THESIS

ASSESSMENT OF ECONOMIC VULNERABILITY AND COMMUNITY RESILIENCE IN LANDSLIDE PRONE AREAS AFTER A LANDSLIDE EVENT

Thesis submitted to the Double Degree M.Sc. Programme, Gadjah Mada University and Faculty of Geo-Information Science and Earth Observation, University of Twente in partial fulfillment of the requirement for the degree of Master of Science in Geo-Information for Spatial Planning and Risk Management

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DISCLAIMER

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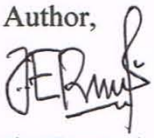

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ABSTRACT

Tawangmangu is one of sub-district in Karanganyar Regency, Central Java Province that has been struck by landslide in 2007. One of trigerring factor that influenced is the high rainfall intensity. It located in slope more than 40 degrees and the geomorphology that influenced by volcanic activity from Lawu Volcano. Moreover, conversion of land into productive land/agriculture land and landuse in area of steep slope for agriculture also made the landslide event. Landuses in Tawangmangu Sub-District depends on topography condition which in lower part is used for agricultural activities and settlement and in hilly also found agricultural and settlement. Most economic activities in Tawangmangu Sub-District are agricultural sector.

The landslide has led some vulnerability especially economic vulnerability and community resilience. Economic vulnerability related to the potential of loss to a given an economy activities as element at risk from the occurrence of a landslide. Economic vulnerability in this study consists of loss of productive, damage of building and infrastructure, capital cost of response and impact on work force. Furthermore, resilience relates to the ability to recover from a disaster and is for every people different. Community resilience becomes an important factor in a disaster mitigation plan. However, data and information related to economic vulnerability and community resilience in micro scale is rare. For this reason, this research intends to assess economic vulnerability and community resilience for landslide disaster. It is also aimed to generate the landslide vulnerability and evacuation route map based on the knowledge of the people.

Primary data was collected through interviews to 35 respondents and focus group discussion (FGD) as well as participatory mapping. The study area was in Tawangmangu Village (Ngledoksari Sub Village) and Tengklik Village (Guyon Sub Village), which struck by the 2007 landslide event. The respondents were choosing randomly on both sub villages which is influenced by landslide. Factors for quantifying community resilience were asked to respondent by FGD, giving questionnaire, and interviewing them. While FGD and PGIS were done in order to gain vulnerability and evacuation map based on community knowledge. Based on questionnaire result, all of commodities agricultural in both sub village happened decline of agricultural production while economic losses in term loss of production depends on total of production and price selling market currency. Based on FGD result, resilience value in Ngledoksari Sub Village is distributed from 0.175 until 0.350 and in Guyon Sub Village is distributed from 0.425 until 0.800. The average value in Ngledoksari Sub Village is 0.256 and in Guyon Sub Village is 0.529. Most of the resilience value was influenced by human capital.

Generally, people in both sub villages can continue their life normally although they are not completely recovers. Culture of Javanese people and religion factors influenced to community recovery in term of psychology. Moreover, in order to increase the community resilience, Government has established landslide control devices and reforestation in this study area.

Keywords: disaster mitigation, economic Vulnerability, economic losses, participatory mapping, landslide characteristic, and community resilience.

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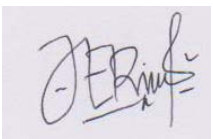
Yogyakarta, March 2013



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Abbreviations and Glossary

Bappenas	:	*Badan Perencanaan Pembangunan Nasional* (Indonesia's National Bureau for Development Planning)
Bappeda	:	*Badan Perencanaan Pembangunan Daerah* (Regional Planning Agency)
BNPB	:	*Badan Nasional Penanggulangan Bencana* (The National Agency for Disaster Management)
BPN	:	*Badan Pertanahan Nasional* (National Land Agency)
BPS	:	*Badan Pusat Statistik* (The Central Bureau of Statistic)
Desa	:	Village in regency
Depdagri	:	*Departemen Dalam Negeri* (Departmen of Internal Affairs)
District	:	an Administrative region comprises of several villages with authority level below a regency
Dukuh	:	Sub area of dusun or equal with RW
Dusun	:	Sub area of village consists of some RW
GIS	:	Geographic Information System
Gotong Royong	:	Community's activities to work together and to help each other
GPS	:	Global Positioning System
Kecamatan	:	Sub-district
Kelurahan	:	Village in municipality
Koperasi	:	Cooperative union
SIRRMA	:	*Sistem Reduksi Resiko Multi Bencana* (Disasters Risk Reduction System)
RBI	:	*Rupa Bumi Indonesia* (Topographis Map of Indonesia)
Regency	:	an Administrative region comprises of several districts with authority level below a province
RT	:	*Rukun Tetangga* (Sub area of RW)
RW	:	*Rukun Warga* (Sub area of village)
TNI	:	*Tentara Nasional Indonesia* (Indonesian National Army)
UNDRO	:	United Nations Disaster Relief Organization
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
UNISDR	:	United Nations International Strategy for Disaster Reduction

CHAPTER I
INTRODUCTION

This chapter describes the general overview of research. It contains background of research, problem statement, objectives, research question, benefit of the result, and limitation of research

1.1.Background

Disasters are events that occurred as a result of natural hazard or human actions which affect human life and properties, cause environmental problems, and damage infrastructures and other public facilities. This causes disruption of the life and livelihoods. The natural hazards consist of earthquake, floods, volcanic eruptions, tsunami, landslide, etc. Almost no part of the earth's surface is free from the impact of natural hazard. Although, it may not be feasible to control nature and to stop the progress of natural phenomena but we can try to prevent and to reduce their effects on human lives and livelihoods.

Landslides are the movement of a mass of rock, debris or soil a long down slope, due to the weight of the soil mass potential energy in the form of gravity, and kinectic energy as the mass movement. Landslides have many types of movements, the materials involved and the states or activities of failed slopes. Landslides are major hazards for human activities, often causing huge economic losses and property damages by posing a threat to settlement, livelihoods, public service, and transport infrastructure.

According to The National Agency for Disaster Management (BNPB, 2011), disasters in Indonesia are concentrated in Java .More than 50% of disasters occurred in Java from 2002 to present. In 2011, 2066 events, approximately 827 disasters (40%) occurred in Java. Disasters and their impacts are predicted to increase. This is a development challenge, because the disaster can limit development. Disaster caused decreases in productive capacity in large scale and has led to economic lose (BNPB, 2011). Landslides in Java usually occur in the rainy season. The last event occurred on February 22nd, 2012 which is 19 point of landslide prone areas that are spread in seven sub-districts. Those are Jenawi, Ngragoyoso, Karangpandan, Matesih, Kerjo, Jatiyoso and Tawangmangu. There are 10.630 ha that have landslide potential spread out in 31 villages in seven sub-districts where is in foot and slope of Lawu Mountain in Karanganyar Regency. Access of road Solo-Tawangmangu was interrupted due to hit of an avalanche when the landslides occur. (www.tawangmangukotaku.blogspot.com, 2012).

Tawangmangu sub-district is an agricultural area which is also a popular tourist destination due to its cool climate and beautiful scenery. The district has no large industry. Agricultural production in Tawangmangu sub-district can be divided into three groups. The agricultural production in Tawangmangu is primary sector which contribute to regional income in Karanganyar Regency. While the tourist sectors can also contribute to economy in Tawangmangu sub-district. Many facilities have been built to increase the economy by promoting activities in tourism sector, i.e. there are 21 hotels, traditional market that sells its agricultural production. This is also supported by increasing access to the tourist attractions (BPS, 2011). All activities in Tawangmangu sub-district will be disrupted when landslides occur almost every year in many aspects (physic, social and economic, and environment). In this research will be focused on economic in micro level (community level).

Economic vulnerability describes a condition of the potential economic loss in the face of hazards. Damage of sites of production, loss of cash crops, the dislocation of transport routes, the disruption of water supplies and power in available workforce are some of the factor that lead to economic in short to long timescales. Several indicators of economic vulnerability include the percentage of households working in vulnerable sectors (sectors that are vulnerable to employment) and the percentage of the poor households. Amount of the indicators economic vulnerability show that one aspect of this area has a level of vulnerability so they need for action to reduce the vulnerability of the capacity owned by the region or with adapt to change of the disasters. Risk assessment needs to identify whether such economic vulnerability exists and the scale and duration of the consequence.

In the framework of economic recovery from landslides requires the role of government and community. Government and local government made policies to prevent and recovery of the economy. One of them is community resilience building which is the rural livelihoods resilience debate are livelihood assets. Landslide risk are not only threat to natural resources and livelihoods, but also the changes they induce in resource flows will affect viability of livelihood unless effective measures are taken to protect them through adaptation and other strategies. For vulnerable rural communities, these strategies should be included natural resources management using knowledge system readily available to the communities.

1.2.Problem statement

Tawangmangu sub-district (7.003 ha) is one of the sub-district in Karanganyar Regency, Central Java which is affected by landslides. Most of the Community in Tawangmangu sub-district work in agriculture land. When the landslides occur, people in affected areas are vulnerable in various aspects such as physical, social, economic and environmental. The economic aspects will be investigated in this research because landslide hazard has an economic impact on the community and government. In community affected by landslide, unemployment expected to increase and agricultural production to decrease, so more families will be poor. Government and local government have been done policy to anticipate/reduce the landslide. They have been taken steps anticipate such as using heavy equipment (bulldozer) to transfer the soil following to landslide. There has also been made early warning of landslide when heavy rains occur.

The big landslide event has been happened on December 26th 2007 in Karanganyar Regency, especially in Tawangmangu village (Ngedoksari sub village) and Tengklik Village (Guyon sub village). Landslide in two villages have difference phenomenon. Those are land earthflow in Tengklik sub village and debris avalanche in Ngledoksari sub village). Most of the district in Karanganyar Regency is a buffer zone of agricultural production in Central Java Province. It's because it has fertile agricultural land that located in foothills Mt. Lawu. Based on Spatial Planning of Karanganyar Regency, Tawangmangu District which have development potential in tourism, transportation, plantation horticulture agriculture and trade. While have priority development in horticultural.

Landslide hazard in Tawangmangu sub-district had been deal with the National Agency for Disaster Management (BNPB) Central Java Province, the Indonesian National Army (TNI) and the local community. Furthermore, the Central Java BPBD had been already made several shelters for the disaster. This was done because of the disaster recovery needs, rehabilitation and reconstruction in order to economic activities back to normal. Moreover local government has also been undertaken several programs to cope with disaster related to the economic such as the establishment of micro finance institution that aim to the livelihoods recovery after disaster. In addition there also facilitation of business in households scale that will be elaborate in several sub-activities as like improved training the quality production, post production and strengthening market access..

Research has been done in Tawangmangu sub-district about integrating landslide susceptibility into land capability assessment (Wati, 2010), Analysis of local risk governance framework and community's coping strategies in relation to

landslide (Setiawan, 2012) while economic vulnerability and community resilience assessment have not been done. So, this research intends to assess (1) the actual economic vulnerability from landslides, (2) the actual economy loss from landslide, (3) analyze of community resilience for 2007 landslide event.

1.3.Objectives

The main research purposes are to assess economic vulnerability and resilience for landslide hazard in Tawangmangu Sub-district. Specific objectives of this research are:

1. To assess economic vulnerability (economic activity as element at risk).
2. To calculate economic loss that occurred during the event.
3. To analyze community resilience for landslide disaster.

1.4.Research question

Based on the objectives above, the research questions can be formulated on the table 1.1.

Table 1.1. Research question

No.	Research Objectives	Research Question
1.	To assess economic vulnerability	a. What are the elements at risk? b. What indicators and parameters can be used to measure economic activities vulnerability? c. What is the economic vulnerability for each activity and overall?
2.	To calculate economic loss that occurred during events	a. What indicators and parameters can be used to measure economic loss? b. How much is the economic loss in different sectors?
3.	To analyze community resilience for landslide disaster	a. What defines community resilience? b. How can community resilience be quantified? c. How is community resilience in study area? d. What is relation between landslide event and community resilience?

1.5.Benefit of the research

The research will give information related to economic vulnerability and community resilience assessment as an important aspect for local government and community in policy and program for disaster mitigation.

1.6.Thesis Structure

The thesis is arranged by the series of chapter that can be seen in figure 1.1. Chapter 1 describes the background, problem statement, objectives, research question, benefit of the research, and limitation of research. Then Chapter 2 explains about literature that related with the research. Chapter 3 defines the research method including population and sampling, questionnaire and Focus Group Discussion. Then Chapter 4 contains the study area including general Tawangmangu Sub District, Tawangmangu and Tengklik Village. Social economic profile, economic vulnerability and landslide risk perception of respondents are described in Chapter 5. Community resilience toward landslide and institutional respond will be explained in chapter 6 and chapter 7. The conclusion and recommendation is presented in chapter 8.

1.7.Limitation of the research

The element at risk of the research focused on the economic aspect of the community, including economic activities, employment, and spatial distribution of economic activities.

Information and data related to the economic activity and community resilience in prone areas are obtained base on participatory of the community. The others factor such as hydrological aspect, morphology, and land capability are not taken into consideration.

CHAPTER II
LITERATURE REVIEW

This chapter reviews the related literatures that used to support the research. This chapter consists of the general understanding of disaster and hazard, landslide, economic, capacity, vulnerability, resilience, participatory GIS, and Conceptual Framework.

2.1 General understanding of disaster and hazard, landslide, vulnerability and resilience

2.1.1. Definiton of disaster and hazard

Firstly, many different definitions of the word "disaster", so need clarify about disasters in this report with the context. A hazard might lead to a disaster. A disaster usually defined as "an event that overwhelms the capacity to cope with it." (Europe Spatial Planning Observ. Netw., 2003) in Thywissen, (2006). Futhermore, UNISDR (2004) disaster is a serious disruption of the functioning of community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope with own resources. It focused on risk process, conditions of vulnerability and capacity or measures to reduce the potential negative impact.

Secondly, definition of hazard also has many definitions. Based on UNDRO (1991) hazard defines as "the probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon". Then Westen et al (2009) writes that a hazard is "a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation".

2.1.2. Definition of landslide

According Highland and Bobrowsky (2008) Landslide defines as "a down slope movement of rock or soil, or both, occurring on the surface of rupture-either curved (rotational slide) or planar (translational slide) rupture-in which much of the material often moves as a coherent or semi coherent mass with little internal deformation". Landslide in Tawangmangu sub district caused by soil conditions in hilly with cropping pattern annual (vegetables), so that the soil becomes loose and flabby, the lack of perennials as a buffer zone in hilly, illegal logging in buffer zone, minimize terracing models, and the attitude and public awareness is still low for safety/nature conservation/environmental.

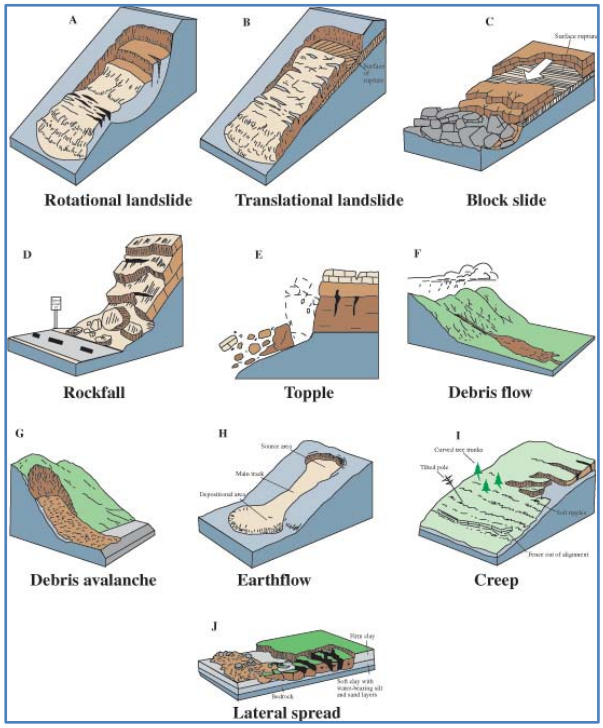
The types of landslide are fall, topple, slide, spread, flow, and complex which can be seen in figure 2.1. Each characteristic type of landslide is described below:

a. Fall

Fall is mass movement suddenly of material geology which detachment from steep slope or cliff after that the material goes down by falling, bouncing and rolling. It depends on gravity, mechanical weathering, and the presence of interstitial water.

b. Topple

Topple can be defined as the forward rotation out of a slope of a mass of soil or rock around a point or axis below the center of gravity of the mass replacing. Topple is not only compelled by gravity exerted by the weight of material upslope from the displaced mass but also it is caused by water or ice in cracks in the mass.



Source: Landslide Type, USGS 2004

Figure 2.1. Type of landslide

c. Slide

A slide is a down slope movement of a soil or rock mass that occurs in surfaces of rupture or on relatively thin zones of intense shear strain. There are two major categories i.e. rotational slide and translational slide. Rotational slide is slide where concavely curved surface broke up and sliding motion roughly around the axis of parallel rotation to the ground and across the slide. Then the other is slide where the moving mass consists of a single unit or a few closely related units that move down slope as a relatively coherent mass. In this type, mass moves along a planar rough surface with the little rotation or backward slash.

d. Flow

Flow is a spatial continuous movement. It occurs when mass movement is driven by water along the valley that reaches hundred of maters away. Velocity depends

on slope, water volume, water pressure, and type of materials. There are five type of flows i.e. debris flow, debris avalanche, earthflow, mudflow, and creep.

e. Spread

Spread describes as an extension movements accompanied by shear or tensile fractures. Several types if spreads are block spreads, liquefaction spreads, and lateral spreads

2.1.3. Definition of vulnerability

Many definitions and different conceptual frameworks of vulnerability exist, because many distinct groups have different views on vulnerability. Based on UNDP (2004), definition "vulnerability is a human condition or process resulting from physical, social, economic and environmental factors, which determine the livelihood and scale of damage from the impact of a given hazard". It means that there are many indicators to assess the vulnerability of hazard such as physical, social, economic, environmental, and capacity.

UNDRO (1991) defines vulnerability as the degree of loss to given element at risk or set of such elements resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1 (total loss) or in percent of the new replacement value in the case of damage property. Vulnerability based on UNDP focused on the human condition or process while for the UNDRO focused on degree of loss from each element from the hazard. UNISDR (2004) vulnerability is the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazard. This is a negative factor as consequence of the hazard.

2.1.4. Definition of economic

Generally, definition of economic based on Lexical source is "connected with the trade, industry, and development of wealth of a country, an area or a society; producing enough profit to continue" (Oxford University Press, 2012). In the context of a rural district in Indonesia, this refers to all economic activities that related with rural (all activities that related with the agricultural sector from trade, industry, development in agriculture to achieve wealth of a rural). It usually influences to the economy in large scale (regional economic).

2.1.5. Definition of capacity

Capacity is "combination of all strength and resources available within a community or organization that can reduce the level of risk, or the effect of a disaster.

It may include physical, institutional, social or economic mean as well as skilled personal or collective attributes as like leadership and management. Capacity may also be described as capability" (UNISDR, 2004). Capacity is the part of vulnerability because it is a combination of all forces and available resources within a community, society or institution that can reduce the risk or impact of disaster. Vulnerability is more emphasis on the human aspect in community level that directly deal with the threat so that vulnerability becomes a primary factors in society that has a higher risk of disaster if not supported by the ability (capacity) such as lack of education and knowledge, poverty, social condition, etc. Related to landslide, coping with landslide is defined as all those measures including policies and implementation strategies which community may apply to alleviate the consequence the landslide events.

2.1.6. Definition of resilience

Resilience is opposite of the vulnerability. UNISDR (2004) defines resilience as "the capacity of a system, community or society potentially exposed to hazard to adapt, by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure". This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures. This is a positive factor that used to reduce the impact of the risk and recovery to pre-disaster conditions rapidly through survival, adaptability, evolution and growth. Furthermore, Brand and Jax (2007) define of resilience is "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks". This focus is on dynamic system when the disaster occurs.

On the other hands, Thywissen (2006) the resilience defines as the capacity that people or groups may possess to withstand or recover from emergencies and which can stand as counterbalance to vulnerability. While related to natural disaster, Ibarraran et al (2009) writes that resilience is the ability of a social; or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self organization, and the capacity to adapt to stress and change. Furthermore everyone has different resilience which vulnerability can affect to resilient. Some people may be better than others in recovery ability after facing certain disasters.

Five major forms of capital on building community resilience based on Islam et al. (2010). Those are natural capital, economic capital, physical capital, social capital, and human capital. Economic capital are saving, income, investments and

credit that describes financial resource for achieving people's livelihoods. While human capital refers to skill and knowledge. It can be associated with education, health, skills, knowledge or information so that can be increased people's understanding or perception of community perception risk and their ability in developing and implementing risk reduction strategies. More detail about elements of resilient community can be seen at the figure 2.2.

Source: Islam et al 2010

Figure 2.2. Elements of resilient community

In this research, we define resilience as the ability which is owned by groups/communities in the face of a disaster, so that they can return to the normal activities. This can be done by looking at an event, where the weakness of society are trying to get up the strength to solve the problem or the others word resilience is defined as the ability of a community to recover from the impact of landslide. Variables that were investigated in order to define community resilience data are:

1. Landslide experiences. According Islam et al. (2010), Human capital in community resilience can be associated with skill and knowledge which can be gotten from the experience. Then this research will be described landslide experiences of respondents as variable that will be used to define community resilience.
2. Education. Islam et al (2010) states that education in human capital in community resilience also can increase community skills and knowledge. Education is one of demographics factor that influence to resilience and will be reflected social grade in community. People who have higher education level can be more adaptable and more able to get help than people who have lower education.
3. Financial resources. Islam et al(2010) categories financial resources in economic capital is very important in building disaster resilient. There are

elements in financial resources such as saving, the sale of property, loan, and family or relation financial support. Financial resources can be increased individual or community to absorb the disaster impact and speed up of process recovery.

4. Speed of recovery in term of rebuilding the house. Islam et al (2010) related resilience with ability to recover quickly from impacts of hazard. Cleaning up the house from the land is the first activity the people do after disaster in order to continue functioning their life.

2.2. Economic vulnerability

Based on definition of vulnerability and economic in 2.1, the economic vulnerability is a potential of loss to a given an economy activities as element at risk from the occurrence of a landslide. The economic dimension of vulnerability recognizes economic damage potential which can be assumed as a fact that affects the economy of the area and can be damaged by a hazard. The economy vulnerability represents the risk to production, distribution and consumption. While economic activities are all human activities leading to income. In this context as element at risk that consist of spatial distribution of economic activities, employment, and economic production in various sectors.

Element at risk is all objects, persons, animal, activities and processes that may be adversely affected by hazardous phenomena in particular area. It can be either directly or indirectly losses. Economic activities as an element at risk in economic vulnerability consist of two type losses. Those are direct losses such as interruption of business due to damage infrastructure, loss of productive, capital cost of response and relief. The other one, indirect losses as like economic losses due to short term disruption of activities, long term economic losses, less investments, capital costs of repair and reduction in tourism (Westen and Kingma, 2009)

Economic activities in this research define as all of activities that related with the agricultural land as the livelihood in research area. The classification economic activities in this research as follow:

a. Loss of productive/Productivity cots
b. Damage of buildings and infrastructure
c. Capital cost of response and relief
d. Impact on work force

2.3. Conceptual framework

Based on literature review in sub title 2.1 and 2.2 above, this sub title describes conceptual framework that will be applied in this research. The conceptual framework for this research is illustrated in figure 2.3. This research is focused on micro level landslide vulnerability assessment. Then the analytical framework for this study based on the local knowledge to the element at risk, the local perception and the capacity to cope with the hazard.

Local knowledge is very important for landslide vulnerability assessment, especially economic activities because the local people have lots of important local knowledge and local initiative to find solutions. So communities become more involved, more transparency, higher feeling of ownership, and better feedback to government.

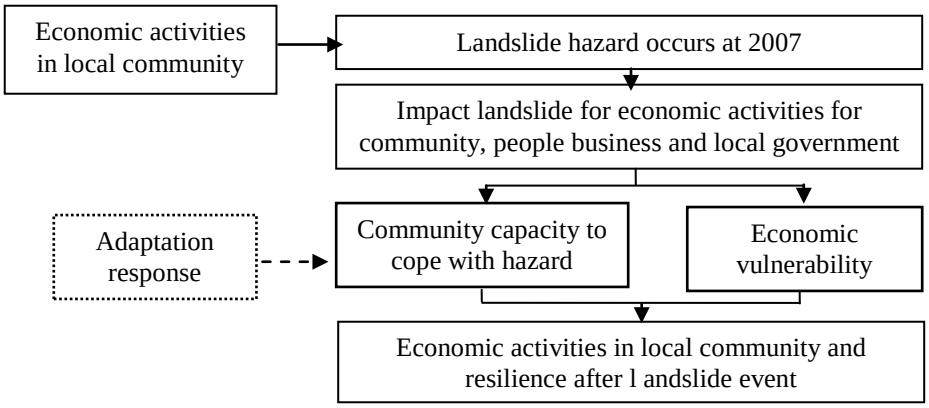


Figure 2.3. Conceptual framework

CHAPTER III
RESEARCH METHOD

This chapter defines research method, population and sampling, questionnaire and interview, and Focus Group Discussion.

3.1 Research method

The research focused on economic vulnerability and community resilience**.** The main methods in this research will be used giving questionnaire, interviewing respondents, Focus Group Discussion, and secondary data from institutional.

For the small scale communities, understanding of vulnerability in certain area is very important. It because the local communities provide substantial information and knowledge related to causes, effect and the way to cope with the landslide hazard. One of key factor which involving the mitigation for landslide hazard is Socio-economic characteristic of community.

Westen et al. (2009) local knowledge can present some information including historical disaster events and the damages they have cause, Element at risk and how they value them, the factor contributing to vulnerability, the coping strategies and capacities to face up to disaster.

To achieve the objectives, the research framework had been made as shown in table 3.1 as follow:

Table 3.1. Research framework

No.	Research Question	Objectives	Method	Source of Data	Outcome
1.	a. What are the element at risk ?	To assess economic vulnerability	Literature Review	Secondary Data	Economic vulnerability
	b. What indicators and parameters can be used to measure economic activities vulnerability?		Literature review	Secondary Data	
	c. what is the economic vulnerability for each activity and overall?		Questionnaire and interview	Primary Data	
2.	a. What indicators and parameters can be used to measure economic loss?	To calculate economic loss that occurred during events	Literature review	Secondary Data	Estimation economic loss
	b. How much does the economic loss?		Calculation with the formula	Primary and secondary Data	
3.	a. What defines community resilience?	To analize the community resilience for landslide disaster	Literature review	Secondary Data	Community Resilience
	b. How can community resilience be quantified?		Questionnaire and interview	Primary Data	
	c. How is community resilience in study area?		Questionnaire and interview	Primary Data	
	d. What is relation between landslide event and community resilience?		Questionnaire and interview	Primary Data	

3.1.1. Data collection

This Research will be used two types data collection. The data can be collected by using a participatory approach. Those are:

1. Primary Data

   Primary data was obtained by giving questionnaire, FGD, and interview respondent. Some people are involved in FGD using PGIS in order to describe and locate the landslide events in their location. In addition to describe the landslide, they are also being involved in weighting the resilience factors. The questionnaire was used for defining the economic vulnerability, community resilience data. For detail information interview was conducted. While participatory GIS is primary local stakeholders and community involvement. P GIS also used in defining weighting value and the value is used to determine resilience of some respondents that can describe community resilience in study area.

2. Secondary Data

   Data Secondary was gotten from journal, some books, and institutions which related with this research such as Regional Planning Agency (Bappeda), Department of Internal Affairs (Depdagri), National Land Agency (BPN), National Agency for Disaster Tackling and Refugee (BNPB), and Center of Statistical Bureau (BPS), etc.

3.1.2. Materials

Spatial and non-spatial data are registered in this research. Data can be obtained by the institutional (secondary data) and Interview for the primary data. Data collection will be done at the time of survey. Some data requirements which will need in this research for reaching the objectives are presented in table 3.2.

There are three main steps that will take in this research: pre-fieldwork, field work, and post fieldwork.

Pre-fieldwork

Collecting and reading some literatures are main activities in pre-fieldwork. Some literatures consist of books, journals, and some reports about the landslide events and their impacts in the internet at Tawangmangu or other places. Moreover, landslide data/map related institutions and site observation also will be done to determine research location. This step is also designing research problem, objectives, research question, data requirement and data source, literature review and methods.

Furthermore, formulation of questionnaire will be used to collect data in the fieldwork.

Fieldwork

The next step will be data collection. Collecting data in this research will be done with two ways, i.e. secondary data and primary data. First, secondary data will be got from institution that related with study such as local government, Agricultural Department, Forestry, Statistic Agency, etc.

Secondly, primary data is the kind of data will be collected by FGD, interview with community and giving them questionnaire. Researcher will take some selection of representative people/samples in getting information for community. Taking of sample has aimed to save the time, money and other sources. This research will be used simple random sampling. It is because in study area has many economic activities which have homogeneity activities as agricultural activities.

Post-fieldwork

The next step is post-fieldwork. In this step, researcher will analyze data that have been collected. Some software will be used in the analysis as like arc GIS. Data processing will dominate post fieldwork. Output of this stage is assessment of economic vulnerability and community resilience in study area. Moreover, researcher also will use descriptive methods to analyze the data in order to understand will be better. For more details of research method can be described in the figure 3.1 about research design.

Table 3.2. Data requirement and data sources

No.	Data	Information	Data Sources	Type of Data Collection
1.	Satellite imagery (Quickbird)	Land use	National Land Agency	Institutional (secondary data)
2.	administrative boundary map	- Administrative boundaries	- Department of Internal Affairs - Bappeda	Institutional (secondary data)
3.	Existing landslide map	Landslide occurrence (location, time and size)	- Sri Eka Wati Thesis - The Office Tawangmangu sub-district - BNPB - Image Analysis - Field checking	- Literature review - Institutional (secondary data) - Primary data
4.	Landslide prone areas		National Agency for Disaster Management	Institutional (secondary data)
5.	Social and economy data	Social economy and social capital condition	- Interview - BPS (Center of Statistical Bureau) - Potential of Village	- Primary data - Institutional (secondary data) - Institutional (secondary data)
6.	Economy activities vulnerability	Economy activities as element risk	- Interview - BPS (Center of Statistical Bureau) of Karanganyar Regency	- Primary data - Institutional (secondary data)
7.	Statistical data	Demography data	BPS (Center of Statistical Bureau) of Karanganyar Regency	Institutional (secondary data)
8.	Policy and program	Policy and program related to the economic	Bappeda	Institutional (secondary data)

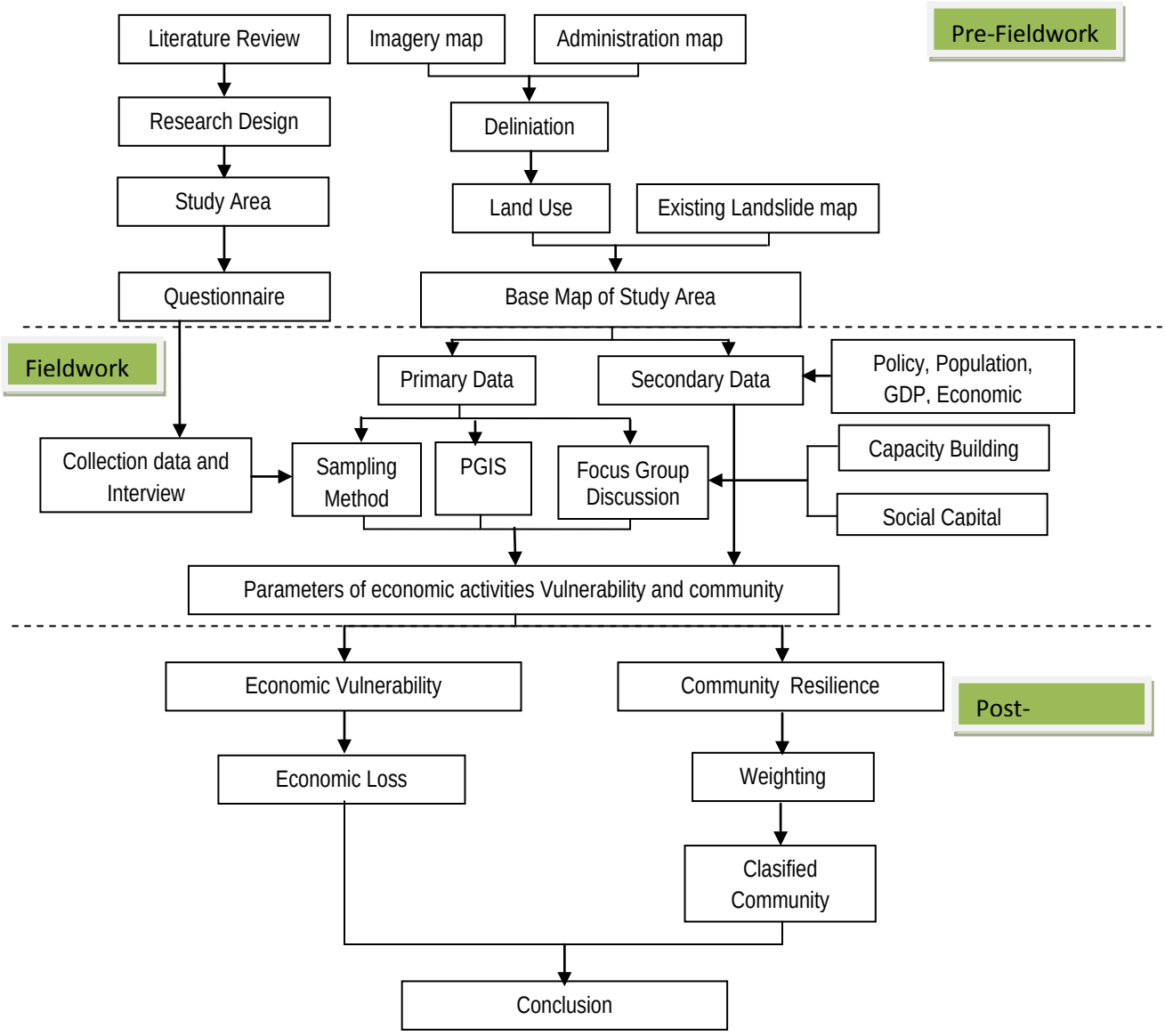


Figure 3.1. Research design

3.2. Population and sampling method

3.2.1. Population

The most important step in data collection was to determine the population in the study area because the population is a source of data that will become the object of research which will be analyzed and answered the research question in this study.

Population is the overall individual symptoms, cases, and problems investigated that exist in the research area which is the object of research (Sumaatmadja, 1998). Based on this definition, the population of this research is population of the community in the area study (Ngledoksari and Guyon Sub Villages) with the 1,753 people which consists of 863 male and 890 female with the total of household 493.

3.2.2. Sample

Sample is a part of the population (preview sample) that representative of the population concerned (Sumaatmadja, 1998). There is no absolute determination to capture the number of samples representative of the population in a study because the validity of the samples lies in the nature and characteristics of the population approaching or not. Sample in this research were aimed to community in Tengklik Village especially in Guyon Sub Village and Tawangmangu Village (Ngledoksari Sub Village).

Figure 3.2 and 3.3 show the spatial distribution of respondents in two sub villages (Ngledoksari and Guyon) which will be taken samples in this research.

3.2.3. Sampling Method

The main objective of the sampling design is to evaluate household perception toward the hazard, economic activities vulnerability and community resilience. The unit of analysis is based upon household unit in 2 sub villages (Ngledoksari and Guyon Sub Villages). The instrument design used questionnaire.

Simple random sampling will be used in the research to get resilience data and economic aspect for indicator of economic vulnerability. The sampling was done in the area which was avalanched in landslide 2007. There are two villages that will be used in sampling. Those are Tawangmangu Village with 1 sub village (only 1 sub village was avalanched in 2007 landslide event: Ngledoksari sub village) and Tengklik Village with 1 sub village (Guyon sub village). We arrange the name of household in the paper and get the number. Then, we selected randomly the name of household and come to their house for the interview or giving questionnaire.

3.2.4. Participatory GIS

Participatory GIS is an approach which integrates participatory with the methods and techniques of GIS as a new approach. PGIS has potential democratic in decision making from and for community. It's called bottom-up decision (Kumar, A). PGIS is very useful method to determine the community who will be sampling in

object of research. Based on data from Quickbird image obtained from Google Earth, map of study area and the mobile Global Positioning System (GPS) will be used to get information related to landslide in study area with causes of landslide, landslide area, etc.

For the small scale communities, understanding of vulnerability in certain area is very important. It because the local communities provide substantial information and knowledge related to causes, effect and the way to cope with the landslide hazard. One of key factor which involving the mitigation for landslide hazard is Socio-economic characteristic of community.

PGIS used in this research especially in the method. Participatory GIS was used in generating landslide map which it included vulnerability and evacuation route. PGIS also used in defining weighting value because there are some parameters that were measured in community resilience. The value is used to determine the resilienceof some respondents that can describe community resilience in the study area. The researcher and the community representative (head of sub village) walk around to the landslide are with the GPS to make the vulnerability zone.

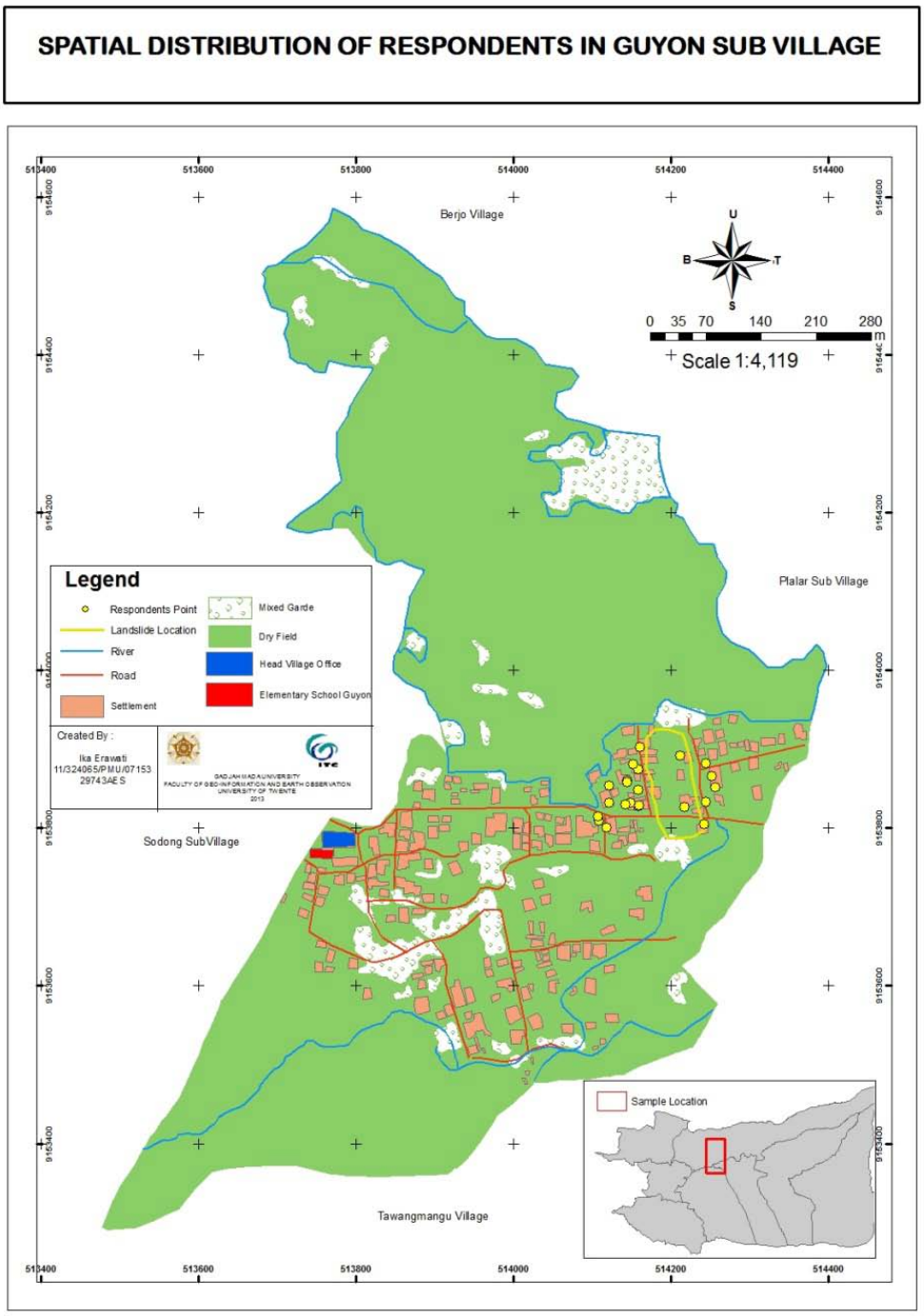


Figure 3.2 Spatial distribution of respondents in Ngledoksari Sub Village

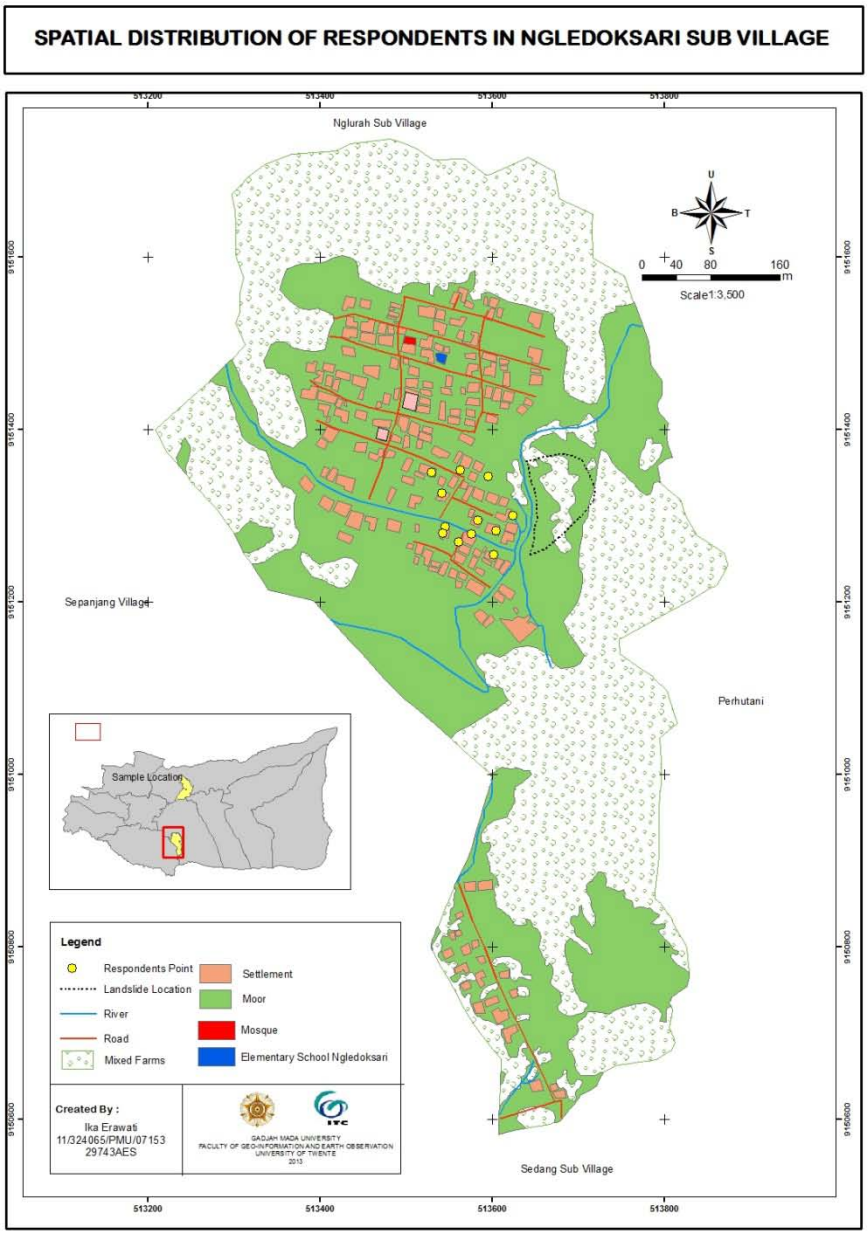


Figure 3.3 Spatial distribution of respondents in Guyon Sub Village

3.2.5. Questionnaire and Interview

Questionnaire will be used to collect economic vulnerability and resilience data from respondent. In depth interview was also done to get community view of both landslide risk perception and resilience. The total number of respondent of this research is 35 households. They have different social economic background.

A questionnaire was arranged by adapting from literature reviews that related with resilience. The questionnaire had written in *bahasa Indonesia* and English in order to help respondent for understanding and filling it. Data that were asked in the questionnaire consist of socio-economic background, landslide characteristic, landslide damage, landslide experience, landslide perception, economic activities as element at risk, physic recovery, economic recovery, psychology recovery, institutional respond of landslide mitigation, etc.

3.2.6. Focus Group Discussion

Focus Group Discussion has been implemented in order to define the 2007 landslide map based on community knowledge. They will be described the landslide events in their location. Furthermore this discussion resulted in weighting value/score for resilience variable. FGD In Ngledoksari sub village was attended by head of RTs, RWs and community representatives while in Ngledoksari sub village was attended by head of *dusun*, head of RT, RW and other community representatives.

In this discussion, the researcher used village map from quickbird. Participants were asked to draw the vulnerability map based on their knowledge and evacuation route . Researcher make the small groups that consist of 4 persons in each groups. Each groups get the cases/title that have been already by the reseacher to discuss and given a case to solve. Each groups was monitored by the committee to look at activity/communication skills of each participant. In FGD, working together in small group started from choosing group leader, solving methods, time division participants to argue, debate breif until making summary solution to be presented to the committee.

CHAPTER IV
STUDY AREA

This chapter contains general Tawangmangu sub-district profile, Tawangmangu and Tengklik Village profile.

4.1 General Tawangmangu Sub-District profile

Karanganyar Regency is one of the landslide prone areas. Landslides occur in several sub-districts such as Jenawi, Ngragoyoso, Tawangmangu, Matesih, Karangpandan, and Ngragoyoso. Those events occur every year with the high rainfall intensity as one of the triggering factors. The other factors are slope more than 40 degrees, moderate level of potential land movement, conversion of land into productive land/agriculture land and land use in areas of steep slope for agriculture, and lithology consists of volcanic breccia and tuff that have been weathered into clay and chunks of rock from small to large size (Sirrma, 2007). This research focuses on Tawangmangu sub-district as an area of study. The big event happened on December 26th, 2006 most damaging landslide took place in Tawangmangu Sub-district.

Tawangmangu Sub-district has the total area as 7,003 Ha that divided in ten villages. Those are Tawangmangu, Plumbon, Tengklik, Gondosuli, Bandadawung, Sepanjang, Karanglo, Nglebak, Kalisoro and Blumbang. This area also consists of 42 sub-villages *(dusun)*, 86 *dukuh*, 99 RW (*Rukun warga)* and 344 RT *(Rukun Tetangga)* (BPS, 2011).

Tawangmangu sub-district lies between UTM zone 49 513319 – 521443E, 9151905 – 9156896N and borders Ngargoyoso Sub-District (N), Jatiyoso Sub-District (S), Karangpandan and Matesih Sub-District (W) and East Java Province (E).

Physical condition in Tawangmanggu Sub District is geomorphology that influenced by volcanic activity from Lawu Volcano, Sidoramping Mount and Jabolarangan Mount. This forms various environmental features. Tawangmangu Sub District consists of sevent class of slope (Wati, 2010). The study area is the dominant situation in very steep slope class. The slope class can be seen in table 4.1.

Table 4.1 Class slope in Tawangmanggu Sub District

No.	Class	Slope (%)	Width Area (Ha)	No.	Class	Slope (%)	Width Area (Ha)
1	Flat	0-3	11	5	Moderately steep	30-45	1.117
2	Undulating	3-8	336	6	Steep	45-65	1.585
3	Moderately sloping	8-15	638	7	Very steep	> 65	1.756
4	Hilly	15–30	1.507	Total			7.003

Source : Wati, 2010

Many landuses in Tawangmangu sub-district are divided into ten classes i.e. forest, pine plantation, paddy field, mixed garden, vegetable garden, mixed paddy fields with vegetable garden, settlement area, shrub and bush, limestone area, and sparse vegetation in forest region (we can see at table 4.2). Distribution of land use depends on topographic condition. Land in lower part of Lawu Volcano is used for agricultural activities and settlement area but in hilly areas also found agricultural land and settlement. Figure 4.1 show Agriculture Area that located in Tawangmangu village with many kinds of vegetables garden using "terasering" system.

Figure 4.1 Agriculture area

Most of the economic activities in Tawangmangu Sub-district are agricultural sector. This sector is as one of the primary sector which has contributed greatly economic growth in Karanganyar Regency. The Agricultural sector is divided into several sub-sectors following food sectors (paddy, fruits and vegetables), harvested crops, livestock and fishery (BPS, 2011). Local community tends to exploit steep slope area as agriculture land (Hadmoko et al, 2008). Landuse changes from perennial to seasonal plant (fruits, Vegetables and sweet potatoes) in lower slope of Lawu Volcano (PVBMG, 2007). Based on figure 4.2 about agriculture area, we can see that the agricultural area are located near with the landslide occurred. It will impact the agriculture product which the most of the agriculture area was buried by landslide while landslide also influences the irrigation system in this area.

Figure 4.2 Agriculture area near with landslide

Tourism in Tawangmangu sub-district has very high potential in Natural Resources and Eco-tourism which is further strengthened by the hospitality of the population. Many tourism attraction such as forest tour (Lawu Peak, Grojogan Sewu,

Pringgodani waterfall), hot springs, central ornamental plants (Nglurah Village), (heritage, and pilgrimage), campground, and flying fox (BPS, 2011).

Table 4.2 Landuse of Tawangmangu Sub District

No.	Land Use	Width Area (Ha)
1.	Forest	3,417
2.	Pine Plantation	65
3.	Paddy field	176
4.	Mixed garden	652
5.	Vegetable garden	800
6.	Mixed paddy field with vegetable garden	749
7.	Settlement Area	935
8.	Shrub and bush	11
9.	Limestone area	8
10.	Sparse vegetation in forest region	190
Total		7,003

Source : Wati, 2010

Figure 4.3 Impact Landslide for agriculture area (a), road (b), and settlement (c,d)

The main economic activities in the study area that may be affected by landslide are: (1) direct effect on agriculture, (2) indirect on agriculture (e.g., road blockages keeping produce from market), (3) tourism. Direct impact on agriculture is damage of agricultural land due to landslides hazard that are expected to the agriculture production (loss of cash crops). While the indirect effect on agriculture is

the damage of the road so that the expected path of the marketing of crop production be inhibited. Another impact on building damage such as settlement, important economic building and road blocked that affect to the community that can be seen in figure 4.3.

This research was done in two villages in Tawangmangu Sub-district. Those are Tawangmangu Village and Tengklik Village. Two villages are the landslide prone areas which have vulnerable on many aspects, as like economic, social, physic and the others. Tawangmangu Village will take in Ngledoksari Sub Village as the area study and Guyon Sub Village as the area study in Tengklik Village. Determination two sub villages as the area study consider that two sub villages had occurred landslide and has impact to the people in there. Other than that two villages had not been held this research about economic vulnerability and community resilience.

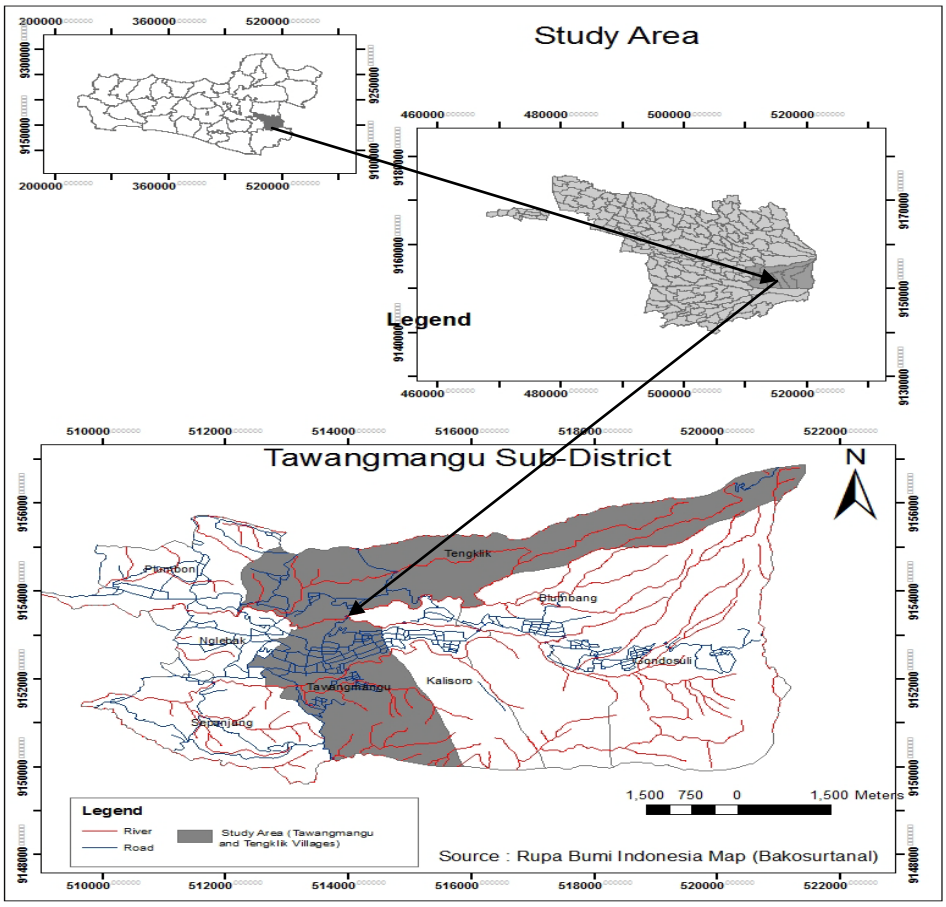


Figure 4.4. Study area

4.2 Tawangmangu and Tengklik Village profile

4.2.1 Tawangmangu Village profile

The area of Kelurahan Tawangmangu is about 3.378,880 Ha, which consists of 5 sub villages (Karling) with the borders Tengklik Village (N), Jatiyoso Sub-district (S), Ngeblak Village (W) and Kelurahan Kalisoro(E).

The five of sub villages (Karling) are Tawangmangu, Nano, Beji, Nglurah and Ngledoksari.

The total population in Kelurahan Tawangmangu in 2011 was 10.262 with the total household 3.926 (Tawangmangu Monography, 2012). Based on sex group, the population consists of 5.009 male and 5.163 female. While the population by livelihood are as follow:

Table 4.3. Population by livelihood in Tawangmangu Village

No.	Occupation	Total
1.	Labour - Civil Servant - ABRI - Private	 161 24 860
2.	Businessman	1.655
3.	Farmer	70
4.	Carpentry/Pertukangan	71
5.	Farmer labour	101
6.	Pensioner	77
7.	Transportation	33
8.	Services	-
9.	others	40
	Total	3.092

Source : Tawangmangu Monography, 2012

Based on table 4.3, we can see about most of the population in Tawangmangu Village work on non agriculture sector. Those are businessman and private labour. It happens because Tawangmangu Village is urban village which oriented in non agriculture sector activities (businessman, pri vate sector).

Landuse in Tawangmangu Village consists of paddy field 159.8830 Ha; garden 177.5050 Ha; forest 2,042 Ha; settlement 2.5 Ha. Agricultural production of Tawangmangu Village is Paddy, vegetables garden as like carrot, onion, tomatoes, etc.

Ngledoksari Sub Village Profile (Study Area)

Total population in Ngledoksari Sub Village is 830 people (233 household) that consist of 410 male and 420 female. While almost people in Ngledoksari Sub

Village work as florist/trader of flower, farmers, labors, etc. there is no people which work as civil servant in this sub village.

Land use in Ngledoksari Sub Village is dominated by agricultural land such as plantation and mixed area. Addition there is settlement in this area. The area of each land use can be seen in table 4.4.

Table 4.4. Landuse in Ngledoksari Sub Village base on interpretation Quickbird.

No.	Land Use	Area (Ha)
1.	Settlement	2.32
2.	Dry Field	17.55
3.	Plantation/mixed garden	20.11

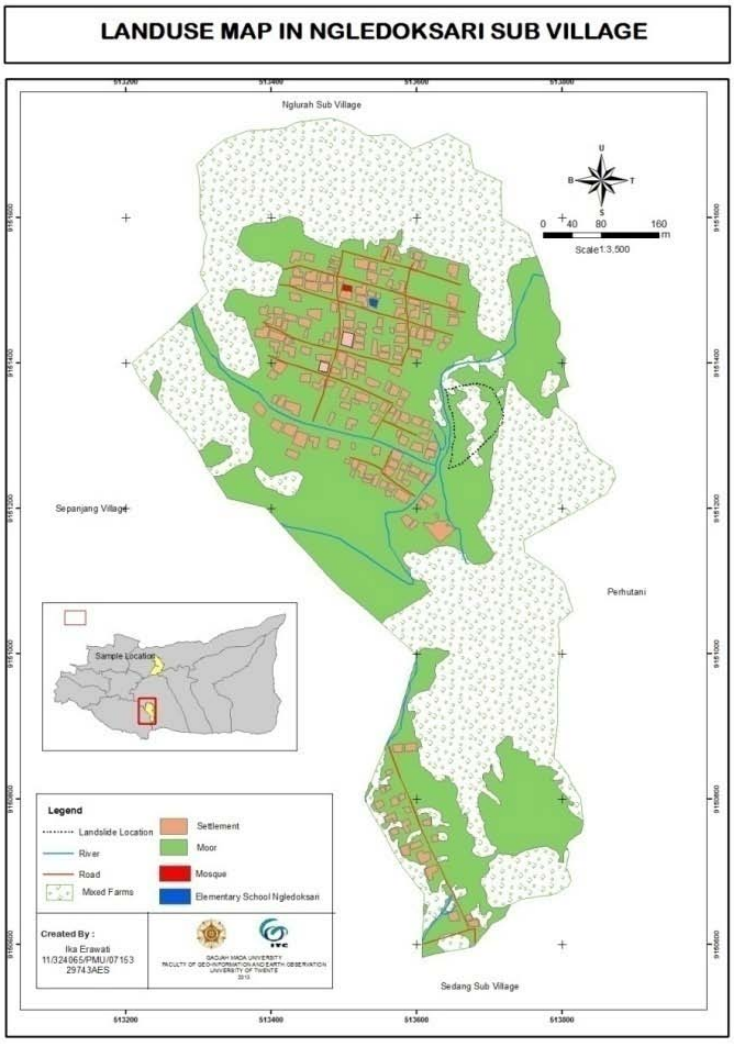


Figure 4.5 Landuse map in Ngledoksari Sub Village

4.2.2 Tengklik Village profile

The area of Tengklik Village is about 810,7810 Ha, wihich consists of four sub villages (Plalar, Sodong, Tengklik, and Guyon) with the boundaries Berjo Village Ngragoyoso (N), Kelurahan Tawangmangu and Nglebak Village (S), Plumbon Village (W), and Kelurahan Kalisor (E).

The total population in Tengklik Village in 2011 was 4.617 with the total household 1.368 (BPS, 2012). Based on sex group, the population consists of 2.307 male and 2.310 female. Furthermore, the population according to livelihood in Tengklik Sub village can be seen in table 4.5.

Table 4.5. Population according to livelihood in Tengklik Village

No.	Occupation	Total
1.	Labour - Civil Servant - ABRI - Private	 11 - 27
2.	Businessman	56
3.	Farmer	1937
4.	Carpentry/Pertukangan	179
5.	Farmer labour	1033
6.	Pensioner	5
7.	Transportation	11
8.	Services	62
9.	others	1296
	Total	4.617

Source : Tengklik Monography, 2012

Based on table 4.5, we can see that the most of the population in Tengklik Village work on an agriculture sector. Those are farmer and private laborer. It happens because Tengklik Village is rural village which oriented in an agriculture sector activities (vegetables, and rose flower).

Landuse in Tengklik Village consists of paddy field, settlement, mixed garden, grazing field, and forest. Commodity that produced in Tengklik Village comprises paddy, corn, cabbage, mustard greens, tomatoes, carrots, soya bean, chili, onion, red onion, beans, cucumber, and etc.

Guyon Sub Village Profile (Study Area)

Total population in Guyon Sub Village is 923 people (270 household) that consist of 453 male and 470 female. Most of the people in Guyon Sub Village work as farmer then labors, trader, etc.

Landuse in Guyon Sub Village is dominated by agricultural land such as dry field and mixed area. Addition there is settlement in this area. The area of each landuse can be seen in table 4.6.

Table 4.6. Landuse in Guyon Sub Village base on interpretation Quickbird.

No.	Land Use	Area (Ha)
1.	Settlement	2.83
2.	Dry Field	49.53
3.	Plantation/Mixed Garden	3.74

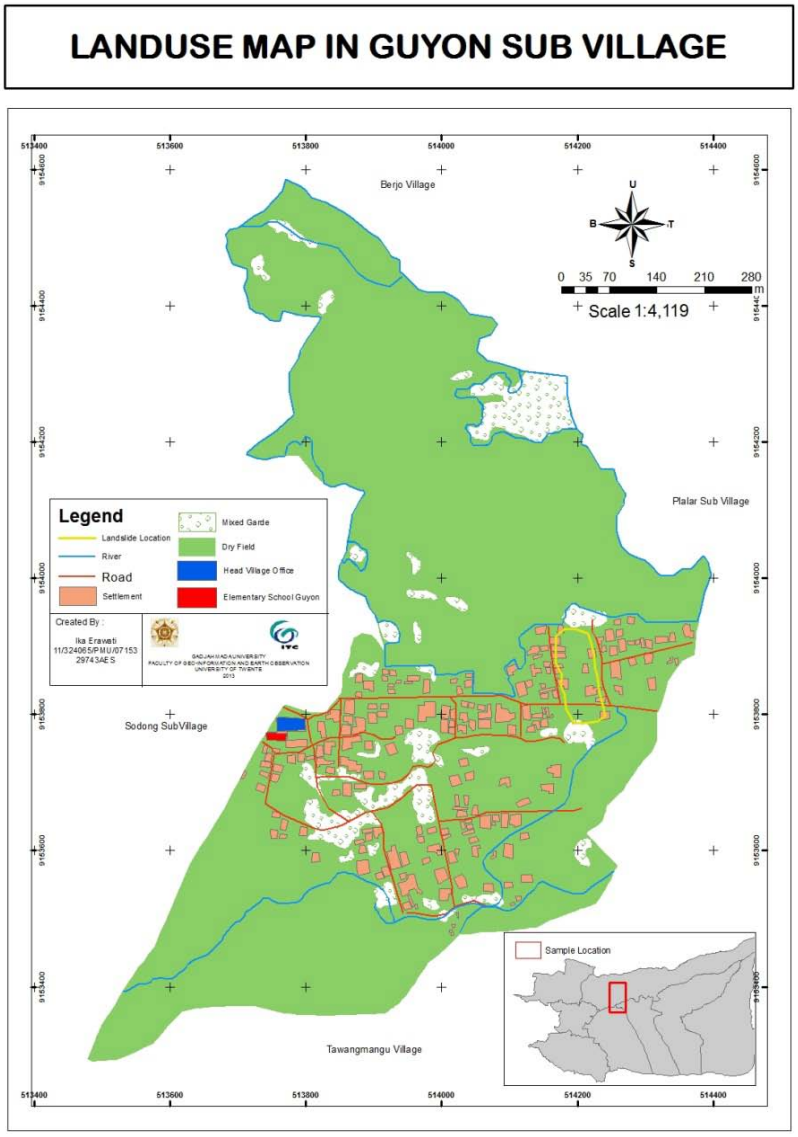


Figure 4.6 Landuse map in Guyon Sub Village

CHAPTER V
SOCIAL ECONOMIC PROFILE, ECONOMIC ACTIVITIES VULNERABILITY, AND LANDSLIDE RISK PERCEPTION OF RESPONDENTS

This chapter describes the social economic profile of 35 respondents in selected area, the impact of the 2007 landslide event, economic vulnerability, and economic loss.

5.1 Introduction

This research was using respondents for identifying economic vulnerability, community resilience toward landslide hazard and landslide risk perception of respondents. The respondents in this study area have different social economic condition which it was assumed would influence the community recovery ability after landslide event. Socio economic respondents that influenced respondent's perception related to landslide include gender, age and education, occupation. The respondents have been taken by household.

Community in both sub villages welcomed the research. They always provide complete information relate to premises research question. Each of respondent were visited by researcher are always received with open arms, friendly and explaines in detail data that requested by researcher.

5.2 Social economic profile respondent

5.2.1. Gender

Most of respondent that were taken in this research are male as 26 respondents (74.29%). Then 25.71% respondents are female who participated in this research. Table 5.1 shows the detail distribution respondents based on gender.

Table 5.1. Distribution of respondents based on gender

Gender	Frequency	Percentage (%)
Male	26	74.29
Female	9	25.71
Total	35	100

The male respondents were incorporated in this research because they could give more detailed information related to the landslide event than female respondent. They often stayed and looked at their house location during the landslide event for monitoring the landslide condition and even to keep their goods which can be saved. While their other families such as wife and their children have been evacuated to a

safe place (mosque, elementary school, village office, etc). Furthermore, male respondents in this research are head of household that has more knowledge about the landslide event in this area.

5.2.2. Age

In this research, five clases have been used for classify the age of the respondents. The youngest age of respondent is 26 years old and the oldest one is 70 years old. Table 5.2 shows distribution of respondents based on age. Most of the respondent is in the age range 41-50 years representing 14 respondents (40.00%). Furthermore, the smalest percentage of respondent's age is in the range of age > 61 years.

Table 5.2. Distribution of respondents based on age

Age of Range (years)	Frequency	Percentage (%)
20-30	3	8.57
31-40	4	11.43
41-50	14	40.00
51-60	12	34.29
> 61	2	5.71
Total	35	100.00

All of respondents have been living in the area more than 20 years ago but some respondents who have age more 40 years old can give more information related to the 2007 landslide event. It is because of the old people know more about historical of this sub village and more concerned to conserve the environment than the young people. This is evidenced by many young people who rarely do *"gotong-royong"* (working together) to clean up the road and environment. Young people who joined in group *"Karang taruna"* are not working optimally in both sub villages. They described about the landslide event, frequency, evacuation and their damage. According to the respondent's perception in Ngledoksari Sub Village, the 2007 landslide event was the biggest landslide in this area and only happened in first time. While respondent's perception in Guyon Sub Village, the 2007 landslide event was the biggest landslide and landslide occurred almost every year, especially in the wet season.

5.2.3. Education

The interview has been done to 35 persons, which 51.43% of the receives the elementary school as the last education level in their life and they are in percentage of age 41-50 and 51-60 years with 22.86%. The smallest percentage of education in this

research is Senior High School with 2.85% (only 1 respondent). It means that human resources in the study area (Ngledoksari and Guyon Sub Village) are still very low. Table 5.3 contains education level of respondent based on age range.

Table 5.3. Eduction level of respondent based on age range

Education Level	Frequency	Age (Percentage)					Total
		21-30	31-40	41-50	51-60	>61	
Elementary School	18	-	5.71	22.86	22.86	5.71	51.43
Junior High School	16	8.57	14.29	14.29	11.43	-	45.72
Senior High School	1	-	-	2.85	-	-	2.85
Total	35	8.57	11.43	40.00	34.29	5.71	100.00

5.2.4. Occupation

Based on interviews that have been conducted to respondents in both sub villages, there are some occupation types. Most of the respondents work as farmer/laborer of farmer that represented 74.29%. Then trader/merchant/florist is the second type of occupation people in this research. This occupation type has correlation with education level of respondents. Table 5.4 shows distribution respondents based on occupation in both sub villages, while the table 5.5 and 5.6 explain the distribution respondents based on occupation in each sub villages (Ngledoksari and Guyon Sub Villages).

Table 5.4. Distribution respondents based on occupation

Occupation	Frequency	Percentage (%)
Trader /Merchant/florist	5	14.29
Laborer	3	8.57
Farmer/labour of farmer	26	74.29
Goverment Officer	1	2.85
Total	35	100.00

Table 5.5 shows that most of people in Ngledoksari Sub Village work as trader of flower/florist with 41.67% (5 respondents), farmer with 25% (3 respondents), laborer with 33.33% (4 respondents), and only 1 respondent works as private sector sebanyakwith 8.33%. Although many agriculture land in Ngledoksari Sub Village, people work as trader specially trader of flower/florist. It is because Ngledoksari Sub Village located in Tawangmangu Village as urban area that oriented in tourism and services. In Ngledoksari sub Villlage, only 3 respondents who has mixed garden or dry field.

Table 5.5. Distribution respondents based on occupation in Ngledoksari Sub Village

Occupation	Frequency	Percentage (%)
Trader/Merchanr/florist	5	41.67
Laborer	3	25.00
Farmer/labour of farmer	4	33.33
Government Officer	0	0
Total	12	100

Table 5.6 shows that most of people in Guyon Sub Village work as farmer or labour of farmer with 95.65% (22 respondents) and only 1 respondent works as government officer (head of sub village). Although he works as government officer, he also works as farmer because he has dry field and mixed garden. All respondents in Guyon Sub Village have a mixed garden or dry field.

Table 5.6. Distribution respondents based on occupation in Guyon Sub Village

Occupation	Frequency	Percentage (%)
Trader/Merchant/florist	0	0
Laborer	0	0
Farmer/labour of farmer	22	95.65
Government Officer	1	4.35
Total	23	100

5.3 Economic Vulnerability

In this research, economic vulnerability classification was based on the section 2.2 explaining the economic activities as the main element at risk. Risk to production, distribution of products and livelihood are the main concern of the researcher.

5.3.1 Loss of Production/Productivity Cost

Loss of production is one of the direct impacts of the landslide to economic vulnerability. Loss of production in this research means the decline in agricultural production experienced by the people due to landslide. Agricultural commodities in both sub villages are mixed vegetables with terracing system. This is done because the both of sub villages are located on the hill of Mt.Lawu. Although most of people in this area cultivate vegetables, there are some people who cultivate paddy in the rainy season. As for agricultural commodities in the both sub villages consist of

carrots, Spanish onion, cabbage, corn, chili, mustard, bean, pea, peanut, tomatoes, chayote, eggplant, sweet potatoes, and cloves.

Agricultural plantations in this research are takes 4 months period that consist of preparatory phase, maintenance phase and harvesting phase. It means that the maximum harvesting frequency is 3 times a year. However, the frequency of harvesting varies from 1 times to 3 times a year due ti the diversity of the crops in the single land.

They cultivate their field with terracing system. Based on interview and questionnaire, farmers do not change the cropping pattern before and after the 2007 landslide. The people only change the irrigation system due to 2007 landslide, especially in Guyon Sub Village irrigation system that was damaged by land subsidence. The farmers installed the pipes to drain water to the field for irrigation purpose.

Agricultural commodities product in both sub villages are sold through middlemen who come to the farm location which will be marketed to the area around such as Solo, Yogyakarta, and surrounding areas. Tawangmangu Village is a supplier of vegetables to the surrounding areas. When the landslide event, the agricultural production disrupted and had the impact on non-current vegetable supply and the prices soar.

Table 5.7. Loss of agriculture production before and after 2007 landslide event in Ngledoksari Sub Village.

Commodity Name	Annual freq. of Cropping in 1 Year	Before Landslide		After landslide	
		Average amount per cropping (kg)	Total Production of Agriculture (kg)	Average amount per cropping (kg)	Total Production of Agriculture
Carrots	2	1,020	2,040	150	300
Spanish Onion	2	410	820	0	0
Cabbage	2	610	1,220	0	0
Chilli	3	120	360	45	135
Bean	2	600	1,200	0	0
Corn	2	800	1,600	0	0
Mustard	3	30	90	25	75
Celery	3	25	75	20	60
Peanut	1	400	400	300	300
Sweet potatoes	2	1,000	2,000	800	1,600
Cloves	1	10	10	0	0
TOTAL			9,815		2,470

To calculate the economic vulnerability, especially in terms of the decline in agricultural production, researcher attempt to calculate agricultural production for one year before and after the landslide event when the landslide occurred in the end of 2007. Table 5.7 and 5.8 explain the loss of agricultural production in Ngledoksari and Guyon Sub Villages.

From the table 5.7, we make a graph about it such as in figure 5.1 and can see that declined of agriculture production in Ngledoksari was significantly. It because the landslide located in agriculture land so the people did not work after landslide for two years. For more detail we can be seen in figure 5.1.

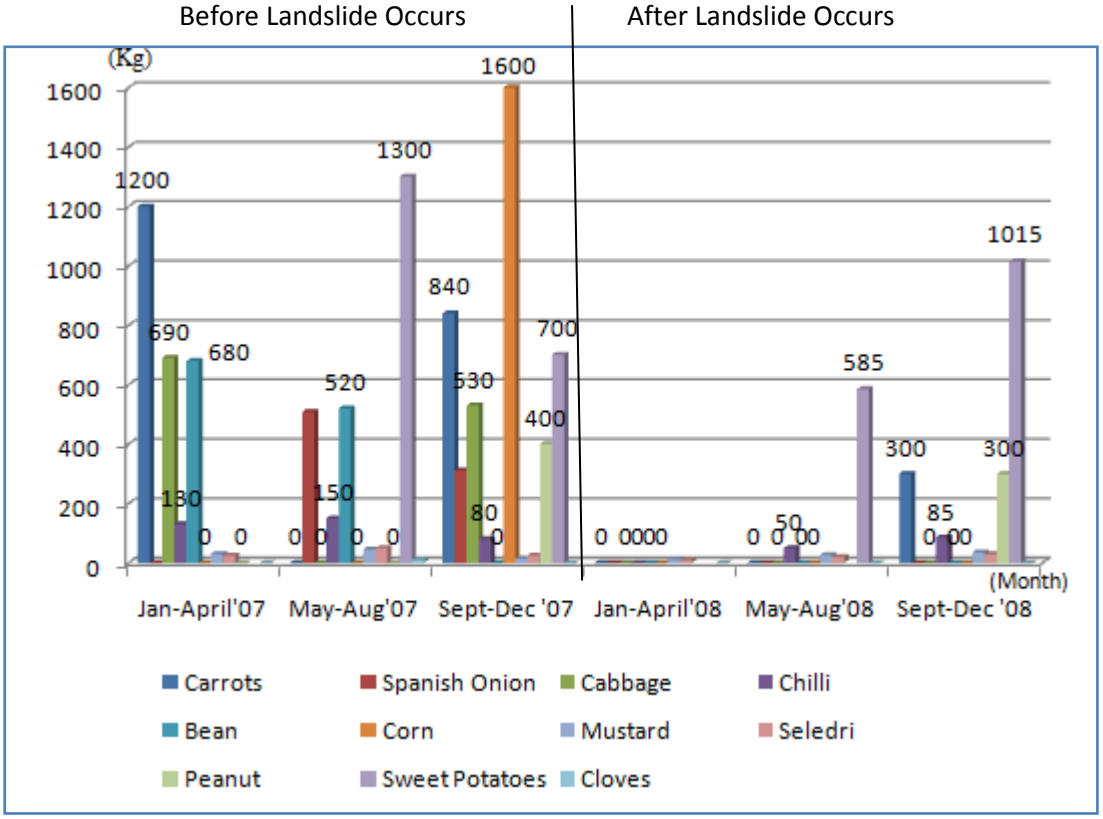


Figure 5.1. Graph of loss of agriculture production before and after 2007 landslide event in Ngledoksari Sub Village

As we know that people in Ngledoksari Sub Village have activities as florist, farmer and agricultural laboprers. There are only 3 respondents which the agricultural lands were affected by landslide. Even they did not work in the agriculture land for 2 years after landslide event so the agricultural land did not produce deeply. Based on calculation of result in Ngledoksari Sub Village, the biggest commodity is sweet potatoes with 2.000 kg before landslide and 1.600 kg after landslide (decline

production as 400 kg or 20%). The decline of commodities agricultural occurred in the first harvest period after landslide 2007 event (January-April 2008). Then the period of April-July 2008 the production of agricultural was increasing and recovered as before landslide 2007 event. The biggest decline in agricultural production is Spanish onion, cabbage, bean, corn, and cloves. It is because the area of agriculture was damaged by landslide 2007 so that number of agricultural production between before and after the 2007 have huge decline of agricultural production (table 5.7). There are different commodities that grow in both sub villages. Those are sweet potatoes and cloves that cultivated in Ngledoksari Sub Village while the commodities can not be found in Guyon.

Table 5.8. Loss of agriculture production before and after 2007 landslide event in Guyon Sub Village.

Commodity Name	Annual freq. of Cropping in 1 Year	Before Landslide event		After landslide	
		Average amount per cropping (kg)	Total Production of Agriculture (kg)	Average amount per cropping (kg)	Total Production of Agriculture (kg)
Carrots	2	43,550	87,100	38,250	76,500
Spanish Onion	2	22,275	44,550	20,015	40,030
Cabbage	2	29,160	58,320	25,570	51,140
Corn	1	3,800	3,800	3,970	3,970
Chilli	2	9,980	19,960	9,275	18,550
Paddy	1	19,500	19,500	17,700	17,700
Mustard	3	235	705	190	570
Bean	2	6,520	13,040	5,560	11,120
Pea	2	6,310	12,620	5,200	10,400
Peanut	1	1,900	1,900	1,800	1,800
Tomatoes	2	13,470	26,940	12,150	24,300
Chayote	2	150	300	150	300
Eggplant	2	245	490	235	470
Celery	2	3,280	6,560	2,730	5,460
TOTAL			295,785		262,310

The major parts of respondents are working on agricultural sector as farmers or workers. This evidence was proven by the presence of the arable land in research area. Therefore two systems of agricultural activities: the leasing system and the more

owner of the land. Most of the people in Guyon Sub Village have the agricultural land. Only some people who have the agricultural land with the leasing system.

Based on table 5.8 shows the agricultural production before and after 2007 landslide event in Guyon Sub Village, we can see that the condition in Guyon Sub Village also have declining of agricultural production in all of commodities except corn. Primary commodities in Guyon Sub Village are carrots, cabbage, chili, and Spanish onion. Almost people in Guyon Sub Village grow the primary commodity. While the minority commodities are mustard, chayote, eggplant, and celery. When the landslide occurred in Guyon Sub Village, the people did not work in the field for 3 until 4 weeks so that their commodity that neglected. The declining of agricultural production was also caused by the irrigation damaged indeed in dry season, the irrigation doesn't work well because there is no water to irrigate their fields.

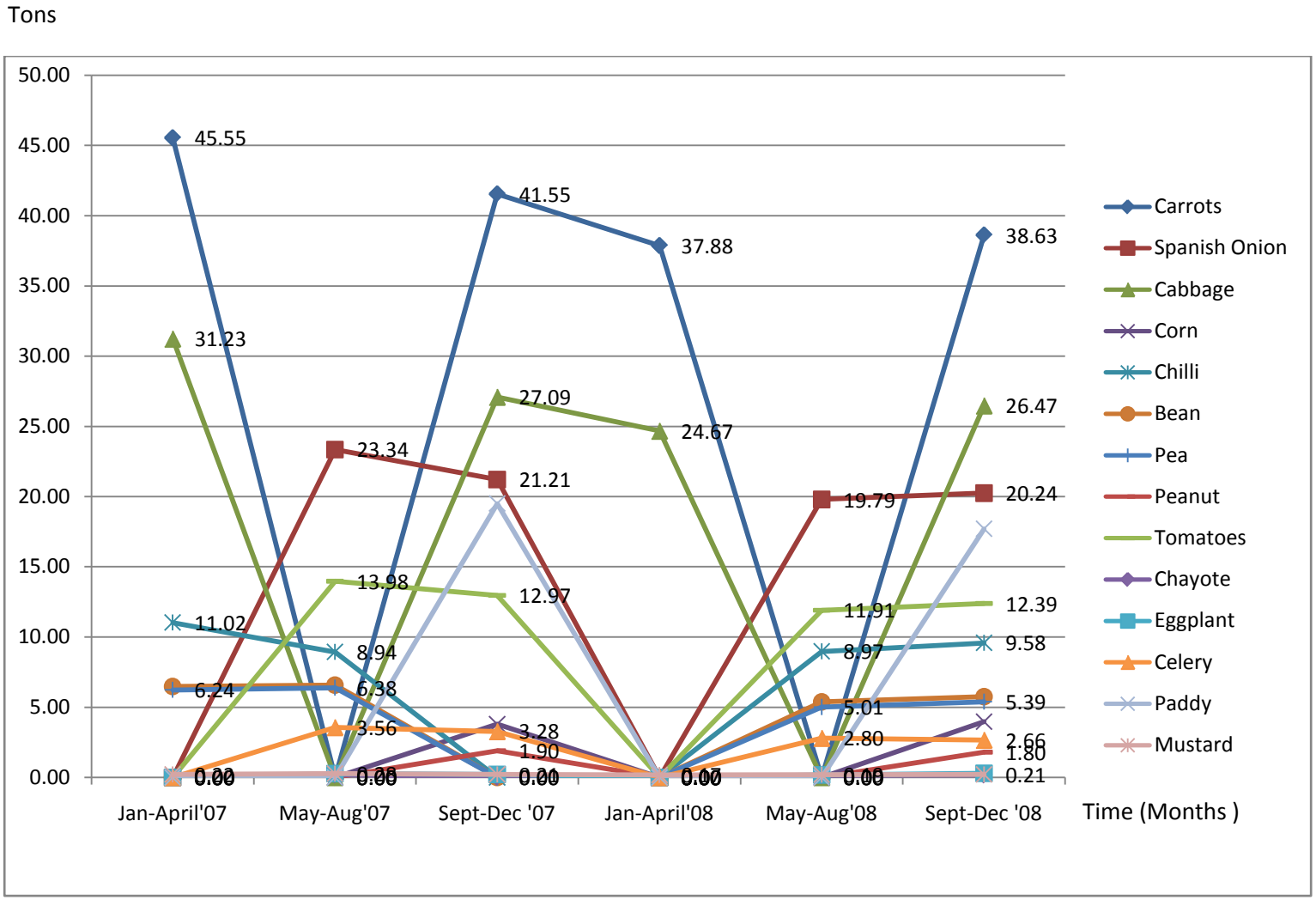


Figure 5.2. Graph of loss of agriculture production before and after 2007 landslide event in Guyon Sub Village

Based on figure 5.2 shows that decline agriculture production in Guyon Sub Village were not significantly because landslide located in settlement area (not agriculture land). It depend people who cultivated their land. The people did not work for 3 until 4 weeks.

Figure 5.3 shows the kinds of commodities that planted in both sub villages. One of picture in Figure 5.3.d. shows that in the dry season agricultural land out of production of agriculture commodities are planted or agriculture commodities can not grow as well because it affected the irrigation system. This is happened in Guyon Sub Village.

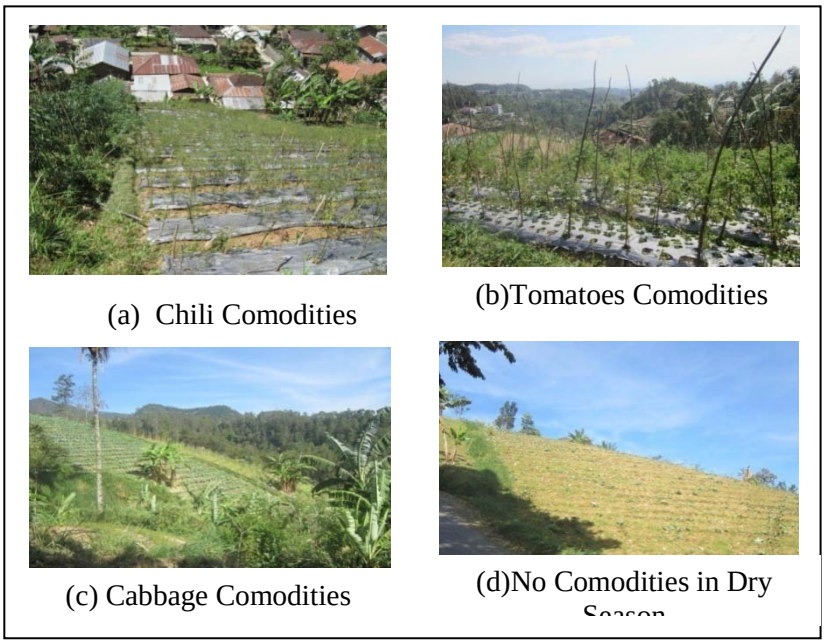


Figure 5.3. Kinds of commodities in study area

5.3.2 Damage of building and infrastructure

Secondly, economic vulnerability is damage to building and infrastructure. Damage to building in this research is in the form of damage to houses. Classification of damage based on the level of damage to buildings or houses. Houses damaged or building in both sub villages are classified in two categories. Those are totally destroyed/heavily and moderately damaged. Based on interview and questionnaire to respondents can be seen that all of respondents have experienced their houses and fields damaged. While the infrastructure that damaged is road and irrigation system. Government try to help the victims, especially the residence has a program with providing house improvement. Providing home repair for the victims is different between two sub villages. In Ngledoksari Sub village, totally damages housed received a grant Rp 10.000.000,- and the moderately damaged received Rp 6.500.000,-. While in Guyon Sub

Village, totally damaged received Rp 6.500.000,- and the moderately damaged received Rp 4.500.000,-.

Based on table 5.9, Ngledoksari Sub Village has 6 or 50% respondents which their houses are totally damaged by landslide and 4 (33.33%) respondents are moderately damaged. There are also 2 (16.67%) respondents are no damaged (only the field that damaged by 2007 landslide). The people in Ngledoksari that the field affected by 2007 landslide can not get the grant from government because allocation grant from government only to repair the house. The people tried to build their house by building their house as before, there is change in the form of house and there is even a shift away their house from the location of landslide. They do together to build their house with "*gotong royong*".

Table 5.9. Type of building damaged in both sub villages

Type of Damaged	Ngledoksari Sub Village		Guyon Sub Village	
	Frequency	Percentage	Frequency	Percentage
Totally damaged	6	50.00	16	69.57
Part of Damage	4	33.33	7	30.43
No damaged	2	16.67	0	0
Total	12	100.00	23	100

While in Guyon Sub Village also have 16 (69.57%) respondents which their houses are totally damaged by landslide and 7 (30.43%) respondents is moderately damaged. Most of the houses were completely destroyed can not be repaired because the soil was unstable, so they moved to the others area/villages around. People who move on the other places or build a house in new location has a feasibility level of life better than they still live in the village. People which the moderately damaged of house will be repaired their house by sliding house/fence away from the landslide site. Furthermore, figure 5.4 shows the landslide impact to the house, road and drainage system.

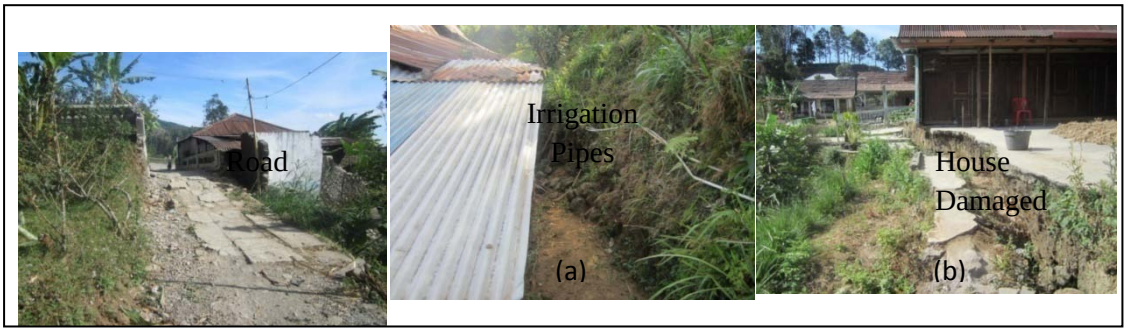


Figure 5.4. Landslide impact to the house, road and irrigation.

5.3.3 Capital cost of response and relief

Capital cost of response and relief also is one of direct losses of economic vulnerability. Capital cost of response and relief is one of important thing that use to recovery process. Most of the respondents in Ngledoksari Sub Villages have no capital cost of response to recovery process. All of their properties have been buried in the ground when the landslides occurred. All of properties consist of livestock, store basic food, and goods such as money and gold. Almost of respondents in Ngledoksari also have no saving money in the bank so that they have no resources to recovery them. They just have the spirit of mutual cooperation (*"gotong royong"*) of capital to rebuild their house.

Furthermore, respondents in Guyon Sub Village have the capital cost of response such as livestock, store basic food, and treasure. Their houses are not buried by landslide and only suffer cracks due to soil instability. Most of respondents in Guyon Sub Village sell goods to get extra or sell the livestock such as cow and buffalo for rebuild their house.

5.3.4 Impact on work force

Landslide in 2007 has impact on work force in both sub villages. People in Ngledoksari and Guyon Sub Villages work in non-formal sector such as farmer, trader, laborers, and mason or construction workers. When the 2007 landslide occurred, they people did not work until some weeks and even some months. It has impact to their income. They did not get the money if they did not work because they worked as non formal sector. Average income people in both sub villages every day is between Rp 25.000,- and Rp 30.000,-.

5.4 Economic Losses

5.4.1 Related to Agriculture Production

Economic losses also are one of the direct impacts related to the disaster. Economics are important things in daily life. Economic losses caused greatly effects on the economic recovery for the people in this research. Economic losses in this research depend on selling cost of each other commodity and the total production of agriculture. Selling cost of each other commodity is always changing by the prevailing market price.

Table 5.10 and 5.11 show that decline economic losses of agriculture product in both sub villages. Economic losses that came from the sale of agricultural product in both sub villages. In Ngledoksari estimate agriculture outcomes before landslide is Rp 24.560.000,- and after landslide is Rp 5.497.500,- . This is a decrease approximately 77.62%. While in Guyon Sub village, Estimate agriculture outcomes before landslide is Rp 884,490,000,- and after landslide as Rp 801,010,000,- (9.44% decrease).

Table 5.10. Economic losses of agricultural commodity in Ngledoksari

Commodity Name	Before Landslide			After landslide			
	Total Production of Agriculture (kg)	Average selling rate per Kg (Rp)	Estimate Agriculture outcomes (thousand Rp)	Average amount per cropping (kg)	Total Production of Agriculture	Average selling rate per Kg (Rp)	Estimate Agriculture outcomes (thousand Rp)
Carrots	2,040	2,000	4,080	150	300	2,200	660
Spanish Onion	820	7,000	5,740	0	0	6,000	0
Cabbage	1,220	1,000	1,220	0	0	1,200	0
Chilli	360	3,000	1,080	45	135	3,500	472.5
Bean	1,200	2,000	2,400	0	0	1,800	0
Corn	1,600	2,500	4,000	0	0	2,300	0
Mustard	90	1,000	90	25	75	1,000	75
Celery	75	6,000	450	20	60	5,000	300
Peanut	400	8,000	3,200	300	300	8,500	2,550
Sweet potatoes	2,000	1,000	2,000	800	1,600	900	1,440
Cloves	10	30,000	300	0	0	35,000	0
TOTAL	**9,815**		**24,560**		**2,470**		**5,497.5**

Table 5.11. Economic losses of aAgricultural comodities in Guyon Sub Village

Commodity Name	Before Landslide event			After landslide			
	Total Production of Agriculture (kg)	Average selling rate per Kg (Rp)	Estimate Agriculture outcomes (million Rp)	Average amount per cropping (kg)	Total Production of Agriculture (kg)	Average selling rate per Kg (Rp)	Estimate Agriculture outcomes (million Rp)
Carrots	87,100	2,000	174.20	38,250	76,500	2,200	168.30
Spanish Onion	44,550	7,000	311.85	20,015	40,030	6,000	240.18
Cabbage	58,320	1,000	58.32	25,570	51,140	1,200	61.37
Corn	3,800	2,500	9.50	3,970	3,970	2,300	9.13
Chilli	19,960	3,000	59.88	9,275	18,550	3,500	64.93
Paddy	19,500	5,000	97.50	17,700	17,700	5,500	97.35
Mustard	705	1,000	0.71	190	570	1,000	0.57
Bean	13,040	2,000	26.08	5,560	11,120	1,800	20.02
Pea	12,620	4,000	50.48	5,200	10,400	4,500	46.80
Peanut	1,900	8,000	15.20	1,800	1,800	8,500	15.30
Tomatoes	26,940	1,500	40.41	12,150	24,300	2,000	48.60
Sayyote	300	1,700	0.51	150	300	1,500	0.45
Eggplant	490	1,000	0.49	235	470	1,500	0.71
Celery	6,560	6,000	39.36	2,730	5,460	5,000	27.30
TOTAL	**295,785**		**884.49**		**262,310**		**801.01**

5.4.2 Related to Income from Loss of Work

People in Ngledoksari and Guyon Sub Villages experience a loss of income due to landslide. This is because they are working in agriculture sector such as farmer, laborer of farmer. Every household has a family member who worked in agriculture sector (farmer, agriculture farmer/construction) although they also have agricultural land. Based on interview result obtained information that the average of people income in both sub villages are Rp 25,000.- until Rp 30,000.-. People in Ngledoksari did not work as farmer/laborer for three weeks (± 21 days) and three until four weeks (± 25 days) in Guyon Sub Village. Based on the foregoing, it can be predicted about the loss of income for the people in both sub villages are greatly affected by landslide.

Table 5.12. Loss of income in both sub villages

Sub Village	Number of Respondent	Income/day (Rp)	Number of Day (Days)	Total Loss Income (Rp)
Ngledoksari	12	27,500	21	6,930,000
Guyon	23	27,500	25	15,812,500
Total				**22,742,500**

5.4.3 Related to Building/House Damaged

In section 5.3.2 has been discussed about the damage of building and infrastructure. There are two categories of building damaged, i.e. totally damaged and partial damaged. Losses suffered by the people in both sub villages are different depending on size and condition of their houses. The big house has big loss affected by landslide. Based on interview result, can be seen that losses building cost affected by landslide such as in table 5.13 and 5.14.

Table 5.13. Losses building cost in Ngledoksari Sub Village

Building Cost (thousand Rp)	Freq. (Number of Respondent)	Total Cost (thousand Rp)
0	3	0
20,000	1	20,000
25,000	1	25,000
30,000	1	30,000
35,000	1	35,000
40,000	2	80,000
45,000	2	90,000
50,000	1	50,000
Total	**12**	**330,000**

Table 5.14. Losses building cost in Guyon Sub Village

Building Cost (thousand Rp)	Freq. (Number of Respondent)	Total Cost (thousand Rp)
0	1	0
15,000	1	15,000
20,000	2	40,000
25,000	4	100,000
30,000	8	240,000
35,000	4	140,000
40,000	2	80,000
50,000	1	50,000
Total	**23**	**665,000**

5.5 Respondent Perception for Landslide

Based on interviews result, all of respondents in both sub villages said that the occurrence of landslide threaten daily life and their livelihood. It is evident that the landslide occurred on December 26, 2007 has made the local people had disruption in carrying out their daily lives. They can't do the usual activities every morning such as they go to the field to manage it. It affects to the production of agricultural decline event they failed harvest. As a result of the landslide, people

in Ngledoksari almost 3 weeks refuge in evacuation places. While People in Guyon Sub Village stayed in evacuation places for 2 weeks.

In addition, 2007 landslide occurred in both sub villages were called as disastrous. It is evident that 2007 landslide has killed 34 people and 12 houses were buried by land in Ngledoksari Sub Village. Whereas in Guyon Sub Village caused 33 houses damaged and could not be occupied by the owner. Landslide location in Ngledoksari Sub Village occurred at precisely the hillside farm owned by local residents, while in Guyon Sub village occurred in the area of settlements. People houses suffered sinkhole and cracked both walls and floors.

On the other hand, reforestation had been done in both sub villages after the 2007 landslide event. The reforestation has not reveal real result because the perennials tress planted in the area of landslide death and neglected crops such as aid reforestation plants was launched during dry season so the plants are drought and many eventually die. It's happened in Guyon Sub Village whereas there are some perennials trees in Ngledoksari Sub Village survive.

With the 2007 landslide event, the local people have experiences of landslide and they will be more prepared for natural hazard. Based on community knowledge through FGD and Participatory GIS, researcher makes prones area mapping of landslide and evacuation routes with community. Researcher and head sub village create vulnerability map that have high vulnerable using GPS. Figure 5.5 is a picture about focus group discussion in both sub villages. While Figure 5.6 and 5.7 are vulnerability map based on FGD and P Gis in both sub villages.

Furthermore, based on P Gis and FGD result also have been done evacuation route map in both sub villages. Ngledoksari Sub Village uses community house which long far from landslide location, elementary school, and mosque as evacuation places. Moreover, Guyon Sub Village uses elementary school and head office as evacuation places. Figures 5.8 and 5.9 show the evacuation route map in Ngledoksari and Guyon Sub Villages.

Figure 5.5. Focus Group Discussion in Ngledoksari and Guyon Sub Villages

Figure 5.6 shows that the vulnerability map in Ngledoksari Sub Village. It is classified in to three groups i.e. high, moderate, and low vulnerable level. Most of the region in Ngledoksari is high vulnerable level zone. It is because most of

the area in Ngledoksari Sub Village is hilly that planted with the agricultural commodities. It is very susceptible to the landslide hazard when the rainy season. Moreover, the settlement areas are in the moderate and low vulnerable zone. It located in the central region in Ngledoksari Sub Village which surrounded by hills.

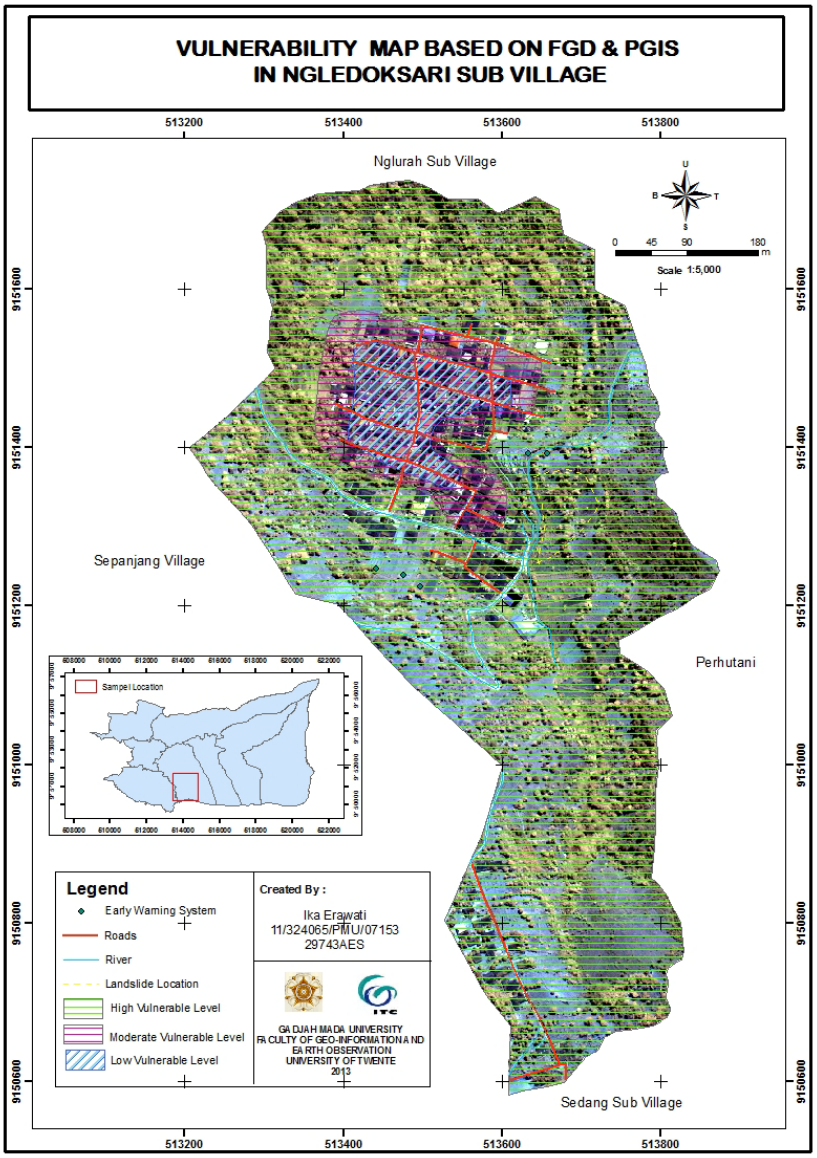


Figure 5.6. Vulnerability map based on FGD and PGIS in Ngledoksari Sub Village

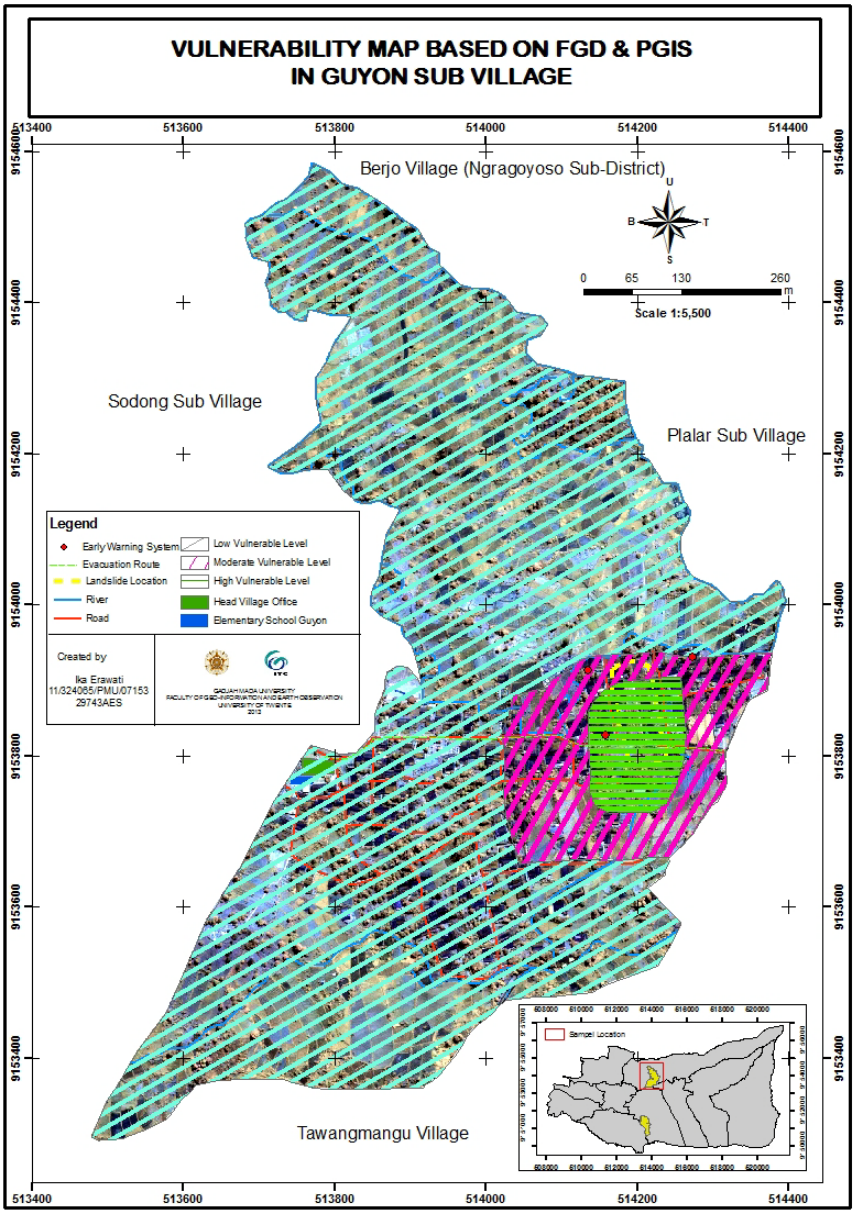


Figure 5.7. Vulnerability map based on FGD and PGIS in Guyon Sub Village

Figure 5.7 shows that the vulnerability map in Guyon Sub Village. It is also divided in to three classes. Those are high, moderate, and low vulnerable level. The high vulnerable zone is around the location of landslide. The site landslide is the settlement areas. Most of the areas in Guyon Sub Village is the low high vulnerable zone which is the agricultural land.

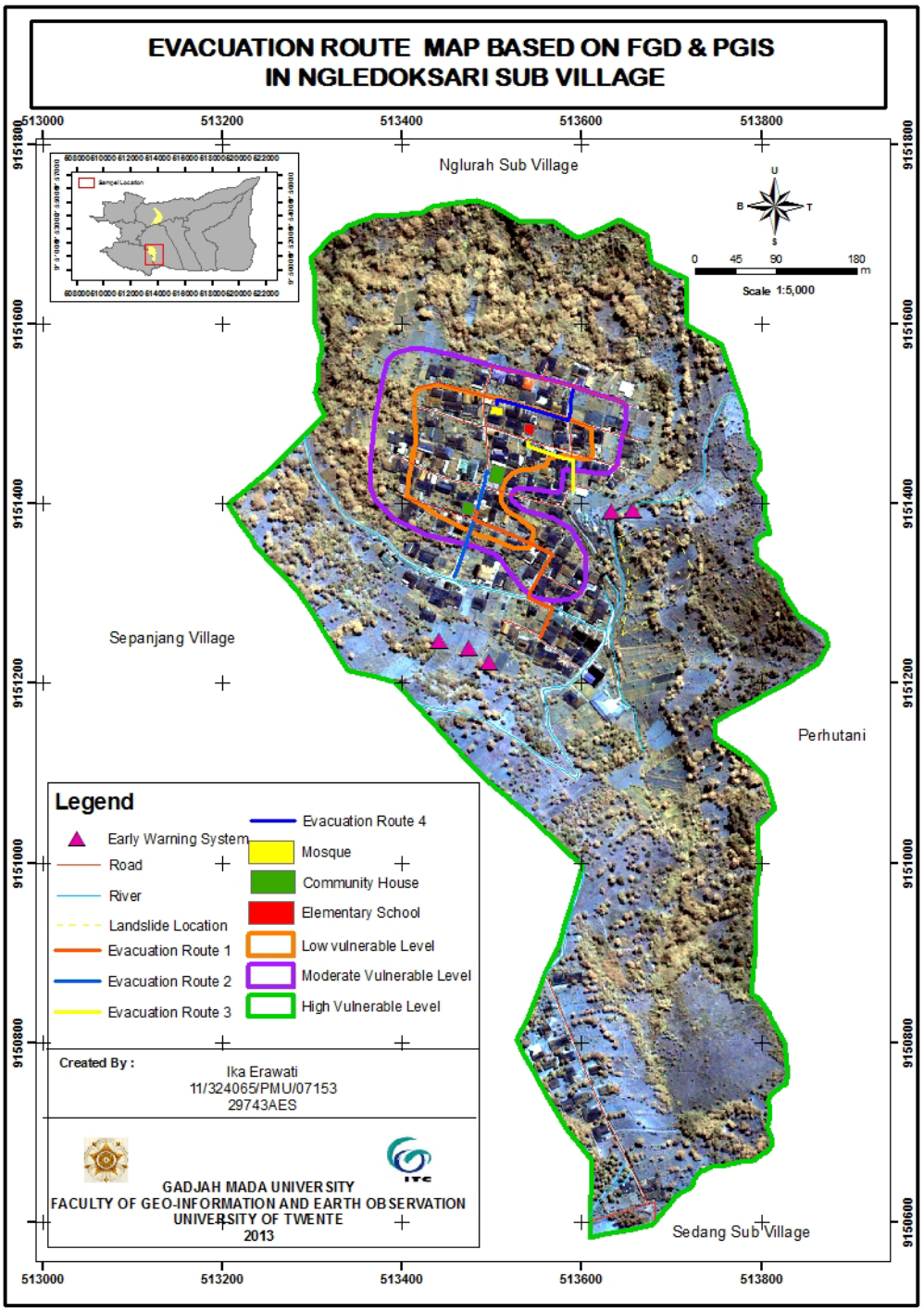


Figure 5.8. Evacuation route based on FGD and PGIS in Ngledoksari Sub Village

Figure 5.8 indicates the evacuation route in Ngledoksari Sub Village. Evacuation places consist of public facilities such as mosque and elementary school and community house which the safety location from landslide (community house that location so far from landslide location). There are four evacuation routes. It depends on the location of the evacuation places.

Socialization has been done about the routes of evacuation and what they do if the heavy rain happened.

Figure 5.9 shows the evacuation route in Guyon Sub Village based on PGIS and FGD. Evacuation places comprise head village office and elementary school which closed each others. There is only one of evacuation route in Guyon Sub Village.

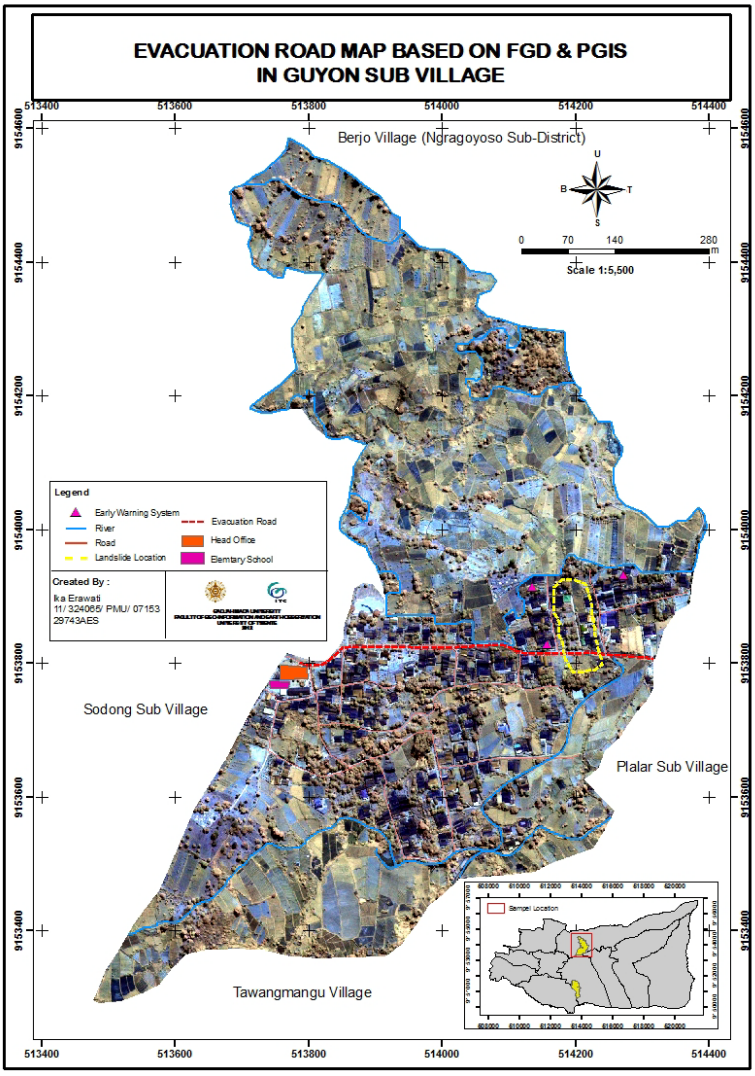


Figure 5.9. Evacuation route based on FGD and interview in Guyon Sub Village

5.6 Impact of Landslide event

5.6.1. Traumatic

Based on interview, most of respondents are traumatized. When the heavy rain occurs more than six hours, they still feel affraid about it. There are 74.29% (26 respondents) of the respondents still have the kind of psychological impact.

The female respondent usually still feel traumatized while the male respondent do not. The respondents which not traumatized feel are the people who can not effect landslide impact directly such as their house which avoid from buried land and their family survived. It usually located far away from the landslide location.

Based on interview result also we can see that the sudden landslide event with the huge volume has caused the trauma to the people. Most of people are familiar with this condition in Guyon sub Village. It is because the big landslide occurred in 2007 in rainy season and landslide happened every year so the land in Guyon Sub Village especially in prone areas collaps/subsidence until 9 meter commencing from 2007 to 2012. The land subsidence occurs slowly in rainy season. While People in Ngledoksari Sub Village assumed that the landslide event is not familiar. It is because only the big one landslide occurred in 2007. After 2007 landslide event, the people of Ngledoksari Sub Village do not feel the landslide occurs after that. Although only one single landslide event, people in Ngledoksari Sub Village felt trauma a long time because of the victims that occurred in this event. Even there are some people who are traumatized to come back in sub village (they loss their children and their parents). For more detail about psychology condition of respondents can be shown in table 5.15.

Table 5.15. Psychology condition of respondents in Ngledoksari and Guyon Sub Village

Psychology Condition					
	Trauma		No Trauma		Total
	Ngledoksari	Guyon	Ngledoksari	Guyon	
Frequency	9	17	3	6	35
Percentage	25.71	48.57	8.57	17.14	100
TOTAL	**74.29**		**25.71**		**100**

Based on table 5.15 shows that most of the respondents in Ngledoksari and Guyon Sub village have traumatized (74.29%) with represented 9 and 17 respondents. Only 3 and 6 respondents in both sub villages that have untraumatized (25.71%). Many traumatized people are located near with the location landslide and got directly impact of landslide especially there are victims from their families that buried in the ground.

Figure 5.10 and 5.11 show the spatial distribution of traumatized respondent spatial distribution in both sub villages. They are distributed randomly. Traumatic circumstance is more caused by distance their house with the landslide location. The nearer landslide location, the more trauma that their felt.

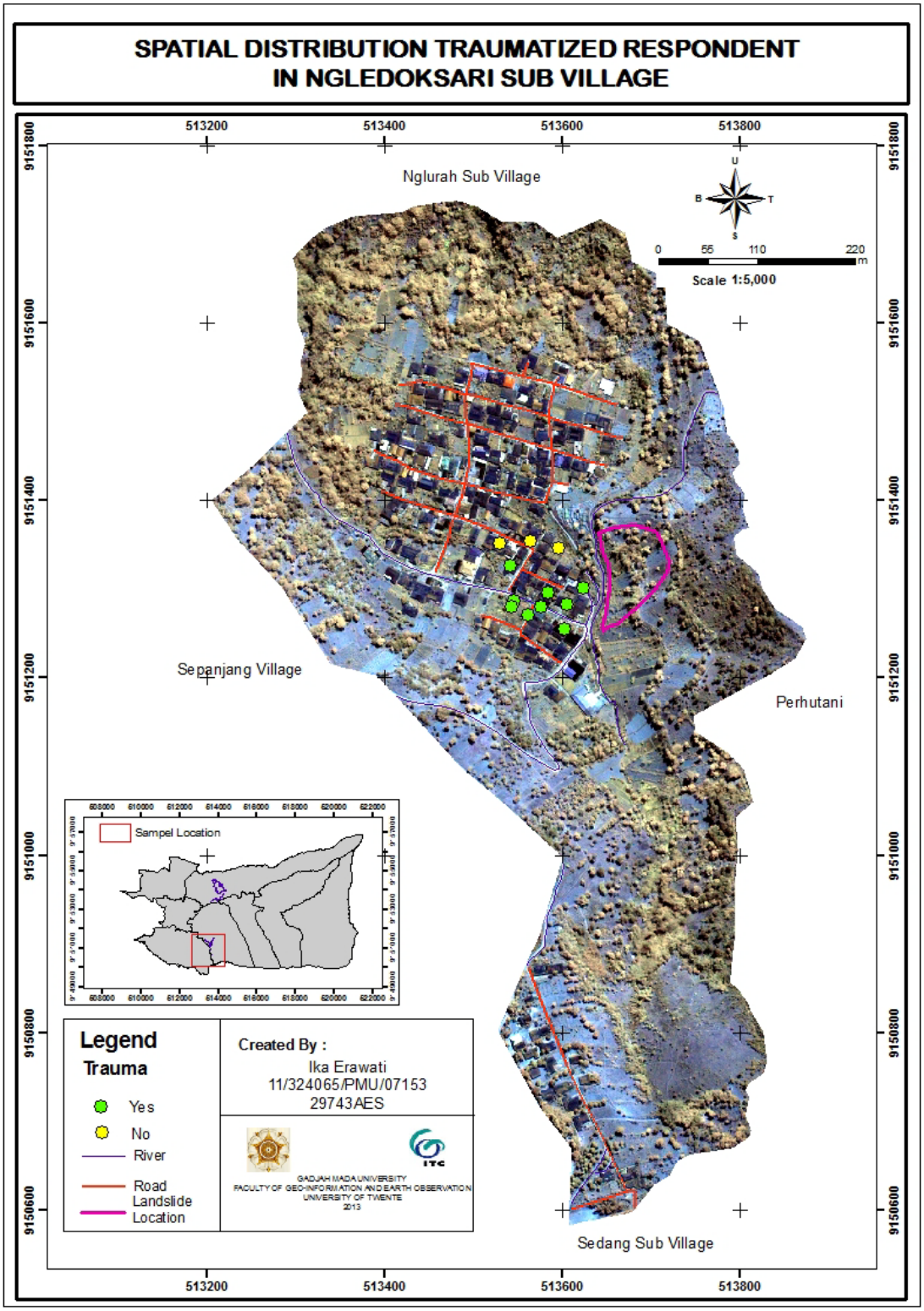


Figure 5.10. Spatial distribution of traumatized respondent in Ngledoksari Sub Village

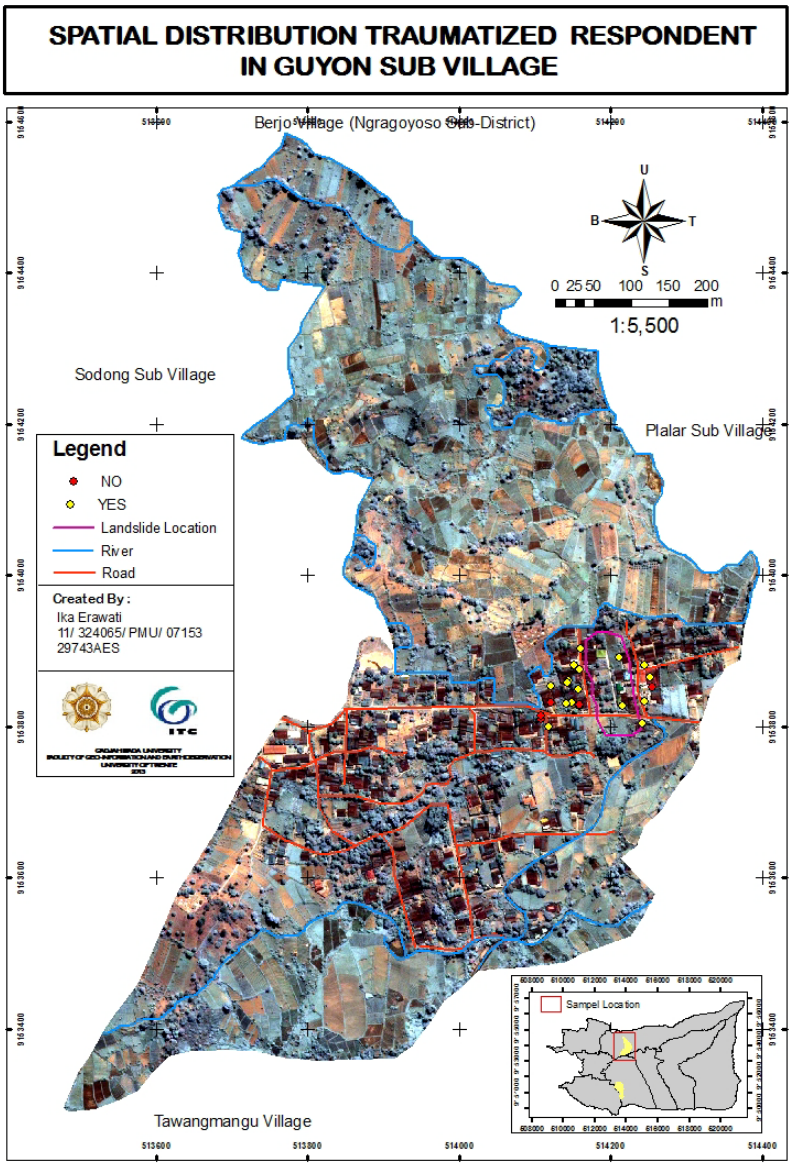


Figure 5.11. Spatial distribution traumatized respondent in Guyon Sub Village

5.6.2. Impact to Income

Landslide event has influenced to respondent's income. This is reasonable since most of their occupation is in non-formal sector. People could not go to work during and some days even almost more one month after landslide occur, people needed some days/weeks for cleaning their house when only most of their house have damaged by landslide or rebuild their house which damaged by landslide. According to the result of interview and questionnaire, we can say that all of respondents in study area have influences to their income. When the 2007 landslide occurred, they are not work until some weeks/months. They tried to

clean/build their house from the mud/land. They depend on help from Government or NGO to provide their basic need for two weeks.

Furthermore, people in Ngledoksari Sub village which their agricultural land affected by landslide (location of landslide) can not use their land for cultivation for two years. They try to recover their land as like originally in order to be planted. The people which agricultural land affected by landslide can't help from government. The types of occupation which had influenced by landslide are trader, farmer, and laborer. For more detail about landslide influence to income of respondent in both sub villages can be seen in table 5.16.

Table 5.16. Landslide influence to income of respondent in both sub villages

Influence to Income	Freq.	Percentage (%)
Yes	35	100%
No	0	0

CHAPTER VI
COMMUNITY RESILIENCE TOWARD LANDSLIDE

This chapter discusses the community resilience which is represented by the respondent in Ngledoksari and Guyon Sub Villages toward landslide. The resilience can be defined by the weighting the resilience factors such as human capital and economical capital. This chapter also discusses social capital and speed of recovery after the landslide.

6.1. Introduction

According to Islam et al (2000), there are five capital major forms in building community resilience. Those are natural capital, physical capital, social capital, economic capital, and human capital. Natural capital and physical capital are not investigated deeply in this research because they do not relate to the respondent's resilience. However, natural capital and physical capital also contribute in determining community resilience.

Islam et al (2000) mentioned that natural resources and environmental possesses are natural capital of community resilience. In both sub villages, soil fertility in this research is natural capital because it gives benefit for the people in this area. Many agricultural commodities production in this region are vegetables such as carrots, cabbage, bean, tomatoes, mustard, etc. This area is the region supplying vegetables to the solo, Yogyakarta, and surrounding areas.

Secondly, the building community resilience was influenced by physical capital. Based on Islam et al (2000), it can be categorized by residential housing, public buildings, dams, and levees. Furthermore, lifelines such as electricity, water, telephone, and critical facilities are also included in to the physical capital (Mayunga (2007) in Islam et al. (2000)). During the landslide event, the Ngledoksari and Guyon Sub villages are blackout/power outage area. The power outage was for safety reason. Government activated the general power sooner after the emergency time. Public building such as village head office, mosque, Elementary school, field that were not damaged, became evacuation area for some people in both sub villages.

This research focused on community resilience that will be investigated to respondents. There are two of five capitals in building community resilience e.g. human capital and economic capital. This research also considered to recovery time and social capital.

6.2. Human Capital

There are two elements of human capital that would be investigated in building community resilience in this research. According to Becker (1975) mentioned that characteristic and potential individual that are determined by the

intersection of nature (genetics) and nurture (social interactions and the environment), i.e. education, skill, health, self-esteem, self-efficacy. Skills and knowledge can be gained through education and experiences. Education and experiences can increase understanding or perception of community risk and also increase the ability in developing and implementing risk reduction strategies. In this research will be investigated education and experiences as factor in determining community resilience. Strengthen the human resource capacity to support crisis response through the training is needed.

6.2.1. Education

The first element in human capital is education. In previous section, have been described the education level in Ngledoksari and Guyon Sub Villages. Education level in both Sub Villages is varies from elementary school to Senior High School. The education level was distributed in some age range from 20 until more than 60 year. The level of education in Ngledoksari and Guyon Sub villages can be shown in Table 6.1.

Table 6.1. Education level of respondent in both sub village

Education Level	Ngledoksari		Guyon	
	Frequency	Percentage	Frequency	Percentage
Elementary School	7	58.33	13	56.52
Junior High School	5	41.67	9	39.13
Senior High School	0	0.00	1	4.35
TOTAL	12	100.00	23	100.00

Based on table 6.1 shows that level educations in Ngledoksari Sub Village is only elementary school (58.33%) and Junior high school (41.67%). It means that the level education is low quality because 9 year basic education program in this sub village has not been fulfilled. They assumed that higher education is not needed for working in agricultural land such as farmer, labour of farmer. In addition, people in this sub village are reluctant to go out of this sub village (migration) to find another job.

While in Guyon Sub Village, the most of the respondent's education level is elementary school with representing 13 respondents (56.52%) and junior high school with representing 9 respondents (39.13%). There was only 1 respondent in Guyon Sub Village who received their last education in Senior High school (The highest education level) while in Ngledoksari Sub Village there is no respondent who gained last education in Senior High School (the highest education level in Ngledoksari Sub Village is Yunior High School). The different level of respondent's education was shown in their first acceptance when the researcher came to their house. The people who have higher education, is easier in accepting researcher.

People who have lower education level are elderly. They have been stayed in this sub village from they were born until now. They didn't know about the landslide before the 2007 landslide event in there. They were shocked when the 2007 landslide occurred. It is because the first landslide occurs in the sub village during they lived in there. Coping mechanism that they did during and after landslide is knowledge that they got down from experience their parents/ancestor. Furthermore, the younger person who has higher education is more aware to this hazard. They are more active on updating information related to landslide. The landslide information that was updated by community before, during, and after disaster were evacuation route, evacuation places, assistance center, aid, and early warning system.

6.2.2. Landslide Experiences

Secondly, landslide experience is one of human capital in community resilience elements. Ngledoksari and Guyon Sub Villages are prone to landslide since the site is located in the foot hills of Mt. Lawu. Geomorpholigically, this area has undulating to hilly relief and the type of soil is weathering volcanic with a mixed of large and small boulders. This soil condition that's weathered volcanic made the more unstable due to the destruction of forest on the mountain slopes.

Most of respondents do not have experience about the landslide. All of people in Ngledoksari Sub Village said that the 2007 landslide event is their first experience and only one landslide event in Ngledoksari. Although there is now some early detection tools for ground movement and rainfall have been installed to anticipate the impact of landslide occurs. While all of people in Guyon Sub Village said the landslide event almost happens every year after 2007 landslide event but the 2007 landslide event is the biggest. Landslide experience in both sub villages can be seen in table 6.2.

Table 6.2. Landslide experiences of respondent in both sub villages

Landslide Experiences	Ngledoksari		Guyon	
	Frequency	Percentage	Frequency	Percentage
1 time	12	100	0	0
2-4 times	0	0	0	0
> 5 times	0	0	23	100
TOTAL	12	100	23	100

6.3.Economic Capital

Economic capital is one of major form in building community resilience. Economic capital is very important in recovery process to face disaster. Economic capital is financial resources that use of people for recovery after they get the problem in face disaster. It includes income, saving, investment, selling things,

and other fund sources. According to Mayunga (2007) in Islam et al. (2019), economic capital is very important in building disaster resilience because it can increase ability and capacity of people to absorb disaster impact and speed up of recovery. Eisinger (1988) mentioned that financial capital is often dominant because it is easy to measure and there is a tendency to put others capitals into financial terms: can result in an appropriately diverse and healthy economy if distribute fairly, i.e. saving, debt capital, investment capital, grants, etc.

Landslide had caused losses for people. In order to get back on the normal condition economic recovery is needed so that people need financial resources for the recovery. The main financial resource for the recovery is income which is assumed that it was used automatically by people in recovery process. However sometimes income is not enough for the recovery process so that the people needed other financial resources to support in recovery. The other financial sources include loan or credit, selling things, relation help and the others. The more financial resources are the faster recovery process.

Mostly, income can be defined by type of occupation. Most of people in Ngledoksari and Guyon Sub Villages work in non-formal sector such as farmer, laborer, and trader/florist. There is no occupation as civil servant, teacher or others which has income routinely in this area. They usually have a low income. Income of household is an indicator that can't be used to measure the level of family welfare because the distribution of income is different among family (Todaro and Smith, 2006).

The income of household or people who work in non-formal sector usually was influenced by the landslide. The landslide has disrupted to their income because they did not work for some week if the landslide occur. The landslide influence to income of respondent can be seen in table 5.9 in sub title impact of landslide event. Landslide caused damage to irrigation and agricultural land. Consequently, they needed another financial source to recover from landslide impact including refund the business and agricultural production.

6.4. Social Capital

According to Putnam (1995) in Islam et al. (2010) Social capital defined as social organizations such as network, norms, and social trust that facilitate coordination and cooperation for mutual benefit. While Coleman (1988) social capital defined as interaction among individuals that occur with a degree of frequency and comfort, i.e. mutual trust, reciprocity, collective identity, sense of shared future, and working together. In addition, social capital can help the survivors recover more quickly but can also have the effect of excluding from assistance those who are not insiders to the network (Daniel. 2012). Furthermore emergency managements of government help people during disasters such as Red

Cross and Salvation Army. Even the neighbors also help the affected persons during the disaster. The spirit of togetherness in working together and helping each other to overcome problem. It called as "*gotong royong*" also became social capital. Some private companies in Karanganyar Regency and other cities also gave attention to the 2007 landslide event. They gave aid to people in both sub villages such as food, instant noodle, rice, second clothes, milk, medicine, and other essential needs. Social capital resources are useful to improve a community's resilience to risk and hazard (Murphy, 2007 in Islam et al. (2010)).

Gotong royong is working together of people in Ngledoksari and Guyon Sub Villages for constructing their house after 2007 landslide event. In Guyon sub village, their houses damage since the 2007 landslide event. Even their houses can not use as a residence for people and they have to build the new house in the new location since the old house location is subsidence and unstable soil condition. While in Ngledoksari sub village, the people always do "Gotong royong" for build/repair their house that damaged. The spirit of cooperation with others is established on three basic ethnics. Those are harmony, respect, and "gotong royong". The harmony and respect were implemented during and after disaster such as people helped each other in distributing food, clothes, and medicine, updating early warning system and informing evacuation road and places. While the spirit of "gotong royong" also looked in recovery time, i.e. cleaning the main road from land, build their houses, and repair the irrigation. Figure 6.1 shows that one of community activities in Ngledoksari Sub Village.

"Gotong royong to clean the irrigation system

"Gotong royong to repair the road

Figure 6.1 Community activities in Ngledoksari Sub Village

6.5.Speed Recovery

The first activity that people in Ngledoksari and Guyon Sub Villages after landslide is cleaning up the house from soil/mud and main road in this area. In

Ngledoksari Sub Village, 2007 landslide event killed 34 people. They were buried by landslide in their houses. In this sub village, emergency response had been held for 14 days and had been used to find the victims. Many volunteers help to find the victims and make the route evacuation. This research also asked the speed of recovery of respondent in term of cleaning up the house after 2007 landslide event. Speed of recovery among respondent was vary. The variation of the recovery speed was influenced by different factors. Those are the damage level of house, landslide experiences, family member, landslide preparedness, and external aid.

Damage level of the house of each respondent is different. It depends on distance from the landslide site. The closer to the landslide site, the greater to the damaged. In addition to the distance factor, the level of damage is also affected by building type in terms of its material and building age.

The second factor that's influence speed of recovery is landslide experiences. Landslide experiences can help people in cleaning up the house and the main road. People who have more experiences knew what should do for evacuating their belonging and family before the next landslide occur. For example, when the heavy rains happen in the wet season for a long day (more than 5 hours), people and their family know what they should do such as they are getting ready on the terrace to immediately evacuate to safer place (the others family house). Respondent's landslide experiences in Ngledoksari Sub Village don't have experience about landslide so that they are shocked about landslide. They only one time landslide occurred in 2007. Based on table 6.5 below, we can see that speed of physical recovery in Ngledoksari between 4 days and 1 month. The fastest speed of recovery in ngledoksari is 4- 7 days and the longest is 1 month.

While respondent's landslide experiences in Guyon Sub Village have been felt landslide event every year, although the big landslide occurred in 2007. Generally, they felt more one time. It makes Guyon's people more ready and more accustomed to the landslide event in this area. There are some houses which did not use to stay, in the others say their house damaged and could not repair. Meanwhile, the houses still occupied, they improved it by making a retreat to a safer distance. Speed recovery of landslide in this research depends on location and impact from landslide occurs. The nearer of the landslide location, the longer of speed recovery process. The cross tabulation speed of physical recovery and landslide experiences in Ngledoksari and Guyon Sub Villages can be seen in table 6.3 and table 6.4.

Table 6.3. Crosstabulation speed of physical recovery and landslide experiences in Ngledoksari Sub Village.

Landslide Experiences	Physical Recovery Time						Total	
	< 1 Week		Freq.	> 1Week			Freq.	Percentage
	1-3 days	4-7 days		1-2	2- 4	4-8		
1 time	-	3	3	6	2	1	12	100
2-4 time	-	-	-	-	-	-	-	-
> 5 time	-	-	-	-	-	-	-	-
Total	-	3	3	6	2	1	12	100

Table 6.4. Crosstabulation speed of physical recovery and landslide experiences in Guyon Sub Village.

Landslide Experiences	Physical Recovery Time						Total	
	< 1 Week		Freq.	> 1Week			Freq.	Percentage
	1- 3 days	4-7 days		1-2	2- 4	4-8		
1 time	2	-	2	-	-	-	2	8.70
2-4 time	-	2	2	5	3		10	43.48
> 5 time	-	1	1	3	4	3	11	47.83
Total	2	3	5	8	8	3	23	100.00

The other factor is family member. Cleaning up the house after landslide usually was done by family member. A family that had more teenagers and adult, could clean the house faster than family that had less one. Generally, people in Ngledoksari and Guyon Sub Villages have son and daughter, in the others say every household has three or more family number. It will be helped to cleaning up or repair the house after landslide occurs. In this research, researcher defined teenagers is people who has age in the range of 12 until 22 and elderly is people who has age more than 60 year. So that the family number that could help to clean the house/repair the house is person who has age in the range 12 until 60 years old. The relation between recovery time, in term of cleaning up/repair the house and family number can be shown in table 6.5 and 6.6.

Based on table 6.5 shows that the fastest physical recovery related to family number is 4-7 days (less than 1 week) and the longest time to physical recovery is more than 1 month (4-8 weeks). It is not correlation with family number. The physical recovery time depends on the level of houses/building damaged. The fastest physical recovery times usually has the part of house/building damaged.

Table 6.5. Crosstabulation speed of physical recovery and family number in Ngledoksari Sub Village.

Family Number	Physical Recovery Time						Total	
	< 1 Week		Freq.	> 1 Week			Freq.	Percentage
	1- 3 days	4-7 days		1-2	2- 4	4-8		
1	-	1	1	-	-	-	1	8.33
2	-	1	1	-		1	2	16.67
3	-	2	2	1	-	-	3	25.00
4	-	3	3	2	-	-	5	41.67
5	-	1	1	-	-	-	1	8.33
TOTAL			**8**	**3**		**1**	**12**	**100**

Table 6.6 shows that the fastest time to physical recovery time related to the family number is less than 1 week (1-3 days) and the longest time is more than 1 month (4-8 weeks). Physical recovery time in Guyon Sub Village depends on the number of family and the level of house/building damaged. The more family number can to increase the physical recover. Some respondents in Guyon Sub Village did not build their house in the area but they build their house in the other location (sub village and even in the othe village). They are worry about the land condition in guyon Sub Village.

Table 6.6. Crosstabulation speed of physical recovery and family number in Guyon Sub Village.

Family Number	Physical Recovery Time						Total	
	< 1 Week		Freq.	Week			Freq.	Percentage
	1- 3 days	4-7 days		1-2	2- 4	4-8		
1	-	-	-	1	-	-	1	4.35
2	-	1	1	-	1	-	2	8.70
3	1	2	3	6	2	1	12	52.17
4	1		1	1	3	1	6	26.09
5	-	-	-	1	-	-	1	4.35
6	-	-	-	-	-	-	-	0.00
7	1	-	1	-	-	-	1	4.35
TOTAL	**3**	**3**	**6**	**9**	**6**	**2**	**23**	**100**

Landslide preparedness is next factor that influenced in recovery time. Information related to rainfall and ground movement is important in landslide preparedness. Almost people in this area did not suppose that will be landslide in 2007 because there were no sign of preceding occurrence landslide. Landslide in 2007 is the first big landslide happened in some villages in Tawangmangu Sub

District including in Ngledoksari and Guyon Sub Villages. Therefore some people did not prepare themselves in facing the landslide.

The next factor is external aid that influenced the recovery time. Based on interview and questionnaire, some people got external aid but some other people did not. The aid could be from their family or relations. After 2007 landslide occurred in Ngledoksari Sub Village, family or community from other area came and helped in cleaning up the house from mud or repair their house which damaged. Even they also helped to find the victims who buried in the land. Furthermore, the family of some people also gave some money to buy materials in repairing the house. While in Guyon Sub Village, the community in this area work together to clean and repair the main road because the main road is the one access way to come and go in this area. There is no external aid that came in Guyon Sub Villages from their family. It was because all of family lived in this location. Landslide site was on settlement area so their house can not repair because their land was unstable. Finally, they moved to other places such as other sub villages, villages and even other sub districts. Cross tabulation of physical recovery time and external aid of both sub villages can be seen in Table 6.7 and 6.8.

Table 6.7. Crosstabulation speed of physical recovery and external aid in Ngledoksari Sub Village

External Aid	Physical Recovery Time					Total	
	< 1 Week		Freq.	> 1 Week		Freq.	Percentage
	1- 3 days	4-7 days		1-2	2- 4		
No Person	-	-	0	-	-	0	0.00
1-5 Person	-	-	0	-	-	0	0.00
6-10 Person	-	-	0	-	1	1	8.33
11-15 Person	-	-	0	-	-	0	0.00
16-20 Person	-	-	0	-	-	0	
> 20 Person	1	7	8	3	-	11	91.67
TOTAL	1	7	8	3	1	12	100

Table 6.7 represents that external aid has impact to the physical recovery time. All of respondents in Ngledoksari Sub Village got the external aid such as "*gotong royong" (working to each other)*. They have a spirit to live together with neighbor with the working together to build their houses. Most of respondents have the time to build their house is less than 1 week with more than 20 person who help each other of people. Only 1 respondent is only 6-10 persons who help it.

Table 6.8. Crosstabulation speed of physical recovery and external aid in Guyon Sub Village

External Aid	Physical Recovery Time						Total	
	< 1 Week		Freq.	> 1Week			Freq.	Percentage
	1- 3 days	4-7 days		1-2	2- 4	4-8		
No Person	-	-	-	-	-	-	0	0
1-5 Person	-	-	-	-	-	1	1	4.35
6-10 Person	1	-	1	1	5	2	9	39.13
11-15 Person	-	1	1	5	1	-	7	30.43
16-20 Person	-	2	2	2	-	-	4	17.39
> 20 Person	1	1	2	-	-	-	2	8.7
TOTAL	2	4	6	8	6	3	23	100

Table 6.8 shows that most of respondents in Guyon Sub Village need external aid to the physical recovery. It has the different phenomena with the Ngledoksari Sub Village. Eventhough, Spirit of "*gotong royong*" also was done in Guyon Sub Village, the physical recovery time had varies time. It is because some respondents/people did not build their house in this area again but they build in the other areas. Their land in Guyon Sub Village is unstable land do they afraid to live in there.

6.6.Weighting Value for Community Resilience

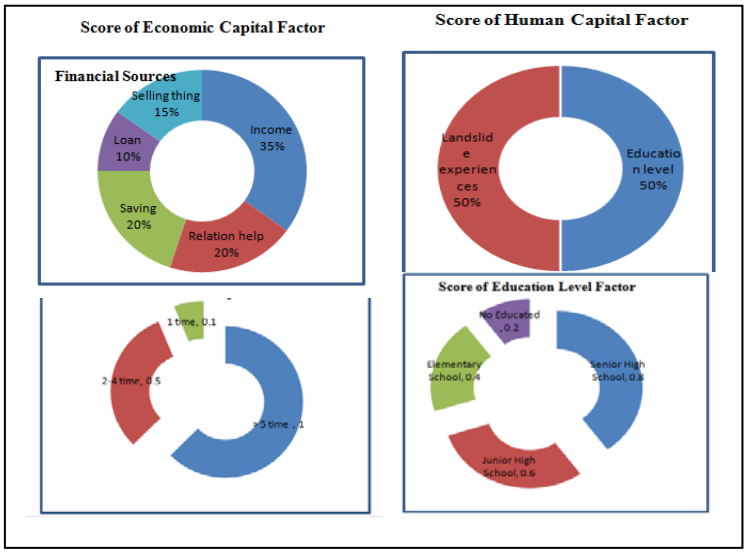


Figure 6.2. Score of resilience factor in Ngledoksari and Guyon Sub Villages based on FGD result.

Based on FGD result that had been held in two sub villages, the score and weighting value in community resilience can be seen in figure 6.2. There are three factors of resilience building that was discussed with the community in order to determine the score. They are landslide experiences, financial resources, and education level. In FGD, the participants decided the range of landslide experiences, the order of finance sub factor and education level. This was aimed to make participant classified each factor easily.

Based on resilience factor value below, the resilience value for each respondent Ngledoksari and Guyon Sub Villages can be calculated. Table 6.9 and 6.10 show that the result of resilience value in Ngledoksari and Guyon Sub Villages. The distribution value of resilience in Ngledoksari is from 0.175 until 0.350 and in Guyon Sub Village is from 0.425 until 0.800.

Table 6.9. Result of resilience value in Ngledoksari Sub Village

No. Resp.	Eco. Cap.	Fin. Source	Total Ec. Capital	Human capital	Total Edu. level	Total Landslide experiences	Total Human Capital	Total Comm. Resilience
1	0.5	0.1	**0.05**	0.5	0.2	0.05	**0.125**	**0.175**
2	0.5	0.1	**0.05**	0.5	0.2	0.05	**0.125**	**0.175**
3	0.5	0.1	**0.05**	0.5	0.3	0.05	**0.175**	**0.225**
4	0.5	0.35	**0.175**	0.5	0.3	0.05	**0.175**	**0.35**
5	0.5	0.2	**0.1**	0.5	0.3	0.05	**0.175**	**0.275**
6	0.5	0.2	**0.1**	0.5	0.2	0.05	**0.125**	**0.225**
7	0.5	0.35	**0.175**	0.5	0.2	0.05	**0.125**	**0.3**
8	0.5	0.35	**0.175**	0.5	0	0.05	**0.025**	**0.2**
9	0.5	0.35	**0.175**	0.5	0.2	0.05	**0.125**	**0.3**
10	0.5	0.1	**0.05**	0.5	0.2	0.05	**0.125**	**0.175**
11	0.5	0.35	**0.175**	0.5	0.3	0.05	**0.175**	**0.35**
12	0.5	0.2	**0.1**	0.5	0.2	0.05	**0.125**	**0.225**
Average			**0.115**				**0.133**	**0.248**
Percentage			**46.218**				**53.782**	**100.000**

Based on calculation of weighting resilience factor, it divided in to three classes. Total resilience value close to 1 means it has a high level of resilience while the total resilience value close to 0 means a low level of resilience.

In theory, respondent who have smaller resilience value will be more vulnerable than respondent that have bigger resilience value. Furthermore, respondent who has the smallest resilience value and located on deep zone of landslide prone areas is the most vulnerable person toward landslide. On the other hand, respondent who has the biggest resilience value and also located on deep zone of landslide prone areas but they have been moved on the other places

(neighbor sub village even on other villages) that have safe area is the least vulnerable toward landslide.

Based on table 6.9 and 6.10, the average of resilience in Ngledoksari Sub Village is 0.248. About 46.22% of the value came from economic capital factor while 53.78% came from human capital. The average resilience value for Guyon Sub Village is 0.529 which 29.36% came from economic capital and 70.64% came from human capital factor. This research shows that human capital gave bigger influence than economic capital in determining resilience value of community, especially in study area.

Table 6.10. Result of resilience value in Guyon Sub Village

No. Resp.	Eco. Cap.	Fin. Source	Total Ec. Capital	Human capital	Total Edu. level	Total Landslide experiences	Total Human Capital	Total Comm. Resilience
1	0.5	0.35	**0.175**	0.5	0.2	0.5	**0.35**	**0.525**
2	0.5	0.35	**0.175**	0.5	0.2	0.5	**0.35**	**0.525**
3	0.5	0.35	**0.175**	0.5	0.2	0.5	**0.35**	**0.525**
4	0.5	0.15	**0.075**	0.5	0.2	0.5	**0.35**	**0.425**
5	0.5	0.35	**0.175**	0.5	0.3	0.5	**0.4**	**0.575**
6	0.5	0.2	**0.1**	0.5	0.3	0.5	**0.4**	**0.5**
7	0.5	0.15	**0.075**	0.5	0.2	0.5	**0.35**	**0.425**
8	0.5	0.55	**0.275**	0.5	0.3	0.5	**0.4**	**0.675**
9	0.5	0.5	**0.25**	0.5	0.2	0.5	**0.35**	**0.6**
10	0.5	0.45	**0.225**	0.5	0.3	0.5	**0.4**	**0.625**
11	0.5	0.15	**0.075**	0.5	0.3	0.5	**0.4**	**0.475**
12	0.5	0.5	**0.25**	0.5	0.2	0.5	**0.35**	**0.6**
13	0.5	0.2	**0.1**	0.5	0.2	0.5	**0.35**	**0.45**
14	0.5	0.15	**0.075**	0.5	0.2	0.5	**0.35**	**0.425**
15	0.5	0.2	**0.1**	0.5	0.3	0.5	**0.4**	**0.5**
16	0.5	0.15	**0.075**	0.5	0.2	0.5	**0.35**	**0.425**
17	0.5	0.35	**0.175**	0.5	0.3	0.5	**0.4**	**0.575**
18	0.5	0.15	**0.075**	0.5	0.2	0.5	**0.35**	**0.425**
19	0.5	0.5	**0.25**	0.5	0.3	0.5	**0.4**	**0.65**
20	0.5	0.35	**0.175**	0.5	0.2	0.5	**0.35**	**0.525**
21	0.5	0.7	**0.35**	0.5	0.4	0.5	**0.45**	**0.8**
22	0.5	0.15	**0.075**	0.5	0.2	0.5	**0.35**	**0.425**
23	0.5	0.2	**0.1**	0.5	0.3	0.5	**0.4**	**0.5**
Average			**0.155**				**0.374**	**0.529**
Percentage			**29.363**				**70.637**	**100.000**

Resilience value in Guyon Sub Village is bigger than resilience value in Ngledoksari Sub Village. It is influenced by landslide experiences (sub-sub factor). In Guyon Sub Village, score weighting of landslide experience is 1 (more than 5 times landslide experiences) while in Ngledoksari Sub Village is 0.10 (only 1 time landslide experiences).

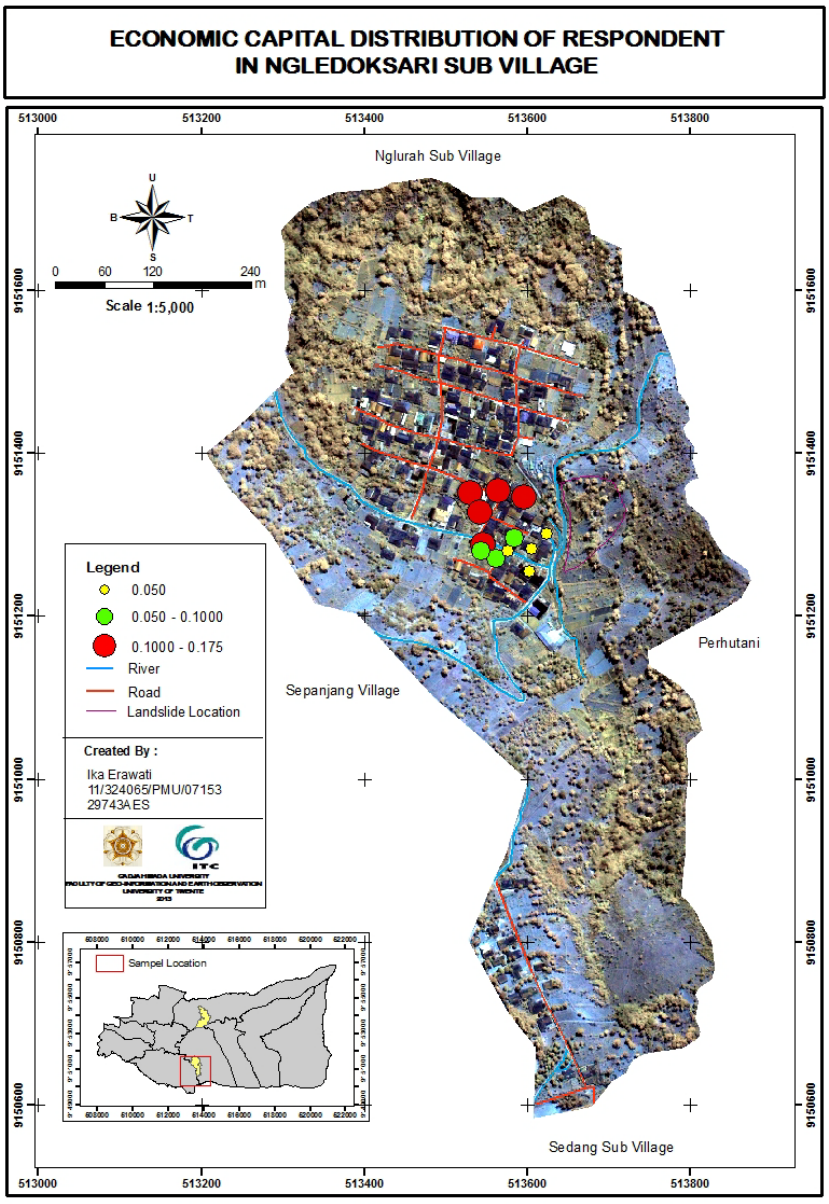


Figure 6.3. Economic capital distribution of respondent in Ngledoksari Sub Village

Figure 6.3 shows that economic capital distribution of respondents in Ngledoksari Sub Village. The distribution is randomly which the smallest value of economic capital located near with the landslide location. Their houses and

properties buried by land so they did not other financial sources except grant from government or loan from their family in other places.

Figure 6.4 is human capital distribution of respondents in Ngledoksari Sub Village. It can be seen that human capital distribution of respondent is randomly which only 1 respondent who has the smallest value. It depends on landslide education level while the landslide experiences factor is the same all of respondents in Ngledoksari Sub village.

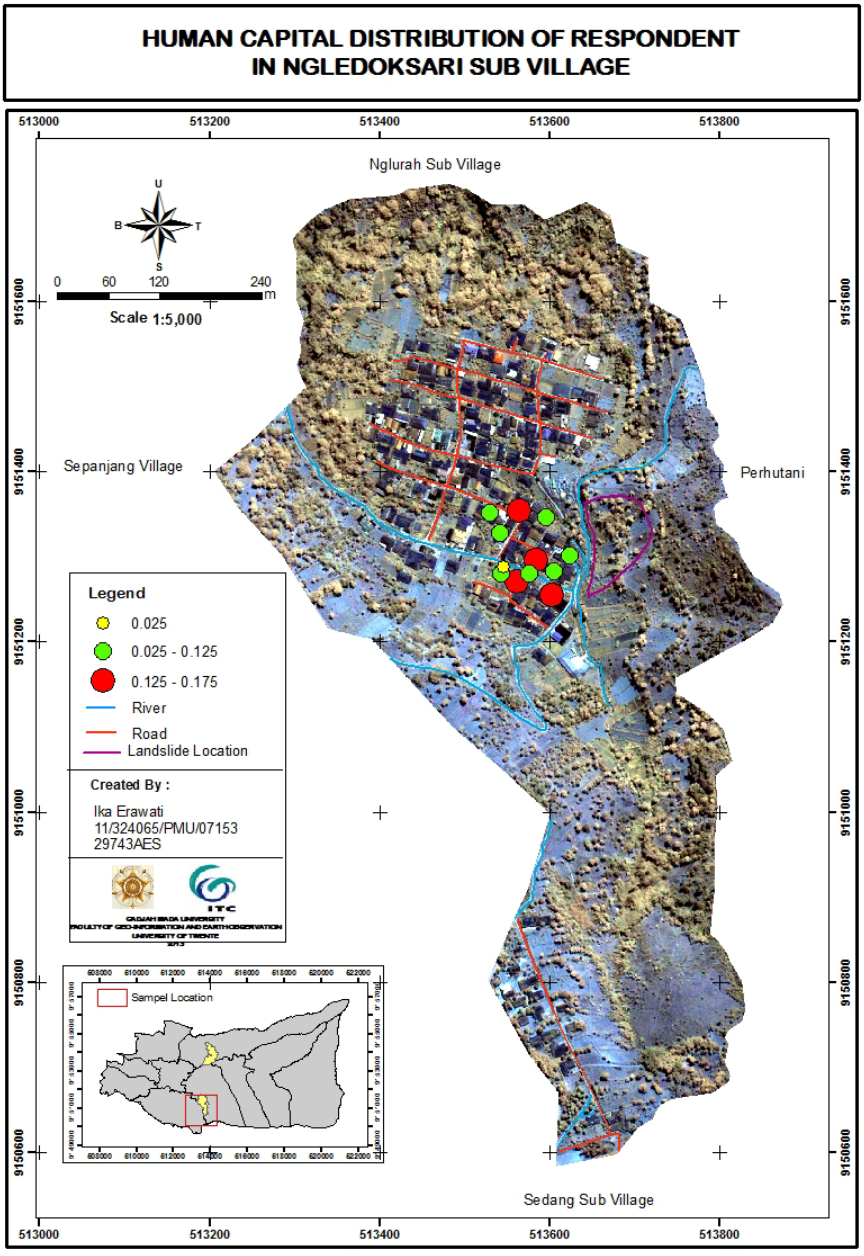


Figure 6.4. Human capital distribution of respondent in Ngledoksari Sub Village

Figure 6.5 shows that resilience distribution of respondent in Ngledoksari Sub Village. It is combination between economic capital factor and human capital factor. Distribution of resilience value in Ngledoksari Sub Village is also randomly. Resilience value in Ngledoksari divided in to three classes. Those are 0.175-0.225; 0.225-0.300; and 0.300-0.375. The highest resilience value in Ngledoksari is only 1 respondent which his house location is far away from the landslide location while the smallest resilience value located near with the landslide location.

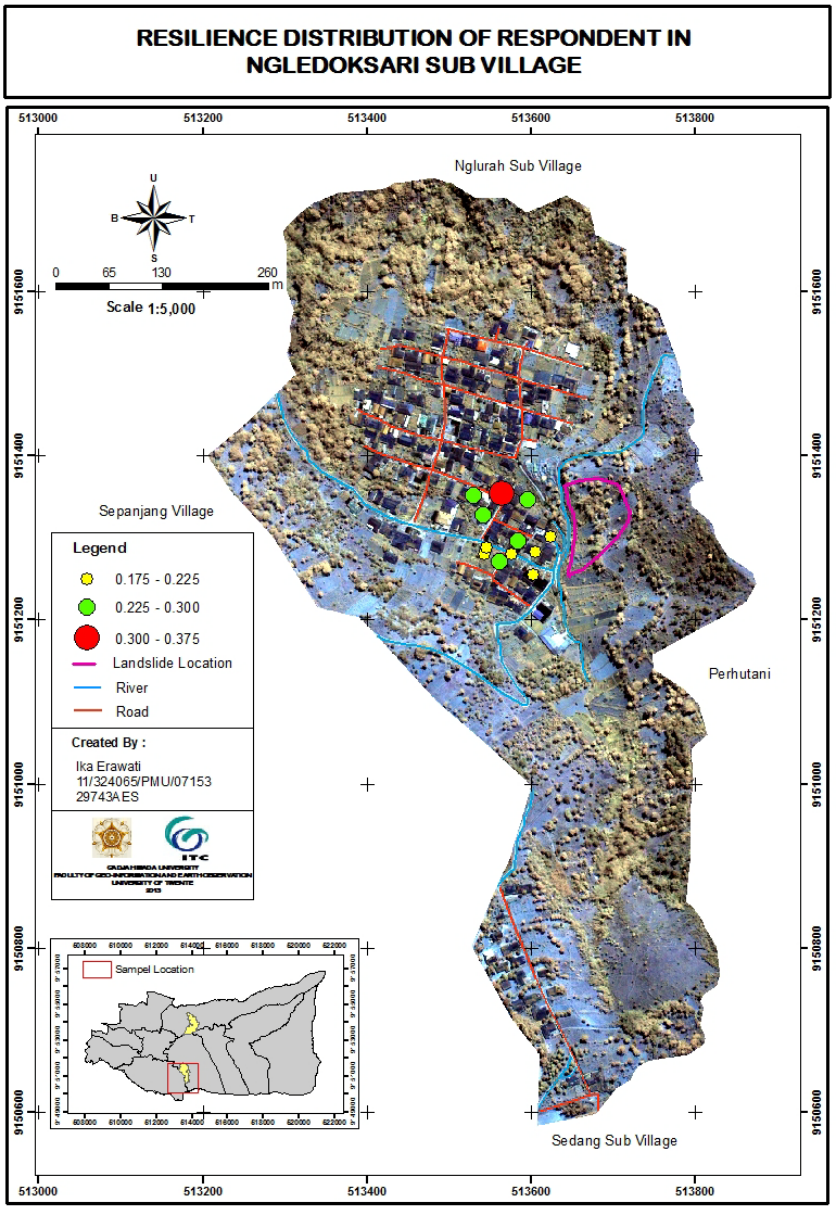


Figure 6.5. Resilience distribution of respondent in Ngledoksari Sub Village

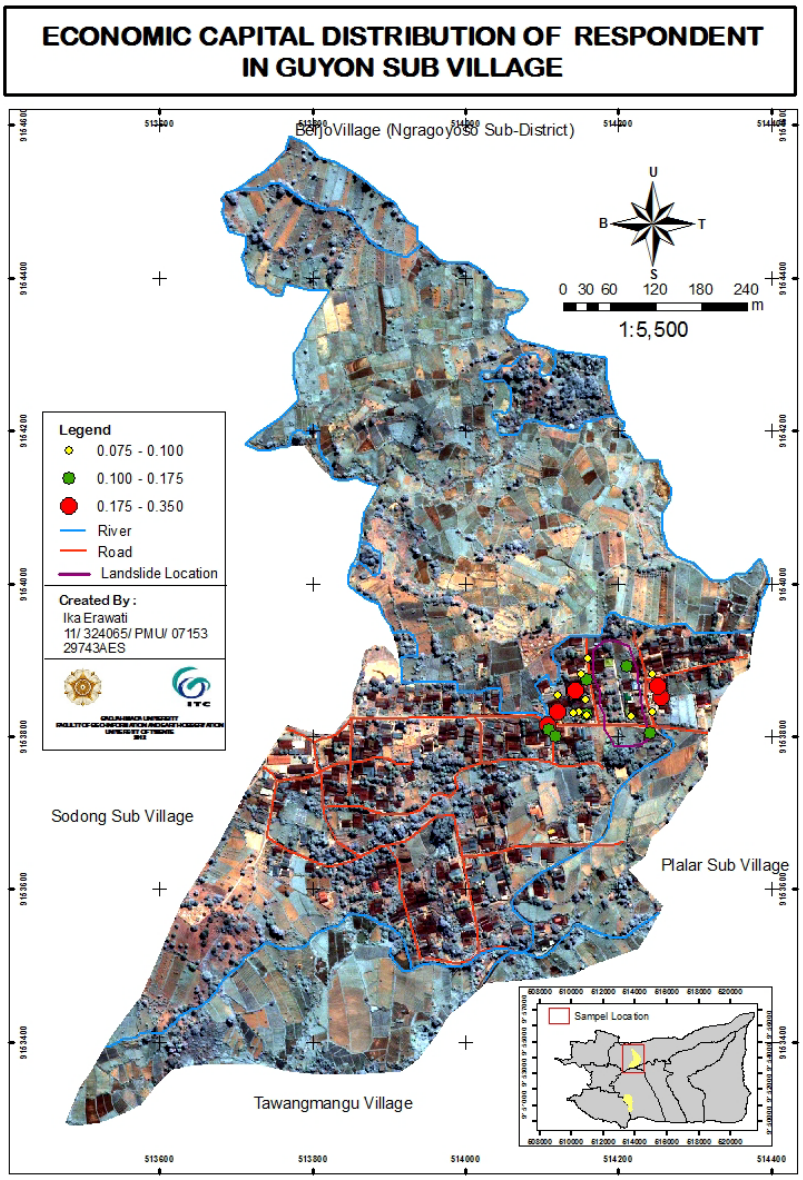


Figure 6.6. Economic capital distribution of respondent in Guyon Sub Village

Figure 6.6 describes about economic capital distribution of respondent in Guyon Sub Village. It depends on financial source in Guyon is varies. There are store basic foods, properties (treasure, livestock such as cow, buffalo). The distribution is also randomly. Economic capital value is between 0.075 and 0.350. Classification of economic capital also divided into three classes. Most of the respondents have the smallest value (12 respondents) and then the medium value (0.100-0.175) with representing 5 respondents. The highest economic capital value in Guyon located in outer the high vulnerable level zone of landslide.

Economic capital value in Guyon Sub Village is bigger than in Ngledoksari Sub Village. It is because the different landslide phenomena in both sub villages. In Ngledoksari Sub Village, people/community did not have store basic foods and properties while community in Guyon Sub Village had it.

Figure 6.7 shows that human capital value in Guyon Sub Village. Classification of human capital value also divided into three groups. The distribution is also randomly. The human capital value is between 0.350 and 0.450. Most of the respondents in guyon Sub Villages have the smallest value of human capital and only 1 respondent who has the highest value.

The human capital value in Guyon Sub Village is bigger than in Ngledoksari Sub Village. It is influenced by landslide experiences. In Guyon Sub village feel the landslide event more than 5 times while in Ngledoksari Sub Village only feel one time. It is because the landslide experience value in Guyon Sub Village is bigger than in Ngledoksari Sub Village.

Figure 6.8 describes the resilience distribution of respondent in Guyon Sub Village. The distribution is randomly. There are three classes of resilience value (0.425-0.500; 0.500-0.625; and 0.625-0.800). Most of respondents have 0.500-0.625 value with representing 11 respondents, 0.425-0.500 with representing 9 respondents and the highest value is 3 respondents. The people which their house damaged and had moved on the other places have a high value of resilience.

The resilience value in Guyon Sub Village is bigger than in Ngledoksari Sub Village. It is influenced by the financial sources and landslide experience factor. In Guyon Village has higher financial sources and landslide experience factor than in Guyon Sub village.

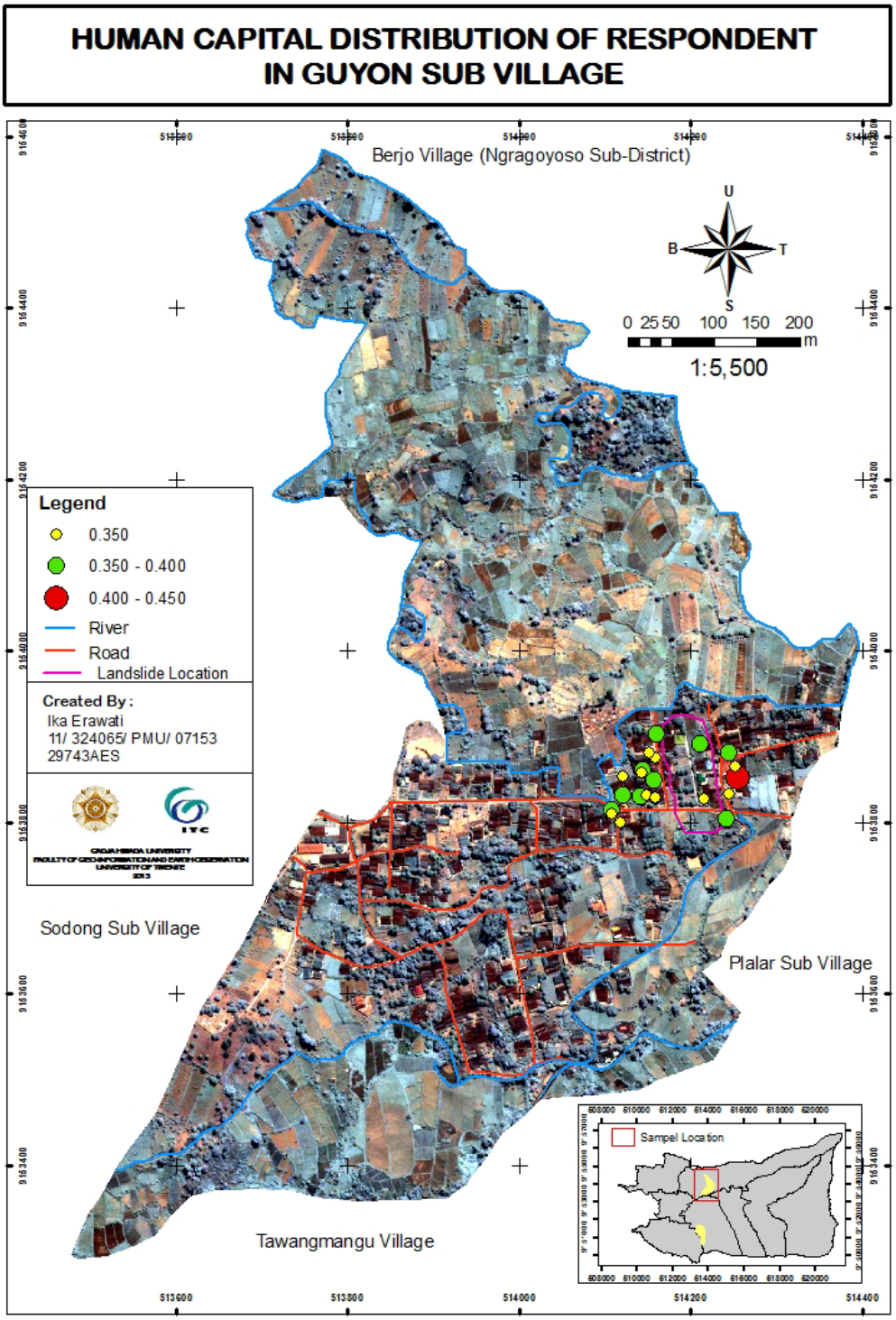


Figure 6.7. Human capital distribution of respondent in Guyon Sub Village

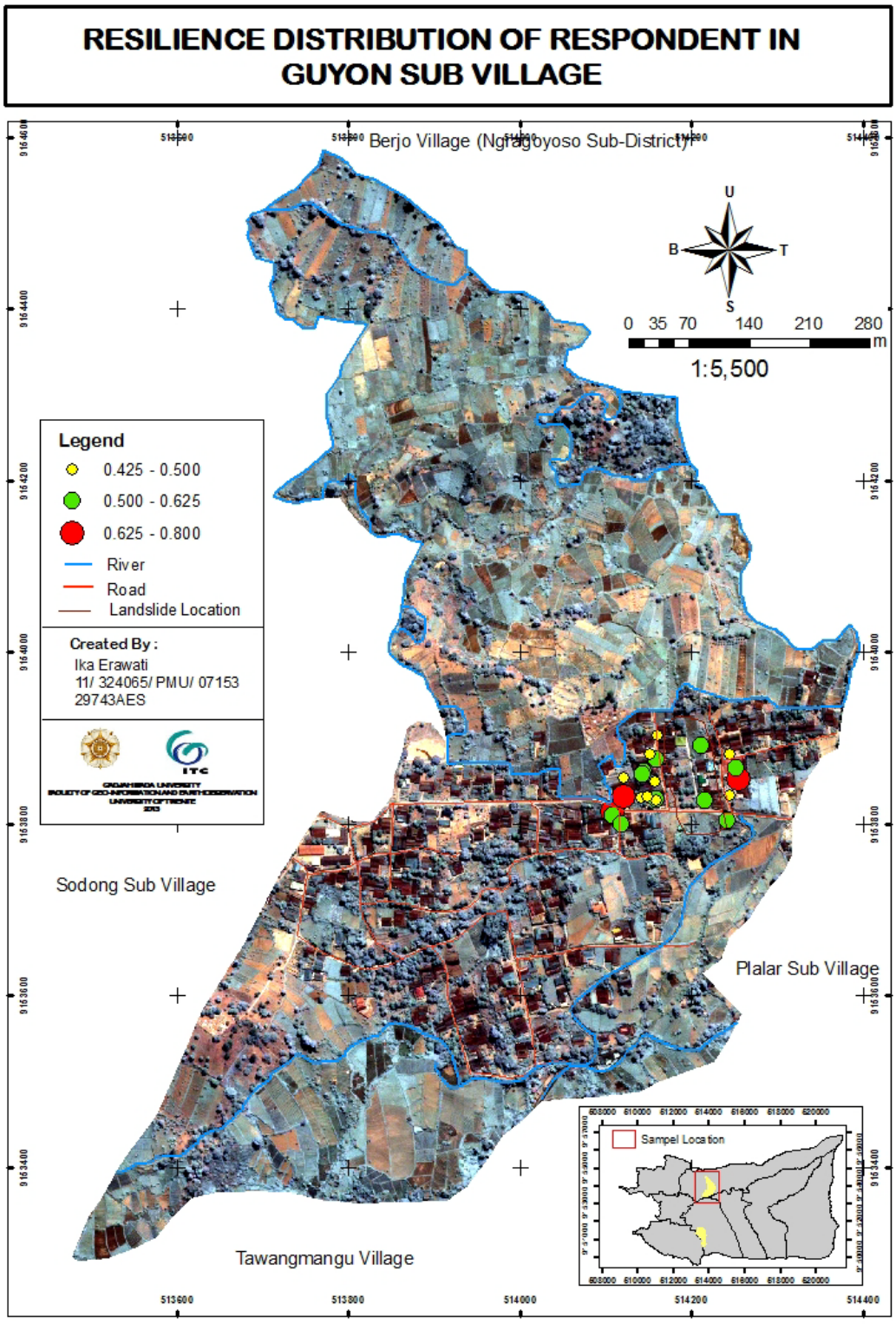


Figure 6.8. Resilience distribution of respondent in Guyon Sub Village

6.7. Community resilience toward Landslide in Ngledoksari and Guyon Sub villages : Comparison

Resilience consists of many measurements. As explained in the previous session, there are five major factors in building community resilience. Those are natural capital, physical capital, social capital, human capital and economi capital. This research also made comparison of community resilience toward landslide in both sub villages. Generally people in both sub villages have the same culture, Javanese culture but landslide characteristic in both sub villages is different. Therefore, this research compares community resilience in both sub villages in term of similarity and difference. The result of comparing community in both sub villages can't represent all of local communities suffering landslide in Indonesia

6.7.1. Similarity

Some similarities of factor that build community resilience in both sub villages. The same type of hazard is landslide that has influenced to community resilience. The similarities of factor in resilience in both sub villages can be seen in table 6.11.

Table 6.11 Similarities of landslide characteristic and factors that build community resilience in Ngledoksari and Guyon Sub Villages.

Elements	Similarities
Landslide Characteristics	- Has potential in damaging agricultural land, houses and its property - Impact of hard rainfall in the rainy season
Natural Capital	People use land resource (agricultural land) for livelihood
Physical Capital	Drainage system, reforestation, Early Warning System
Social Capital	Have the same spirit in social life "*Gotong Royong*" in facing common the problem
Human Capital	Depends on landslide experiences in facing landslide and coping strategy
Economic Capital	Looking for additional financial resources against landslide impact

6.7.2. Difference

Community resilience in both sub villages is also different so that there are differences of landslide characteristic. Table 6.12 shows the differences of factors that build community resilience in both sub villages.

Table 6.12. Differences of landslide characteristic and factors that build community resilience in Ngledoksari and Guyon Sub Villages.

Elements	Differences	
	Ngledoksari	**Guyon**
Landslide Characteristics	- Only one big 2007 landslide - The houses can be repaired - Houses buried by avalanche - The type of landslide is slide	- Landslide happened every year specially in the rainy season - The houses can't be repaired because the lans unstable - The house cracked due to land subsidence - The type of landslide is creep
Natural Capital	Use land for additional income (the primary occupation as flower trader or florist)	Use land as main income source (farmer)
Physical Capital	- Repair the house and shifting the location of the house - Cleaning main road from mud/land	- Repair the drainage system - Repair the main road because the land sinkhole
Social Capital	Work together due to landslide recovery such as repair the house and the main road	Work together due to avoid the landslide as increasing the main road and drainage system
Human Capital	People have not experience about landslide	Most people experience landslide as well as its frequently of occurrence
Economic Capital	No other financial sources of recovery	Diversification of income source as like livestock

CHAPTER VII
INSTITUTIONAL RESPOND

This chapter describes the general respond of government that is related to landslide in landslide prone areas. This respond comprises reforestation, early warning system, and emergency respond training.

7.1. Reforestation

Landslide that occurred on 26 December 2007 and claimed the lives of 34 people and also 12 houses damaged in Ngledoksari Sub Village. Meanwhile, in Guyon Sub Village also subsidence occurred that caused dozens of house can not be occupied because of subsidence on settlement. Although in Guyon Sub Village there were no fatalities but 33 houses uninhabitable or even repaired. Many hills with steep slopes in both sub villages but almost no tree crops/perennials in there. It causes no strong roots that can withstand ground movement when high rainfall, water can't be absorbed by the soil, the soil at the surface was loose with swift water soluble. Green hills around the both sub villages caused by the proliferation of corn crops are the source of most of the population and the economy are also the various types of plants that are cultivated. This one causes of the landslide.

Policy development for dryland farming aims to harness the potential of management of land suitable for dryland agriculture to increase food production with maintaining environmental sustainability. The government has provided assistance such as teak tree, pine that planted on the hillsides. In addition, has been done socialize the importance of greenery on the hillsides of Mount Lawu from department of Agriculture. 2007 landslide event had given the public awareness to preserve the environment. Public awareness needs to be supported in terms of the community to increase knowledge, including planning and organizing better.

7.2. Early Warning System

After the 2007 landslide event, government built landslide control devices. There are 3 landslide control devices in Ngledoksari Sub Village. The devices are early warning system that consists of detectors of ground movement and rainfall. Installation of this tool has done by UGM Students. If there is movement and rainfall is high then it will be rang. Installation of the tool was conducted in a location that is in agricultural hills. Center of tools are located in the head of RT. Head of RT has done training how to operate the tool and what is being done when the tool rang and socialization has been done with the surrounding community.

While in Guyon Sub Village has also installed several detectors of movement and rainfall which do installted by UGM Students. The detector was

placed at the landslide site in the settlement. These devices are connected to the cable in the pole. If the ground movement happened, the cable will be moved so that people will know about it and preparing what will be done.

Figure 7.1. Early Warning System Utilization in Ngledoksari and Guyon Sub Villages

7.3. Emergency Respond Training

Government gave some training for community related to emergency respond. The training focused in facing landslide during emergency time. The purpose of the training are to make people not traumatized and back the spirit of life, make people know more about what to do in the landslide event and create evacuation routes. This training was attended by community representatives such as RT, RW head, youth leader. Some of them joined with the team that legitimated by the head of regency. The team usually called ‘TAGANA” stand for Taruna Siaga Bencana. The Tagana focused on the activity on dis emergency respond. Based on interview result with one of Tagana member, the instructor in training came from army, Social Agency, and paramedics.

CHAPTER VIII
CONCLUSION AND RECOMMENDATION

This chapter describes about conclusion from discussion and summarizes the findings of this research related to the objectives of the research. Some recommendations also will be described in the last part of this chapter.

8.1. Conclusion

8.1.1. Economic vulnerability

a. What are the elements at risk?

Elements at risk are all objects, person, activities and processes that may be adversely affected by landslide event in particular area.

b. What indicators and parameters can be used to measure economic activities vulnerability?

There are four classifications of economic activities as element at risk in economic vulnerability, i.e. loss of production/productivity cost, damage of building and infrastructure, capital cost of response and relief, and impact on work force.

c. What is the economic vulnerability for each activity and overall?

Four classifications of economic activities as element at risk in economic vulnerability assessment are loss of production/productivity cost, damage of building and infrastructure, capital cost of response and relief, and impact on work force. Loss of production in this study area is one of the direct impacts of the landslide event. Loss of production in this research means the decline in agricultural production experienced by the people due to landslide. Agricultural commodities in both sub villages are mixed vegetables such as cabbage, carrots, chili, mustard, Spanish onion, bean, pea, tomatoes, squash sweet potatoes, chayote, eggplant, corn, and cloves.

Process of planting agricultural commodities need 4 months from prepatory stage until harvest stage so there are three times in a year in the process of planting agricultural commodities. Researcher attempted to calculate agricultural commodities for one year before and after the landslide event. In Ngledoksari Sub Village, almost respondents work as florist, farmer and agricultural laborers. There are only 3 respondent which the agricultural land affected by landslide so they did not work in the agricultural land for 2 years after 2007 landslide event. While in Guyon Sub Village, almost respondent's work on agriculture sectors such as farmer and agricultural laborers.

Based on calculation result, in Ngledoksari Sub Village has the biggest commodity is sweet potatoes with 2.000 kg before landslide and 1.600 kg after

landslide (20% decline production). Almost agricultural commodities have been declined of agricultural commodities such Spanish onion, cabbage, bean, corn, and cloves. While in Guyon Sub Village also have decline of agricultural production in all commodities except corn. Primary commodities in Guyon Sub Village are carrots, cabbage, chili, and Spanish onion.

Secondly, economic vulnerability in this research is damaged to building and infrastructure. Based on interview and questionnaire result, almost respondents in both sub villages damaged house and their fields. While infrastructure was damaged by landslide is road and irrigation system. House damaged or building in both sub villages are classified in two categories i.e. totally destroyed/heavily and moderately damaged. There is different grant which got from government in both sub villages. In Ngledoksari Sub Viilage, totally damages housed received a grant Rp 10.000.000,- and the moderatelt damaged received Rp 6.500.000,-. While in guyon Sub Village, totally damaged received Rp 6.500.000,- and the moderately damaged received Rp 4.500.000,-.

In Ngledoksari Sub Village has 6 or 50% respondents which their houses are totally damaged, 4 or 33.33% respondents are moderately damaged and 2 or 16.67% respondents are no damaged (only the field that damaged by 2007 landaslide). While in Guyon Sub Village, 19 or 69.57% respondents which their houses are totally damaged and 7 or (30.43%) respondents are moderately damaged.

The next economic vulnerability is capital cost of response and relief. It is one of important thing that use to recovery process. Most of the respondent in Ngledoksari Sub Village has no capital cost of response to recovery process. All of their properties have been buried in the ground when the landslide occurred. While in Guyon Sub Village, most of respondents have capital cost of response such as livestock (cow, buffalo), store basic, and treasure. Their houses are not buried by landslide and only suffer crack due to unstable soil.

The last economic vulnerability is impact on work force. People in both sub villages work in non-formal sector such as farmer, florist and laborers. They did not work until some week event some months when the 2007 landslide occurred. It has impact to their income.

8.1.2. Economic Losses

a. What indicators and parameters can be used to measure economic loss?

Indicators and parameters that can be used ro measure economic loss are related to the parameters/indicator in economic vulnerability. Those are losses that related to agricultural production, related to income from loss of work, and related to building/house damaged.

b. How much is the economic loss in different sectors?

Economics losses are one of the direct impacts related to the disaster and have greatly affects the economic recovery for the people in this research. Based on questionnaire result, landslide in 2007 has impact to the economics of the people in both sub villages. Economics losses that investigated in this research is agricultural production that produce in this area. Economic losses in this research depend on selling cost of each other commodity and the tota production of agriculture. Selling cost of each other commodity is always changing by the prevailing market price.

Based on calculation of agricultural production and average selling price per kg each commodity in both sub villages show the estimates agriculture production is decline. Total estimate agriculture production before landslide is Rp 24.560.000,- and after landslide is Rp 5.497.500,- in Ngledoksari Sub Village. While total estimate agriculture production in Guyon Sub Village before landslide is Rp 884.485.000,- and after landslide is Rp 800.995.000,-. While related to income from loss of work, total loss of income for the people in both sub villages are Rp 22,742,500.-. This consists of Ngledoksari Sub Village who affected by landslide is Rp 6,930,000.- and in Guyon Sub Village is Rp 15,812,500.-

Furthermore, economic losses related to building/house damaged are classified by two categories, i.e. totally damaged and partial damaged. The losses building cost that affected by landslide in Ngledoksari Sub Village is Rp 330,000,000.- and Guyon Sub Village is Rp 665,000,000.-

Respondent Perception for landslide in both sub villages said that the occurrence of landslide threaten daily life and their livelihood. They can not do the usual activities every day. While the respondents perception for landslide also called that the landslide in 2007 as disastrous because the landslide in 2007 has killed 34 people and 12 houses were buried by land in Ngledoksari and 33 houses damaged and could not be occupied by the owner in Guyon Sub Village.

8.1.3. Community Resilience

a. What defines community resilience?

Community resilience is the ability which is owned by communities/groups in the face of a disaster.

b. How can community resilience be quantified?

Community resilience can be quantified by the weighting score of resilience factors that investigated in this research. The factors are economic capital and human capital. For making quantify community resilience, 35 respondents had been selected to be interviewed related to resilience. In human capital, there are two sub factors that were investigated in this research. Those are

education level and landslide experiences. While in economic capital, the financial source of recovery was the factor that was investigated. The sequence of human capital and economic capital was defined by people in Focus Group Discussion.

c. How is community resilience in study area?

Distribution of resilience value in Ngledoksari Sub Village is from 0.175 until 0.350 and distribution of resilience value in Guyon Sub Village is from 0.425 until 0.800. While the average resilience value of respondent in Ngledoksari Sub Village is 0.256 and in Guyon Sub Village is 0.529. This can be seen that the average resilience value of respondent in Guyon Sub Village is higher than resilience value in Ngledoksari Sub Village. The value consists of economic capital and human capital. Based on weighting result, about more than 50% of the resilience value of respondent came from human capital in both sub villages.

d. What is relation between landslide event and community resilience?

Relation between landslide event and community resilience is interconnected and influenced. With the landslide is needed the ability to get up to normal life as like before landslide event. People often experience a disaster will have higher level of resilience than the people whos has never experienced a disaster. Five major forms of capital in building community that were used in defining community resilience in this research. Those are natural capital, physical capital, human capital, economic capital, and social capital. Social capital related to social organizations such as network, norms and social trust that facilitate coordination and cooperation for mutual benefit. Social capital that has high value in facing the landslide event is*"Gotong Royong"*. Meanwhile, human capital and economic capital were investigated through the respondent for the resilience value.

8.2. Recommendation

Based on result and conclusion, there are some recommendations can be proposed:

1. Giving loan/soft loans to the people in Ngledoksari and Guyon Sub Villages for business improvement and welfare.
2. Provision of education and training to the people to increase their knowledge and expertise in land management aims to agricultural product in Ngledoksari and Guyon Sub Villages
3. Provision of socialization to the community about landslides hazard. It aims to prevent/minimize the impact and increase resilience in the face of disaster.

4. The deeper study between economic vulnerability and landslide characteristic will be valuable to provide information related to community resilience in risk assessment.
5. Related to economic vulnerability and economic loss, the more indicators in element at risk is the better result in describing economic vulnerability assessment. Furthermore, the deeper investigation about element at risk in economic vulnerability assessment will be valuable to inform economic vulnerability and economic loss assessment.
6. Focus Group Discussion by relying on community knowledge is the best effective way to get information in wide scope. Furthermore, FGD can be used by government in order to gain information related wide scope because this method is easier to be adopted n implemented than other methods.
7. Especially in Guyon Sub Village, the deeper study about land condition what is habitable or not. In fact land condition in Guyon Sub Villages always decline occurred in settlement area.

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Appendix-1

Questionnaire

Assessment of Economic Vulnerability and Community Resilience in Landslide Prone Areas After Landslide event (Case Study : Tawangmangu Sub-district, Karanganyar Regency, Central Java)

Purpose : only scientific research purpose study economic vulnerability and community resilience for the 2007 landslide event in Part of Tawangmangu Sub-district.
Researcher : Ika Erawati
Contact : dek_ik97@yahoo.com; erawati29743@itc.nl

Part of this questioner is adopted from some questionnaires of previous researchs done by Damayanti (2011) and Pamungkas (2012)

Questionnaire No.: ……	Respondent's name :……
No.Kuesioner : ……..	*Nama Responden :* …….
Date : ……	House No.: ……
Tanggal : ……..	*No. Rumah* : …….
Interviewer : ……..	Address ……..……..
Pewawancara : ……..……	*alamat* : ……
Time of interview :…….	……
Waktu interview : …….	GPS: Lat..……..…Long:……

1. Respondent Profile
Profil Responden

(1). Age : ……..years Umur : ……..tahun	(2). Sex : Female/Male *) Jenis Kelamin : Perempuan/Laki-laki *)
(3). Position in household : ☐ Father ☐ Mother ☐ others …….. *Posisi dalam keluarga* : ☐ Ayah ☐ Ibu ☐ lainnya……..	
(4). Education : ☐ ES ☐ JHS ☐ SHS ☐ GS *Pendidikan* : ☐ SD ☐ SMP ☐ SMA ☐ Sarjana	
(5). Ethnic : ☐ Javanese ☐ others …… *Suku* : ☐ *Jawa* ☐ lainnya ……	
(6). Job : ☐ Government Officer ☐ Military ☐ Businessman ☐ Farmer ☐ Labour ☐ Others ……. *Pekerjaan* : ☐ *Kantor Pemerintahan* ☐ *Polisi/TNI* ☐ *Bisnis* ☐ *Petani* ☐ *Buruh* ☐ *Lainnya…..…..*	
:ome : ☐ < Rp 1.000.000, ☐ Rp 1.000.000 – Rp 2.000.000,-	

ndapatan ☐ > Rp 2.000.000,-

2. Family Information
Informasi Keluarga

Name ***Name***	**Sex (F/M)** ***Jenis Kelamin (F/M)***	**Age at 2007 (Years)**	**Education and Jobs** ***Pendidikan dan Pekerjaan***
……	……	……	……
……	……	……	……
……	……	……	……
……	……	……	……

3. The 2007 Landslide Characteristic
Karakteristik Longsor 2007

(1). When did landslide occur? ……
Kapan longsor terjadi? ……
(2). What is the distance of ground that covered the agriculture land? ……
Berapa jarak tanah yang menutupi lahan pertanian? ……
(3). What is the maximum depth of ground that covered your house? ……
Berapa tinggi maksimum tanah menutupi rumah? ……

4. Damage
Kerusakan

(1). Was your house and/or your belonging damaged by the 2007 landslide event?
Apakah rumah dan/atau asset anda rusak akibat longsor 2007?
☐ Yes (*Iya)* ☐ No (*Tidak)*
(2). If your answer "Yes", what were the damages?
Jika jawaban anda "iya", apa saja kerusakan tersebut?

No. *No.*	Type of Damages *Jenis Kerusakan*	Losses (Rp) *Kerugian (Rp)*	Repairing of Damages *Perbaikan/Penggantian Kerusakan*		
			Yes *(Iya)*	Not Yet *(Belum)*	No *(Tidak)*

(3). Was the damage influenced to your daily life?
Apakah kerusakan tersebut berpengaruh terhadap kehidupan sehari-hari anda?
☐ Yes (*Iya)* ☐ No (*Tidak)*
(4). Did you think you need repair the damages?
Apakah anda merasa perlu memperbaiki kerusakan tersebut?
☐ Yes (*Iya)* ☐ No (*Tidak)*

5. Element at risk (Economic Activities)

a. Agricultural business before landslide event *Bisnis pertanian sebelum kejadian longsor*				
Size of farm area *Luas area pertanian*		……(Ha)		
Name of farm commodities *Nama komoditas*	Annual Frequency of cropping in one year	Average amount per cropping *Jumlah rata-*	Average selling rate per kg *Rata-rata penjualan per kg*	Estimates Agricultural outcomes (Rp) *Jumlah penghasilan pertanian*

	Frekuensi penanaman dalam 1 tahun	*rata per tanam*		
……	……	……	……	……
……	……	……	……	……
……	……	……	……	……
b. Non Agricultural business before landslide event *Bisnis non pertanian sebelum kejadian longsor*				
How many non-farming jobs present before the landslide event? *Berapa banyak pekerjaan non pertanian yang ada sebelum longsor terjadi?*			…… …… ……	
How important do you look your agriculture product contribution to your households economy? *Menurut anda, seberapa penting kontribusi hasil pertanian dalam ekonomi rumah tangga?*			…… …… ……	
Estimates of total non agricultural business outcome? *Jumlah penghasilan non pertanina?*			Rp …… ……. (filled by surveyor)	
c. Agricultural business after landslide event *Bisnis pertanian sesudah kejadian longsor*				
Size of farm area *Luas area pertanian*		…….(Ha)		
Name of farm commodities *Nama komoditas*	Annual Frequency of cropping in one year *Frekuensi penanaman dalam 1 tahun*	Average amount per cropping *Jumlah rata-rata per tanam*	Average selling rate per kg *Rata-rata penjualan per kg*	Estimates Agricultural outcomes (Rp) *Jumlah penghasilan pertanian*
……	……	……	……	……
……	……	……	……	……
……	……	……	……	……
d. Non Agricultural business after landslide event *Bisnis non pertanian sesudah kejadian longsor*				
How many non-farming jobs present after the landslide event? *Berapa banyak pekerjaan non pertanian yang ada sesudah longsor terjadi?*		…… ……		
How important do you look your agriculture product contribution to your households economy? *Menurut anda, seberapa penting kontribusi hasil pertanian dalam ekonomi rumah tangga?*		…… ……		
Estimates of total non agricultural business outcome? *Jumlah penghasilan non pertanina?*		Rp …… (filled by surveyor)		

6. Impact of Landslide event
Pengaruh bencana longsor

How many percent of your total farm area did get damaged by landslide event? *Berapa persen luas area pertanian yang rusak akibat longsor?*	…… ……
How important do you think irrigation service for your regular farming activity? *Seberapa penting pelayanan irigasi untuk kegiatan pertanian menurut anda?*	…… …… ……..
How long were you being inactive from farming activity? *Berapa lama anda tidak bekerja ketika longsor terjadi?*	……(months) …….....(*bulan)*

7. Disaster Perception
Persepsi Bencana

(1). Do you think landslide threat your daily life and your occupation?
Apakah menurut anda bencana longsor di daerah anda mengancam kehidupan sehari-hari dan mata pencaharian anda?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(2). What is your perception about the 2007 landslide event?
Bagaimana pendapat anda mengenai bencana longsor 2007 di daerah anda?
☐ No Problem ☐ Nuisanc☐ Disastrous
(Tidak masalah) Mengganggu Merupakan bencana

(3). Do you thik reboitation can reduce the landslide risk?
Apakah menurut anda reboisasi masih cukup/mampu mengurangi resiko longsor?
☐ Yes (*Iya)* ☐ No (*Tidak)*

8. Landslide Familiarity
Keterbiasaan Longsor

(1). Are you accustomed to landslide?
Apakah anda terbiasa dengan longsor?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(2). How many landslide have you experience with? …….times
Berapa kali longsor yang pernah anda alami? ……..kali

(3). Do you know the signs that landslide will be occurred?
Apakah anda tahu anda tanda-tanda akan datangnya longsor?

(4). If landslide occurs, do you know what you should do to save your family and belonging?
Bila Longsor terjadi lagi, apakah anda tahu apa yang harus anda lakukan untuk menyelamatkan keluarga dan harta benda anda?
☐ Yes (*Iya)* ☐ No (*Tidak)*

9. Social Status
Status Sosial

(1). How long have you been staying in this area?
Berapa lama anda tinggal di desa ini?
☐ 0-5 years ☐ 5-10 years ☐ 10-20 ye☐s > 20 years
0-5 tahun 5-10 tahun 10-20 tahun > 20 tahun

(2). What is your social in this village?
Apakah posisi social anda di desa ini?
☐ Village officer ☐ RT/RW/Dukuh head ☐ Youth Organization leader/other …..

Perangkat desa	*Ketua RT/RW/Dukuh*	*Ketua Karang Taruna/ lainnya*
☐ Religion leader *Pemuka agama*	☐ Village elder *Sesepuh desa*	☐ Community member *Anggota masyarakat*

(3). What is the average distance your nrighbor's house and yours?

☐ 0-3m ☐ 3-6m ☐ 6-10m ☐ > 10m

10. Coping Strategies in Economic and Social Aspects
Strategi dalam Aspek Ekonomi dan Sosial

Before landslide	After landslide
Saving money (*Tabungan)*	Sell goods to get extra *(menjual barang barang simpanan)*
Lend money *(pinjaman uang)*	Money to repair house and farm area (*uang untuk memperbaiki rumah dan area pertanian)*
Store basic food *(simpanan bahan makanan pokok)*	Lend money from …. (*meminjam uang dari ……………*
Equipment	
Gotong royong to build to secure the road, farm area and house *(gotong royong untuk membangun jalan, lahan pertanian dan rumah yang aman)*	Clean the road, house and farm area after the landslide event together with neighbor *(membersihkan jalan, rumah dan area pertanian setelah longsor terjadi bersama-sama tetangga)*
Discuss with neighbor in farm area *(diskusi dengan tetanggan di area pertanian)*	
Holds about action plan to cope with landslide *(bersama-sama membuat rencana kegiatan untuk mencegah longsor)*	
………………………………………… …………………………………………	………………………………………… …………………………………………

11. Physical Recovery Process
Proses Pemulihan Fisik

(1). The repair of your house/asset as the impact of landslide was done professionally by the expert? (bricklayer/carpenter, etc)
Perbaikan rumah/asset akibat longsor dilakukan secara profesioanl oleh ahlinya (tukang batu/kayu, dsb)

☐ Yes (*Iya)* ☐ No (*Tidak)*

(2). If "yes" the total cost of the repair by the expert is Rp …………………………….
Jika "Iya", total perbaikan oleh ahli tersebut sebesar Rp ………………………………

(3). The repair the house/asset as the impact landslide was done together with society
Perbaikan rumah/asset akibat longsor dilakukan secara bersama dengan masyarakat

☐ Yes (*Iya)* ☐ No (*Tidak)*

(4). The number of people that was involved in the repair was …………………(person)
Jumlah orang yang terlibat dalam perbaikan tersebut adalah ……………….. (orang)

(5). The repair was done for …………………………………………………….(days)
Perbaikan tersebut berlangsung selama…………………………………………….(hari)

12. Recovery aid and financing

Bantuan Pemulihan dan Pembiayaan

(1). When the 2007 landslide event occurs, did you have any saving?
Ketika longsor 2007 terjadi, apakah Anda mempunyai tabungan?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(2). Did you use your saving for financing the repair as the impact of landslide?
Apakah anda menggunakan semua tabungan anda untuk biaya perbaikan akibat longsor?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(3). If "Yes", total saving that was used for repairing cost as the impact of the 2007 landslide event was Rp ……
Jika "Iya", Jumlah tabungan yang digunakan untuk biaya perbaikan akibat longsor 2007 adalah Rp …….

(4). Did you sell your asset for financing the repairing cost as the impact of the 2007 landslide event?
Apakah anda menjual barang pribadi anda untuk biaya perbaikan akibat longsor 2007?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(5). If "yes", the proceed was Rp …….
Bila "Iya", maka hasil penjualan barang pribadi tersebut adalah Rp ……..…

(6). Did you use all of the proceed to finance repairing cost?
Apakah anda menggunakan semua hasil penjualan barang tsersebut untuk biaya perbaikan akibat?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(7). If "No", total proceed that was used for financing repairinf cost was Rp …….
JIka "Tidak", hasil penjualan yang digunakan untuk biaya perbaikan adalah Rp ……..

(8). Did you get any help/aid from family for the repairing?
Apakah anda mendapat bantuan dari keluarga anda dalam perbaikan tersebut?

(9). If "Yes", total of help/aid from family that you got for repairing was Rp …….
Jika "Iya", total bantuan dari saudara yang anda terima untuk perbaikan adalah ……..

(10). Did you borrow any fund for the repairing cost?
Apakah anda meminjam dana untuk biaya perbaikan?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(11). If "Yes", the detailed loan fund was
Jika "Iya", pinjaman tersebut secara detail adalah sebagai berikut:

No. *No.*	Loan Source *Sumber Pinjaman*	Total of Loan *Total Pinjaman*	Loan Duration (Year) *Waktu Pinjaman (Tahun)*	Returning Period *Periode Pengembalian*	
				Starting Year *Mulai Tahun*	Ending Year *Selesai Tahun*

(12). Did you get any supporting fund from government in the repairing?
Apakah anda mendapat dukungan dana dari pemerintah dalam perbaikan?

☐ Yes (*Iya)* ☐ No (*Tidak)*

(13). If"Yes", the total supporting fund from government was Rp …….
Jika"Iya". Jumlah dukungan dana dari Pemerintah tersebut adalah Rp …….

(14). Did you get any help supporting fund from NGO in the repairing?
Apakah anda mendapat dukungan dana dari LSM dalam perbaikan akibat longsor?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(15). If"Yes", the total of supporting fund from NGO was Rp ……
Jika "Iya", jumlah dukungan dana dari LSM tersebut adalah Rp ……

13. Economic Recovery Process
Proses Pemulihan Ekonomi

From the following strategies of dealing with farming activity interruption due to landslide event, which one did you implementation during this event? *(Dari strategi berikut untuk mengatasi gangggguan aktivitas pertanian akibat longsor, mana yang akan anda lakukan selama longsor terjadi?)*	(…..) Having water supply for farming *(mempunyai pasokan air untuk pertanian)* (…..) Continued old cropping pattern practice *(melanjutkan pola tanam lama)* (…..) Changing cropping pattern and or farming commodity (*mengubah pola tanam dan atau komoditas pertanian)* (…..) ……..
What are efforts made by community to face of landslide event? *(Usaha apa saja yang dilakukan masyarakat dalam menghadapi bencana longsor?)*	…… ……
What are efforts made by local government to minimize the impact of landlide? *(usaha apa saja yang dilakukan pemerintah untuk meminimalisasi pengaruh longsor terjadi?)*	…… ……
How long the economic recovery process required? *(berapa lama proses pemulihan ekonomi yang diperlukan)*	…… ……

14. Psychology Recovery Process
Proses Pemulihan Psikologis

(1). Do you still feel trauma with landslide?
Apakah anda masih merasa trauma dengan kejadian longsor?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(2). How many time did you need to relieve the trauma?
Berapa lama waktu yang anda butuhkan untuk menghilangkan rasa trauma tersebut?

(3). Was there any assistance from government/NGO to reduce your traumatic?
Apakah ada pendampingan dari Pemerintah/LSM untuk mengurangi trauma anda?
☐ Yes (*Iya)* ☐ No (*Tidak)*

(4). If "Yes", mention the programmem ……..
Jika "Iya" tolong sebutkan programnya ……

(5). If "No', what did you do to reduce your traumatic?
Jika "Tidak", apa yang anda lakukan untuk mengurangi rasa trauma anda?
☐ Nothing. Time will release the traumatic?

Tidak ada. Waktu akan menghapus rasa trauma tersebut

☐ Religious approach
Pendekatan agama

15. Institutional Respond
Respon Institutional

(1). Was there any action from government related to mitigation?
Apakah ada tindakan pemerintah terkait dengan mitigasi/pengurangan bahaya longsor?

☐ Yes (*Iya)* ☐ No (*Tidak)*

(2). If "Yes", the action was ……..
Jika "Iya", apakah tindakan tersebut? ……..

(3). Was there any rule related to disaster risk reduction from local government that emerged after the occurrence of the 2007 landslide event?
Apakah ada peraturan terkait dengan pengurangan resiko bencana dari Pemerintah setempat yang muncul setelah longsor 2007?

☐ Yes (*Iya)* ☐ No (*Tidak)*

(4). If"Yes", the rule was ……..
Jika "Iya", Peraturan tersebut adalah ……..

Note:
*) : unnecessary streak

----------THANK YOU FOR YOUR COOPERATION----------

Appendix 2 Calculation of Agricultural Production

Guyon Sub Village

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
1	Carrots	0.3	owner	2	1800	2000	1	Carrots	0.3	2	1500	2500
	Spanish Onion			2	500	7000		Spanish Onion		2	800	6000
	Cabbage			2	1000	1000		Cabbage		2	700	1200
	Corn			1	500	2500		Corn		1	700	2300
	Chilli			2	200	3000		tomatoes		1	500	2000
	Paddy			1	1500	5000		Paddy		1	1000	5500
2	Carrots	0.1	rent	2	400	2000	2	Carrots		2	350	2500
	Mustard			3	75	1000		Mustard		3	60	1000
	Chilli			2	150	3000		Chilli		2	150	3500
	bean			3	100	2000		bean		3	100	2300
	Chayote			2	150	1700		Chayote		2	150	1500
	eggplant			2	125	1000		eggplant		2	125	1500
	Tomatoes			2	200	1500		Tomatoes		2	170	2000
	Peai			2	60	4000		Pea		2	70	4000

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
3	Carrots	0.1	owner	2	400	2000	3	Carrots		2	300	2500
	Spanish Onion			2	150	7000		Spanish Onion		2	200	6000
	Mustardi			3	80	1000		Mustard		3	60	1000
	Pea			2	50	4000		Pea		2	40	4500
	Chilli			2	160	3000		Chilli		2	120	3500
	eggplant			2	120	1000		eggplant		2	110	1500
	Bean			3	100	2000		Bean		3	120	2300
4	Carrots	0.2	TM	2	700	2000	4	Carrots		2	900	2500
	Tomatoes			2	400	1500		Tomatoes		2	500	2000
	cabbage			2	700	1000		cabbage		2	600	1200
	Chilli			3	60	3000		Chilli		3	150	3500
	Pea			2	80	4000		Pea		2	60	4500
	Mustard			3	80	1000		Mustard		3	70	1000
	Spanish Onion			2	250	7000		Spanish Onion		2	300	6000
5	Carrots	0.2	TM	2	750	2000	5	Carrots		2	800	2500
	Spanish Onion			2	275	7000		Spanish Onion		2	250	6200

Pre Disaster							**Post Disaster**					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
	Cabbage			2	700	1000		Cabbage		2	600	1200
	Chilli			3	80	3000		Chilli		3	70	3700
	Pea			2	60	4000		Pea		2	60	4500
	Tomatoes			2	400	1500		Tomatoes		2	350	2000
	Paddy			1	1200	5000		Paddy		1	1000	6000
	Spanish Onion			2	200	7000		Spanish Onion		2	200	6200
	Cabbage			2	400	1000		Cabbage		2	400	1200
	Chilli			3	50	3000		Chilli		3	60	3700
	Tomatoes			2	225	1500		Tomatoes		2	250	2000
	Pea			2	30	4000		Pea		2	40	4500
7	Carrots	0.2	TM	2	800	2000	7	Carrots		2	800	2500
	Spanish Onion			2	350	7000		Spanish Onion		2	300	6200
	Cabbage			2	800	1000		Cabbage		2	700	1200
	Chilli			3	80	3000		Chilli		3	50	3500
	Tomatoes			2	450	1500		Tomatoes		2	400	2000
	celery			2	30	6000		celery		2	40	6000

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
8	Carrots	0.4	TM	2	1500	2000	8	Carrots		2	1300	2500
	Spanish Onion			2	800	7000		Spanish Onion		2	800	6200
	Cabbage			2	1200	1000		Cabbage		2	1000	1200
	Chilli			3	200	3000		Chilli		3	300	3500
	Tomatoes			2	600	1500		Tomatoes		2	750	2000
	Pea			2	100	4000		Pea		2	80	4500
	celery			2	150	4500		celery		2	120	5000
	Paddy			1	2500	5000		Paddy		1	2000	6000
										2		
9	Carrots	1	TM	2	4500	2000	9	Carrots		2	4200	2500
	Spanish Onion			2	2300	7000		Spanish Onion		2	2000	6200
	Cabbage			2	3000	1000		Cabbage		3	2800	1200
	Chilli			3	500	3000		Chilli		2	450	3500
	Tomatoes			2	1000	1500		Tomatoes		2	850	2000
	Pea			2	250	4000		Pea		2	200	4500
	celery			2	400	4500		celery		1	350	5000
	Corn			1	1200	2500		Corn		1	1500	2700
	Paddy			1	5000	5000		Paddy			5500	6000

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
10	Carrots	0.2	TM	2	750	2000	10	Carrots		2	800	2500
	Spanish Onion			2	275	7000		Spanish Onion		2	250	6200
	Cabbage			2	700	1000		Cabbage		2	600	1200
	Chilli			3	80	3000		Chilli		3	70	3700
	Pea			2	60	4000		Pea		2	60	4500
	Tomatoes			2	400	1500		Tomatoes		2	350	2000
	Paddy			1	1200	5000		Paddy		1	1000	6000
	celery			2	100	4500		celery		2	120	5000
11	Carrots	0.2	TM	2	700	2000	11	Carrots		2	620	2500
	Chilli			3	90	3000		Chilli		3	80	3700
	Pea			2	50	4000		Pea		2	60	4500
	Tomatoes			2	350	1500		Tomatoes		2	320	2000
	Paddy			1	1000	5000		Paddy		1	1000	6000
	celery			2	90	4500		celery		2	80	5000
12	Carrots	0.5		2	2300	2000	12	Carrots		2	2100	2500
	Spanish Onion			2	1400	7000		Spanish Onion		2	1000	6200
	Cabbage			2	1500	1000		Cabbage		2	1200	1200

Pre Disaster							**Post Disaster**					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
	Chilli			3	300	3000		Chilli		3	300	3500
	Peanut			1	1000	8000		Peanut		1	1000	8500
	Tomatoes			2	600	1500		Tomatoes		2	400	2000
	Bean			2	400	2000		Bean		2	300	1800
13	Carrots	1.2	TM	2	5000	2000	13	Carrots		2	4000	2500
	Spanish Onion			2	2500	7000		Spanish Onion		2	2200	6200
	Cabbage			2	3500	1000		Cabbage		2	3100	1200
	Chilli			3	900	3000		Chilli		3	700	3500
	Tomatoes			2	1300	1500		Tomatoes		2	1200	2000
	Pea			2	400	4000		Pea		2	400	4500
	celery			2	450	6000		celery		2	350	5000
	Corn			1	1600	2500		Corn		1	1300	2300
	Paddy			1	7000	5000		Paddy		1	6000	5500
14	Carrots	0.2		2	750	2000	14	Carrots	0.2	2	700	2500
	Spanish Onion			2	200	7000		Spanish Onion		2	170	6200
	Cabbage			2	700	1000		Cabbage		2	680	1200
	Chilli			3	90	3000		Chilli		3	70	3500

Pre Disaster							**Post Disaster**					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
	Pea			2	50	4000		Pea		2	40	4500
	Tomatoes			2	300	1500		Tomatoes		2	270	2000
	celery			2	90	6000		celery		2	60	5000
	Bean			2	170	2000		Bean		2	150	2300
15	Carrots	0.1		2	400	2000	15	Carrots	0.1	2	350	2500
	Spanish Onion			2	200	7000		Spanish Onion		2	170	6200
	Cabbage			2	400	1000		Cabbage		2	360	1200
	Chilli			3	50	3000		Chilli		3	40	3500
	Tomatoes			2	225	1500		Tomatoes		2	200	2000
	Pea			2	30	4000		Pea		2	25	4500
16	Carrots	0.3		2	1800	2000	16	Carrots	0.3	2	1600	2500
	Spanish Onion			2	500	7000		Spanish Onion		2	500	6200
	Cabbage			2	900	1000		Cabbage		2	820	1200
	Corn			1	500	2500		Corn		1	470	3500
	Chilli			2	250	3000		Chilli		2	200	3500
	Paddy			1	1400	5000		Paddy		1	1200	5500

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
17	Carrots	0.2	TM	2	600	2000	17	Carrots		2	560	2500
	Spanish Onion			2	200	7000		Spanish Onion		2	175	6200
	Cabbage			2	750	1000		Cabbage		2	690	1200
	Chilli			3	80	3000		Chilli		3	75	3500
	Pea			2	60	4000		Pea		2	45	4500
	Tomatoes			2	320	1500		Tomatoes		2	300	2000
	Paddy			1	900	5000		Paddy		1	1000	5500
	celery			2	70	6000		celery		2	60	5000
18	Carrots	0.1		2	400	2000	18	Carrots	0.1	2	370	2500
	Spanish Onion			2	225	7000		Spanish Onion		2	200	6200
	Cabbage			2	360	1000		Cabbage		2	320	1200
	Chilli			3	60	3000		Chilli		3	50	3500
	Tomatoes			2	200	1500		Tomatoes		2	190	2000
	Pea			2	30	4000		Pea		2	30	4500
19	Carrots	0.3		2	3000	2000	19	Carrots		2	2400	2500
	Spanish Onion			2	2500	7000		Spanish Onion		2	2000	6200

Pre Disaster							**Post Disaster**					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
	Cabbage			2	2000	1000		Cabbage		2	1800	1200
	Chilli			3	2000	3000		Chilli		3	1800	3500
	Tomatoes			2	1500	1500		Tomatoes		2	1300	2000
	Bean			2	1000	2000		Bean		2	1000	2300
	Pea			2	1100	4000		Pea		2	790	4500
20	Carrots	1.2		2	5000	2000	20	Carrots		2	4000	2500
	Spanish Onion			2	2700	7000		Spanish Onion		2	2500	6200
	Cabbage			2	3400	1000		Cabbage		2	3000	1200
	Chilli			3	1400	3000		Chilli		3	1300	3500
	Tomatoes			2	1500	1500		Tomatoes		2	1300	2000
	Pea			2	1300	4000		Pea		2	1200	4500
	celery			2	700	6000		celery		2	600	5000
	Bean			2	1300	2000		Bean		2	1000	2300
21	Carrots	1.5		2	6000	2000	21	Carrots		2	5000	2500
	Spanish Onion			2	3200	7000		Spanish Onion		2	3000	6200
	Cabbage			2	3700	1000		Cabbage		2	3200	1200
	Chilli			3	1900	3000		Chilli		3	1600	3500

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land statuse**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg (Rp)**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
	Tomatoes			2	2000	1500		Tomatoes		2	1700	2000
	Pea			2	1800	4000		Pea		2	1400	4500
	celery			2	800	6000		celery		2	600	5000
	Bean			2	1900	2000		Bean		2	1700	2300
22	Spanish Onion			2	2000	7000		Spanish Onion		2	1700	6200
	Cabbage			2	1500	1000		Cabbage		2	1200	1200
	Chilli			3	1000	3000		Chilli		3	840	3500
	Tomatoes			2	1000	1500		Tomatoes		2	900	2000
	Pea			2	800	4000		Pea		2	600	4500
	celery			2	400	6000		celery		2	350	5000
	Bean			2	1200	2000		Bean		2	890	2300
23	Carrots	0.4		2	2100	2000	23	Carrots		2	1900	2500
	Spanish Onion			2	1300	7000		Spanish Onion		2	1100	6200
	Cabbage			2	1200	1000		Cabbage		2	1100	1200
	Chilli			3	300	3000		Chilli		3	300	3500
	Peanut			1	900	8000		Peanut		1	800	8500
	Tomatoes			2	500	1500		Tomatoes		2	450	2000
	Bean			2	350	2000		Bean		2	300	2300

Ngledoksari Sub Village

Pre Disaster							Post Disaster					
No. House-hold	**commodity name**	**area (ha)**	**Land Status**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average income/months**	**No. House-hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
1	-			worker	40000	< 1000000	1					
2	-			florist	35000	< 1000000	2					
3	-			florist	40000	< 1000000	3					
4	-			worker	40000	< 1000000	4					
5	-			private		< 1000000	5					
6	-			farmer			6					
7	Carrots	0.06	own	2	200		6	Carrots		2	150	
	Cabe			3	60			Chilli		3	45	
	Mustard			3	30			Mustard		3	25	
	celery			3	25			celery		3	20	
	Peanut			1	400			Peanut		1	300	
	Cassava			2	1000			Cassava		2	800	
8	-			florist			7					
9	-			Farmer worker	30000		8					
10	-			Farmer worker	30000		9					
11	Carrots	0.1	own	2	400		10	Carrots		2	0	

Pre Disaster							**Post Disaster**					
No. House-hold	**commodity name**	**area (ha)**	**Land Status e**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average income/months**	**No. House - hold**	**commodity name**	**area (ha)**	**Annual freq. of Cropping in 1 Year**	**Avarage ammount per cropping**	**Average selling rate per Kg**
	Spanish Onion			2	200			Spanish Onion		2	0	
	Cabbage			2	300			Cabbage		2	0	
	Chilli			3	30			Chilli		3	0	
	Bean			2	300			Bean		2	0	
	Corn			2	400			Corn		2	0	
12	Spanish Onion		own	2	210			Spanish Onion		2	0	
	Cabbage			2	310			Cabbage		2	0	
	Chilli			3	30			Chilli		3	0	
	Bean			2	300			Bean		2	0	
	Corn			2	400			Corn		2	0	
	Cengkeh			1	10			Cengkeh		1	0	