate themselves. Money is important and try to buy inexpensively, where brands dont matter. Religious, seek stable incomes and large families for work.	Women that seek family wellbeing. Religious and traditional, feel responsible for home related issues. Prefer stability, dont take risks and seek peace. Conserve the status and moral entity of their family. Housewives, worried about decoration and do not care about clothe as much. Usually Uneducated and cherish savings to provide with enough food.	Family oriented men, passive and unambitious. Take social status seriously and dont like changes. Cherish savings and education. Take time from work for socializing. Prefer stability of income rather than self employment. Choose secure outcomes, low risk.

To fulfill the second parameter, each person answers Arellano's Lifestyle survey questionnaire which was conducted directly on site and answers were inserted into the online questionnaire which provides with the algorithm to designate each segment. With a previously identified household type proportion and a wide array of lifestyles available, the cluster's psychographic behaviors are "exhibited in the consumers' buying and consumption behavior, as a specific lifestyle includes specific needs and desires which influence a consumer's buying decisions. Furthermore, the economic level at which people live is also a part of their lifestyle" [28]. As a neighborhood recovery support,"the current trend-driven amongst others by the advances in 'big data' technology- is to move towards using segmentation as a way to characterize individual households to enable more 'tailor made' customer interactions" [29], entrepreneurship is considered.

### 2.2.3 Compatible Occupation Profiles Parameter

The purpose of clustering households within similar occupational profiles relies on the fact that people transfer to their daily routine activities affecting the transportation and land use system. According to (Shan, 2013) "the choices on residential/job/school location, and mobility and activity in the long term are often intertwined together, and are fundamentally influenced by the values and attitudes of the household as a whole. We argue that when considering households' long term decision making process, we should treat household location, mobility and activity profile choices as a package, whose components would be simultaneously influenced by household values, or lifestyles" [30]. Therefore, in the attempt to satisfy a future activity-based mobility system, each adult from the data set is assigned with a land use acronym that represents their occupational profile. Land uses within the conducted survey are: Small Industry (SI), Tourism (T), Education (E), Services (Se) and Commerce (C). Each household with more than one adult is assigned with a combined occupational acronym. These land use acronyms are further arranged to form compatible "States" as shown in Fig. 2, where 4 highlighted states compose the diagram. The number of possibilities is a function of the number of occupants (per household) and the number of job acronyms. Land use compatible states are organized by determining their proximity to a desired polar growth node within the urban fabric. Each cluster is formed with households belonging to a same state so that the future location of such cluster efficiently diminishes energy consumption, vehicle displacement and unnecessary trips.

E+T	T+T	T+T	T+T	T+SI
E+E	C+T	T+C	C+SI	SI+SI
E+E	E+C	C+C	C+SI	SI+SI
E+E	E+C	C+SE	C+SE	SI+SI
E+SE	SE+SE	SE+SE	SE+SE	SI+SE

Fig. 2 - Compatibility "Commerce" Land Use Chart

For brevity, commerce is chosen to represent a polar growth node. Acronym combinations represent double adult households only, nevertheless these are used to specifically define which land use combinations can be found close to a commercial polar node and consequently, organizing distances are also obtained. For example, from C+C at the center of the diagram denominated as the pole, its immediate sides are filled with a combination of each of the land uses found in the sample data. Subsequently, the corners of C+C are filled



with a repetition of its neighboring result in a clockwise shift. Finally, the outer rim is filled by securing the extreme sides of the cross (E+E, SE+SE, SI+SI and T+T). Each of their farther sides repeat the same combination and lastly the farthest corners become a combination of its two consecutive sides. This process is repeated for all the polar growth node diagrams. Since each state is represented by one of the 4-square corners on each diagram, State 4 for commerce is defined by the resulting possibilities of land use acronyms SE, SI and C as shown in Fig. 3.

States	Sub State	Occupatio	HH_type
S4	4-1	C+SI	19
	4-2	SI+SI	20
	4-3	C+Se	29
	4-4	Se+Se	28
	4-5	C+C	4
	4-6	C	5
	4-7	SI	21
	4-8	Se	30
	4-9	C+SI+C	22
	4-10	SI+SI+C	26
	4-11	C+Se+SI	37
	4-12	Se+Se+Se	32
	4-13	C+C+C	12
	4-14	C+SI+SI	26
	4-15	SI+SI+SI	23
	4-16	C+Se+Se	35
	4-17	Se+Se+SI	38
	4-18	C+C+Se	33
	4-19	SI+SI+Se	39

N	State	State Codes
1	S4	20,21,5,23,52,53,54,16
2	S7	20,21,6,23,52,53,54,16
3	S9	20,21,5,23,52,53,54
4	S13	53,20,21,5,6,23,52,54,16
5	S14	53,20,6,21,23,52,54,16
6	S15	20,21,5,23,52,53,54
7	S18	6,21,52,53,54

Fig. 3 - State 4 Possibilities

A total of 20 states and 54 household combinations are available for clustering. Each combination is codified and highlighted if found within the data. Household combination number 52, 53, 54 and 16 are added to every selected state considering that those represent the most common households found in Pagerjurang settlement and contain segmentation needed to satisfy the second parameter. Seven are the resulting states with the higher amount of households found within the data set. It became evident that many interviewed residents had a similar occupation profile and household composition, therefore a same state code.

Finally, a clustering code is written to command the formation of a 26 household cluster with 10 single, 8 double and 8 triple-adult households totaling 50 residents that belong to a single occupational state and proportioned to the sample data segment output with progressist (18), modernist (15), austere (10), conservative (1), and formalist (6). Cluster data sets are subsequently drafted for a tactical administrative simulation.

## 2.3 Short Range Administrative Performance

### 2.3.1 Segmentation Behavioral Assessment

Based on the correspondent's answers to the segmentation Lifestyle's questions and a designated weight scale: 1 (No Risk) to 5 (High Risk), data is organized onto tables to secure and relate each lifestyle segmentation to a weight and devise its psychographic risk-taking behaviour. The following Table 3 and Fig. 4 illustrate this step.

Table 3 - Modernist Behavioral Pattern

	No Risk	Very Low Risk	Low Risk	Medium Risk	High Risk	
Weights (Never - Always)	1	2	3	4	5	Person
Seek Promotions	5	0	5	5	0	15
Fashion	2	0	8	4	1	15
Buy at low prices	0	0	0	13	2	15
Buy latest technologies	0	0	2	13	0	15
Total	7	0	15	35	3	60
Total	12.0%	0.0%	25.0%	58.0%	5.0%	100.0%

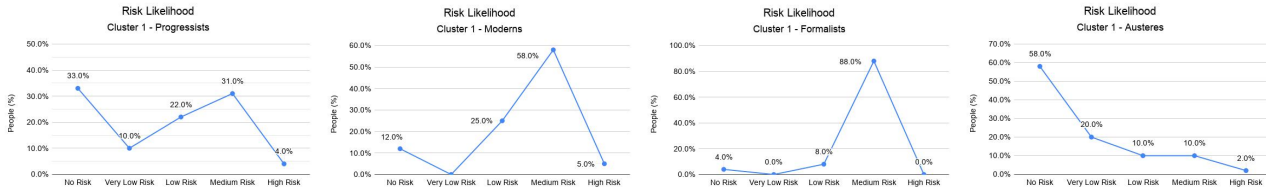


Fig. 4 - Behavioral Risk Likelihood Per Segmentation

2.3.2 Short Range Administrative Output

To capture a quantitative amount of risk-taking in a time scale, a year is subdivided in quarterly time frames. Five risk weights are used in total but “low risk” stands in the middle of the risk scale and therefore is not accounted for. From 0% to 100%, each risk weight adopts a percentage scale and a mean average of such scale: No Risk (0-25)% (Mean: 12.52) , Very Low Risk (26-50)% (Mean: 39.6), Medium Risk (51-75)% (Mean: 62.7), High Risk (76-100)% (Mean: 88). The mean average is multiplied with its corresponding likelihood percentage for each segment from the curves above, leading to weight factors that consider each segment’s risk taking behavior in a risk based scale. These are represented as investment behaviors in Fig. 5.

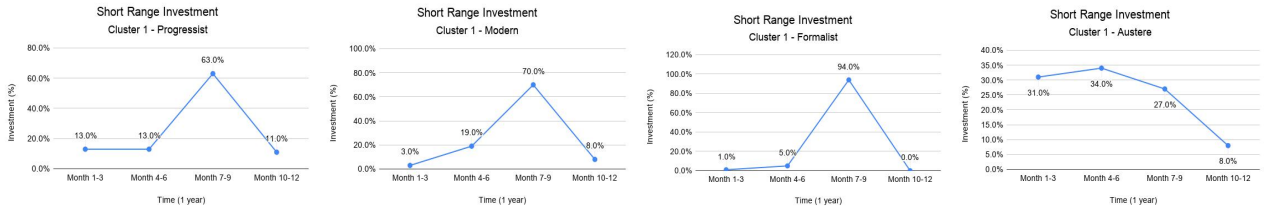


Fig. 5 - Annual Investment Output Per Segmentation

2.4 Long Range Business Simulation

Small holder dairy business is the selected enterprise known to most people in Pagerjurang. Four business strategies are chosen as investment possibilities measured by the amount of risk involved in the rate of returns; Savings (no risk), inefficiency reduction by 30% (Low Risk), breeding cows with a 56% rate of return (Medium Risk) and buying more land with a 78% rate of return after land value payment (High Risk). Even though results have showed that increasing the size of the herd does not necessarily mean a income increase if the technical performance is not managed correctly, according to (Sembada, P. Duteurtre, G. Purwant, 2016), one of the main challenges to increasing dairy farmers’ income in the future is the need to help them increase the number of milking cows on their farm (taking access to land into account)” and “in addition to promoting appropriate milk production models that include intensive cultivation of forage” [31]. Every cow is estimated to need a 66sqm space of forage cultivation, therefore the strategies are linked. Additionally, a financial simulation in Table 4 is performed for the first 5 years of a cluster assuming government cooperation with 33 cow heads for the first year in a 1 cow per farmer ratio and 2,200sqm of cultivation land.

Table 4 - Milk Production Business Simulation

Milk Production				Year 1		Year 5	
INCOME	Unit Price	Units	Amount	Units	Amount	Units	Amount
10 Liter of milk / day / cow	\$11.70	9 months / year	\$3,159.00	33 heads	\$104,247.00	166 heads	\$524,394.00
King Grass / Kg / 10 Ha	\$0.004	1,376,571 Kg	\$5,569.00	1,301,371 Kg	\$5,205.48	-	-
<b>Income total</b>			<b>\$8,728.00</b>		<b>\$109,452.48</b>		<b>\$524,394.00</b>
<b>EXPENSES (fixed)</b>				<b>33 Heads</b>		<b>166 Heads</b>	
Feed / year (55%)	\$856.47	1 head	\$856.47		\$28,263.51		\$142,096.00
Vet. Services (3.36%)	\$52.32	1 head	\$52.32		1726.56		\$8,685.12
water	0.014 / L	222L	\$3.11		102.63		\$516.26
Transportation (3.10%)	\$29.00	-	\$29.00		29	\$29.00	\$145.00
Fuel (1.44%)	\$13.55	-	\$13.55		13.55	\$13.55	\$67.75
<b>Subtotal</b>			<b>\$954.45</b>		<b>\$30,135.25</b>		<b>\$151,552.68</b>
<b>Income Subtotal</b>			<b>\$7,773.55</b>		<b>\$79,317.23</b>		<b>\$372,883.87</b>
Tax 10%			\$777.36		\$7,931.72		\$37,228.38
<b>Total Income</b>			<b>\$6,996.19</b>		<b>\$71,385.51</b>		<b>\$335,655.49</b>
<b>Local Dairy Production Business</b>				<b>Recovery Funds: 33 heads</b>		<b>Constant Growth Rate</b>	





2.4.1 Management Administrative Strategy

A cluster’s business long-term outcome can be forecasted by separating its management into two scenarios:

1. Election Based Candidates (EBC): One person or group of persons are voted to administer a cluster’s income.
2. Candidate’s Distribution Cycle (CDC): Each segmentation group leader takes turns administering a cluster’s income annually.

For a Calculated Cluster that fulfills all three parameters, EBC and CDC administrative simulations are conducted in Fig. 6 using each segment’s risk taking behaviors to determine how the income is invested into the business in a time lapse of 4 years. Also, the total of \$181,250 mark on year 5 (half of total income) for investment from the \$71,385 mark on year one (Table 4) is assumed to happen with collaboration of technical assistance from the IOM and GIZ organizations in Java.

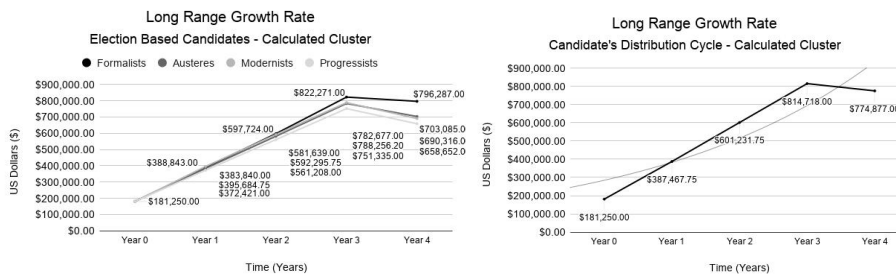


Fig. 6 - Calculated Cluster EBC & CDC Outcomes

A random cluster of households from within our synthetic population data is formed to compare administrative results in Fig. 7 with the aim of supporting our management hypothesis and to demonstrate that randomly formed clusters can have a leverage on EBC’s strategy due to lacking segment groups.

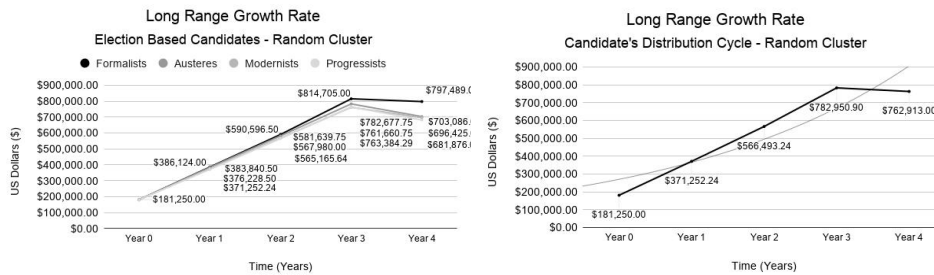


Fig. 7 - Random Cluster EBC & CDC Outcomes

3. Discussion

Two comparisons become the objective results in this study. First to validate the clustering technique by understanding that segment groups behave differently affecting their administered results and therefore having unequal incomes on a same period of time. Secondly, to understand a recovery rate within each group and to combine it by implementing a cyclical leadership which leads to a balanced risk raking affair which may increase their income faster on the long term basis.

Under Election Based Candidates, a single segmentation group has a repetitive effect on investment output per year; while some segment groups are investing more on breeding cows and land as the higher risk takers, others invest in inefficiency reduction and savings avoiding the possibility of losing their investment. These classifications are differentiated by their rate growth curve, specifically austeres, progressists and modernists tend to secure their choices based on safety as opposed to formalists who are straight forward risk takers. The following Table 5 allows to see the outcome differences between them.



Table 5 - EBC Comparative Analysis

Calculated Cluster	Year 0	Year 1	Year 2	Year 3	Year 4	Random Cluster	Year 0	Year 1	Year 2	Year 3	Year 4
Formalists	\$181,250.00	\$388,843.00	\$597,724.00	\$822,271.00	\$796,287.00	Formalists	\$181,250.00	\$386,124	\$590,597	\$814,705	\$797,489
Austeres	\$181,250.00	\$383,840.00	\$581,639.00	\$782,677.00	\$703,085.00	Austeres	\$181,250.00	\$383,841	\$581,640	\$782,678	\$703,086
Modernists	\$181,250.00	\$395,684.75	\$592,295.75	\$788,256.20	\$690,316.00	Modernists	\$181,250.00	\$376,229	\$567,980	\$761,661	\$696,425
Progressists	\$181,250.00	\$372,421.00	\$561,208.00	\$751,335.00	\$658,652.00	Progressists	\$181,250.00	\$371,252	\$565,166	\$763,384	\$681,876

From the resulting final incomes, the same outcome order is evidence of segmentation behavior having actual effect on their business. In both clusters, Austeres, modernists and progressists have a proportionate growth that represents stability. Formalists have a higher growth rate helping them to buy land without having a large toll on their final output. Formalists represent a small percentage of the cluster having 6 representatives for a calculated cluster and 7 for random. A second comparison is presented in Table 6 to compare results from the Candidate's Distribution Cycle strategy.

Table 6 - CDC &amp; Formalists Comparative Analysis

Time Scale	Calculated		Random	
	CDC	EBS: Formalists	CDC	EBS: Formalists
Year 0	\$181,250.00	\$181,250.00	\$181,250.00	\$181,250.00
Year 1	\$387,467.75	\$388,843.00	\$371,252.24	\$386,124.00
Year 2	\$601,231.75	\$597,724.00	\$566,493.24	\$590,596.50
Year 3	\$814,718.00	\$822,271.00	\$782,950.90	\$814,705.00
Year 4	\$774,877.00	\$796,287.00	\$762,913.00	\$797,489.00

Within the calculated and random clusters, Formalists tend to have a higher income by approximately \$20,000 and \$30,000 respectively. Formalists represent 12% of the sample data in Pagerjuran and similarly within each formed cluster, therefore they constitute a small proportion of the total population. Also they are high risk takers which represent a potential threat to administrative efficiency. Nevertheless, they are the essential segment group needed at the beginning of the CDC administrative cycle. Their participation allowed to make a high risk investment and then the other segment leaders safely paced the growth of that investment. The CDC strategy reached almost the Formalist's output without inconvenience while the formalist themselves had to take high risks every year. Calculating segment proportion allows as many cluster formations as possible in order to have enough users from each segment group within a cluster. Essentially, calculating clusters using segmentation and combining their behavior with the presented administering strategy highlights safe and progressive recovery while addressing social cohesion.

#### 4. Conclusion

This comparison provides definitive results to whether segmentation can be a organizing tool used in the emergency stage of pre planning for short and long term livelihood recovery. It is imperative that by organizing families into small groups with a deeper understanding of their life characteristics, they have better chances of becoming a highly productive organization and have multiple incomes which not only sum to their overall recovery process, but also helps to undermine the psychological impact after disaster. The greater success surfaces from the cyclical strategy of administration being the basis for calculating segmentation. Diversity and social dynamics are consequence of such organization which in return influence competition among neighborhood clusters launching an overall economic thrive. It is also safe to say that such places with these characteristics have vernacular spatial and physical development, product of diversity which altogether summons visitors and creates a catalyst for small scale business success.

Further research is needed to develop segmentation categorization for specific cultural backgrounds and societies which dont fall under Latin American or United States societies each having their own system. Related to the context of this investigation, a deeper study is required to understand the effects of calculated segmentation on the development of neighborhoods and the relationship between them. This may lead to a manifestation which favors the population's identity, income, social status and overall satisfaction.



## 5. Acknowledgement

The study attributes its appreciation to Professor Osamu Murao whose work and insight has led the application of knowledge and thorough research. Two professionals who have influenced the outcome of this topic; Dr. Luis A. Moya post-doctoral researcher at the International Research Institute of Disaster Science in Tohoku University who led the clustering activity while Dr. Syamsul Bachri, faculty member at Malang University in Malang, Indonesia became the official translator and caring friend during the data survey.

## 6. Copyrights

17WCEE-IAEE 2020 reserves the copyright for the published proceedings. Authors will have the right to use content of the published paper in part or in full for their own work. Authors who use previously published data and illustrations must acknowledge the source in the figure captions.

## 7. References

- [1] Yonetani, Michelle. "Disaster-Related Displacement in a Changing Climate." *World Meteorological Organization*, 6 Dec. 2016, <https://public.wmo.int/en/resources/bulletin/disaster-related-displacement-changing-climate>
- [2] Shi, G. (2008). "Discussion on Resettlement Science". *Proceedings of 16th IAHR-APD Congress and 3<sup>rd</sup> Symposium of IAHR-ISHS. IV*, pp.1456-1462. Nanjing: Springer-Verlag Berlin Heidelberg.
- [3] Estuning Tyas Wulan Mei, Alia Fajarwati, Surani Hasanati, Ifa Meilyana Sari, "Resettlement Following the 2010 Merapi Volcano Eruption", *Procedia - Social and Behavioral Sciences*, Volume 227, 2016, pp 364-365
- [4] "Community-based Settlement Rehabilitation and Reconstruction Project for Central and West Java and Yogyakarta Special Region". *The World Bank, Report No: ICR00003662*. Feb. 24, 2016. Pp. 5-10, 24, 25.
- [5] The World Bank. "Rekompak; Rebuilding Indonesia's Communities After Disasters". *Jakarta: The MDF for Aceh and Nias and the JRF Secretariat*. 2012. PP. 66, 67, 72 -74, 158 -165
- [6] Elizabeth MALY, Kanako IUCHI, Ardhya NARESWARI. "Community-Based Housing Reconstruction and Relocation: REKOMPAK Program after the 2010 Eruption of Mt. Merapi, Indonesia". *Journal of Social Safety Science*. Volume 27, Pages 205 - 214, Released August 02, 2017. doi:[https://www.jstage.jst.go.jp/article/jisss/27/0/27\\_205/article/-char/en](https://www.jstage.jst.go.jp/article/jisss/27/0/27_205/article/-char/en)
- [7] Singgih, Bhaskara Abraham, and Junichiro Asano. "Study on Impact of Relocating Settlement as a Post-Disaster Mitigation." *Urban and Regional Planning Review*, vol. 6, 2019, pp. 111–124., doi: 10.14398/urpr.6.111.
- [8] Aldrich, D. P. (2012), 'Social Capital in Post Disaster Recovery: Towards a Resilient and Compassionate East Asian Community', in Sawada, Y. and S. Oum (eds.), "Economic and Welfare Impacts of Disasters in East Asia and Policy Responses". *ERIA Research Project Report 2011-8*, Jakarta: ERIA. pp.163-164, 171.
- [9] Rindrasi, Erda. (2018). "Under the Volcano: Responses of a Community-Based Tourism Village to the 2010 Eruption of Mount Merapi, Indonesia". *Sustainability*. doi: 10.1620.10.3390/su10051620.
- [10] The World Bank. 2012. "Rekompak; Rebuilding Indonesia's Communities After Disasters". *Jakarta: The MDF for Aceh and Nias and the JRF Secretariat*. PP. 66, 67, 72-74, 158-165
- [11] JRF Secretariat. 2012. "Disaster Response & Preparedness: From Innovations to Good Practice". *Java Reconstruction Fund Final Report*. Jakarta: JRF Secretariat. pp.38-46, 56-62
- [12] Cho, S.E.; Won, S.; Kim, S. "Living in Harmony with Disaster: Exploring Volcanic Hazard Vulnerability in Indonesia". *Sustainability* 2016, 8, 848. pp. 2, 5-6.
- [13] Nurtini, Sudi & Rochijan, R. & Guntoro, Budi & Widyobroto, Budi & Indratiningsih, Indratiningsih & Umami, Nafiatul. (2017). "The Performance of Milk Production, Total Milk Revenue and Reproduction Indicators on Dairy Smallholders in Yogyakarta and East Java, Indonesia". *Buletin Peternakan*. PP. 41. 212-218. doi: 10.21059/buletinpeternak.v41i2.23152.



- [14] Ummul, Muzayyanah Anggriani, et al. "Profiles of Smallholder Dairy Farmers Groups after Volcanic Eruption Damage in Indonesia : A Case Study of Sleman Regency, Daerah Istimewa Yogyakarta." *Journal of International Development and Cooperation*, vol. 19, no. 4, 29 Mar. 2013, pp. 121–129., doi: <http://doi.org/10.15027/35056>. <https://ir.lib.hiroshima-u.ac.jp/ja/00035056>
- [15] Priyanti, Atien & Soedjana, Tjeppy. (2016). "Indonesian Dairy Industry Perspective Within the ASEAN Economic Community". *Indonesian Bulletin of Animal and Veterinary Sciences*. Doi: 25.10.14334/wartazoa.v25i4.1226.
- [16] Atzori, A.s., et al. "A Multivariate and Stochastic Approach to Identify Key Variables to Rank Dairy Farms on Profitability." *Journal of Dairy Science*, vol. 96, no. 5, 1 Mar. 2013, pp. 3378–3387. Science Direct. <https://www.sciencedirect.com/science/article/pii/S0022030213001549?via%3Dihub>
- [17] Tri Anggraeni Kusumastuti, Rochijan, Budi Prasetyo Widyobroto, Budi Guntoro and Ambar Pertiwiningrum, 2017. "Intangible Costs Resulting from Inefficient Feeding and Water Usage in Smallholder Dairy Farm in Indonesia". *International Journal of Dairy Science*, 12: P 211-217. <https://scialert.net/fulltextmobile/?doi=ijds.2017.211.217#t6>
- [18] WAHYUDIN, ARIF and ROBITH SYA'BANI. "Merapi - Danone Ecosystem Fund." *Danone*, Apr. 2017, <http://ecosysteme.danone.com/projectslists/merapi/>
- [19] Pramana, A.Y.E. (Yunastiawan Eka). "Impact of Land Use Regulation on Land Values". Rotterdam, 2016. Retrieved from Web: <https://thesis.eur.nl/pub/42298>. pp. 2 - 31.
- [20] Hall, Peter. "Planning, planners and plans". *Urban and Regional Planning*. Abingdon, Oxon: Routledge, 1992. pp.,16 – 72.
- [21] De Silva, D.A.M. and M. Yamao (n.d.), 'Developing Social Capital to Replace Forgoing Donors: A Case of Sri Lanka' in Yamao, M. (ed.) "Developing Social Capital to Replace Foregoing Donors: A Study on the Changes in the Structure and Functioning of Coastal Communities of Sri Lanka, Thailand and Indonesia in Post-Tsunami Period". Hiroshima: Hiroshima University. pp.22-61. <http://home.hiroshima-u.ac.jp/cbrmcm/tunami/tunami2.pdf>
- [22] Moeckel, R., Spiekermann, K., Wegener, M. (2003). "Creating a Synthetic Population". *8th International Conference on Computers in Urban Planning and Urban Management (CUPUM)*, Sendai. pp. 2-3
- [23] Paula Thornton-Ruth Adler-R. Anderson-Richard Lachance-Annie January- Ross Chapin Post- Retrieved from: <https://rosschapin.com/cohousing-vs-pocket-neighborhoods-whats-the-difference/>
- [24] McCamant, Kathryn, et al. "Cohousing: a Contemporary Approach to Housing Ourselves". *Ten Speed Press*, 1994.
- [25] "Arellano: Consultoría e Investigación De Mercados." *Consultora Arellano*. Retrieved from: <https://www.arellano.pe/>.
- [26] Vela, Aguilar, et al. "La Relación Entre Los Criterios Socialmente Responsables y La Decisión De Compra De Los Consumidores Autoidentificados Como Socialmente Responsables, Segmentados Por Los Estilos De Vida Propuestos Por Arellano. Estudio De Los Consumidores De Agua Mineral Embotellada En Lima Metropolitana". *Dspace Home*, Pontificia Universidad Católica Del Perú, 1 Jan. 2019, <http://tesis.pucp.edu.pe/repositorio/handle/20.500.12404/13211>
- [27] Arellano, Rolando. "Mucho más Que Tener Latir: Los Estilos De Vida Latinoamericanos según Actitudes, Tendencias, Intereses y Recursos". *Planeta*, 2017. Cap. 7 y 8
- [28] Töpfer, Myriam & Bug, Peter. (2015). "Classical consumer lifestyle segmentation methods".
- [29] S3C (2015). "Guideline: Using Segmentation to Better Target User Groups". *S3C Consortium*, 2015. Retrieved from: [https://www.smartgridengagementtoolkit.eu/fileadmin/s3c/toolkit/user/guidelines/GUIDELINE\\_USING\\_SEGMENTATION\\_TO\\_BETTER\\_TARGET\\_USER\\_GROUPS.pdf](https://www.smartgridengagementtoolkit.eu/fileadmin/s3c/toolkit/user/guidelines/GUIDELINE_USING_SEGMENTATION_TO_BETTER_TARGET_USER_GROUPS.pdf)
- [30] Jiang S., Ferreira J., Gonzalez M. "Analyzing Households Lifestyles, Mobility and Activity Profiles: A Case Study of Singapore". *Transportation Research Board 92nd Annual Meeting* (2013).
- [31] Sembada, P., Duteurtre, G., Purwanto, B.P. "Improved milk production performance of smallholder farms in West Java (Indonesia)". *Trop Anim Health Prod* 48, 793–799 (2016) doi:10.1007/s11250-016-1029-2
- [32] Shoemaker, Diana. "A Look at Dairy Cost of Production". *Dairy Herd Management*. February 19, 2019. <https://www.dairyherd.com/article/look-dairy-cost-production>
- [33] Search Properties for Sale | *Rumah123.Com*, <https://www.rumah123.com/en/>