

COMMUNITY RESILIENCE IN DISASTER PRONE AREAS BASED ON LAND RIGHTS/OWNERSHIPS

*Chinnapan (Makpiboon) Charoenkalunyuta ^{*a}, Arbind Tuladhar ^{*b} and Jaap Zevenbergen^{*c}*

*^a Photogrammetrist, Bureau of Mapping Technology, Department of Lands, Ministry of Interior
Surveying and Mapping Bldg, Cheangwatta Rd., Pakket, Nonthaburi 11120, Thailand;
Tel +66 2503 2110-9 ext. 215; E-mail: charoenkal20008@itc.nl*

*^b Assistant Professor, University of Twente, ITC, Hengelosestraat 99, 7541 AE Enschede,
Netherlands; Tel +3153 4874312; E-mail: tuladhar@itc.nl*

*^c Professor in Land Administration Systems, University of Twente, ITC, Hengelosestraat 99, 7541 AE
Enschede, Netherlands; Tel +3153 4874351; E-mail: zevenbergen@itc.nl*

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ABSTRACT: The effects of disasters are increasingly becoming a worldwide problem. Climate change is an important cause of the increase of serious natural disasters. Despite many efforts by the international, national and local organizations on disaster risk management (i.e. prevention/mitigation, preparedness planning, response, recovery and risk assessment) in disaster prone areas, disaster still causes people to become landless and/or to lose the ability to prove land rights to their land. People also lose the ability to use the land because it becomes unusable after the disaster. Therefore, it is important to investigate how land issues (including land management and administration) can strengthen community resilience in disaster risk management to reduce vulnerability. The ability to recover a disaster area and the livelihood of victims depends among others the community resilience and the availability of land information. The purpose of this paper is to present an approach to identify resilience indicators and to discuss how these indicators affect the community resilience in disaster prone-areas threatened by flooding. The approach used in our research paper is basically a case study approach using the SWOT (Strength, Weakness, Opportunity and Threat) analysis technique on the information of the cases in various countries where disasters did occur. Our results reveal that the most important elements relating to land issues in all phases of disaster risk management are: land tenure security, land use, land registration (including land reallocation) and stakeholder interaction. The twenty land related-indicators identified are found to be most relevant for disaster risk management. The paper concludes with a discussion on how these land related-indicators are relevant to predict whether a community is resilient to a disaster caused by flooding.

1. Introduction

Nowadays, the damage caused by unexpected natural disasters has increased worldwide with manifold damages. Examples are the South East Asia Tsunami in 2004 that took lives of almost 230,000 people, Hurricane Katrina in North America in 2005 with a loss of more than \$75 billion of economic damage (FIG, 2006), and the Haiti earthquake in January 2010, where more than 200,000 lives were lost and over one million have been rendered homeless (PDNA, 2010).

These disaster events not only destroy lives and resources, but also reduce liquidity of economic and social development (GTZ, 2002). In the case of flood risks, floodplains and deltas also offer favourable conditions for settlement and economic development. Flood risks are traditionally minimized by building physical structures such as embankments or dikes along the rivers. However, such an approach creates an endless need for raising and improving the physical structures, and it restricts the natural dynamics of a river system and spoils landscape qualities such as cultural heritage and scenery. An alternative approach is to minimize the consequences of flooding by a community learning to live with the floods. Such approach is generally called “Resilience strategies” (Vis, Klijn, de Bruijn & van Buuren, 2003). Within Disaster Risk Reduction (DRR), the term “Resilience” refers to “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” (UNISDR, 2009). In the context of flooding, considering the goal of reducing the socio-economic impacts by learning to live with flood risks, this research paper emphasizes not only land use planning but also takes into account of land rights or ownership aspects within land policy for Disaster Risk Management (DRM). Therefore, the main aim of this paper is to study the community resilience (specifically resilience indicators) in the flood risk areas from land rights perspectives for all DRM phases.

2. Research Methodology

For this paper, the study is divided into three main phases. First phase mainly consists of a theoretical study on land policy within disaster risk management using desk research. This is mainly to review how the policy of land management/administration can affect to the resilience of communities in disaster risk areas. Critical land policy elements are identified in DRM phases. Then the second phase describes various case studies on flood risks in the Netherlands, Thailand, Germany and Turkey, hurricane case studies in USA and Honduras, earthquake in Iran, and tsunami and earthquake case study in Indonesia. These cases are analyzed using SWOT analysis to identify those strategies that help in improving community resilience. Then the last phase concentrates on determining indicators that directly relate to those strategies.

3. Land policy in Disaster Risk Management

An appropriate mean for managing land and its use is to have a suitable land policy developed and implemented in accordance with spatial planning and tenure arrangements in the disaster risk areas (Quan & Dyer, 2008). Such policy implementation is likely to better equip the communities (or citizens) of the areas for their role as managers (i.e. by learning to live) in the disaster prone areas during pre- and post- disaster phases. If they are aware of the benefits of a spatial plan and of ownership arrangements, this drives them to the appropriate use of land in the pre-disaster phase, and some hazardous areas can even be left idle/vacant to

allow flooding during the disaster period. Land ownership should then also include the rights to access land for recovery after a disaster takes place.

In Disaster risk Management we consider two important elements associated with the harmful effects, and damage of life and property (UNU-ITC DGIM, 2009). 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” (ISDR, 2010). Vulnerability relates to “inadequate ability to protect against the natural disasters and insufficient ability to recover quickly from its effects”. The factors of vulnerability comprise political-institutional, economic, socio-culture and environmental factors. The causes of vulnerability from natural disaster occur at different levels. These are: global level e.g. climate change and demographic change, national level e.g. poor governance and tenure insecurity and community level e.g. unsustainable land use and poor land use plan (UN-HABITAT, 2010).

Our research indicates that an appropriate (or good) land policy implementation increases the community resilience with high resistance and recovery capacities and low effect of disaster on vulnerability. Figure no. 1 shows that if there is poor implementation of land policy, there would be high risk of disaster and poor resilience.

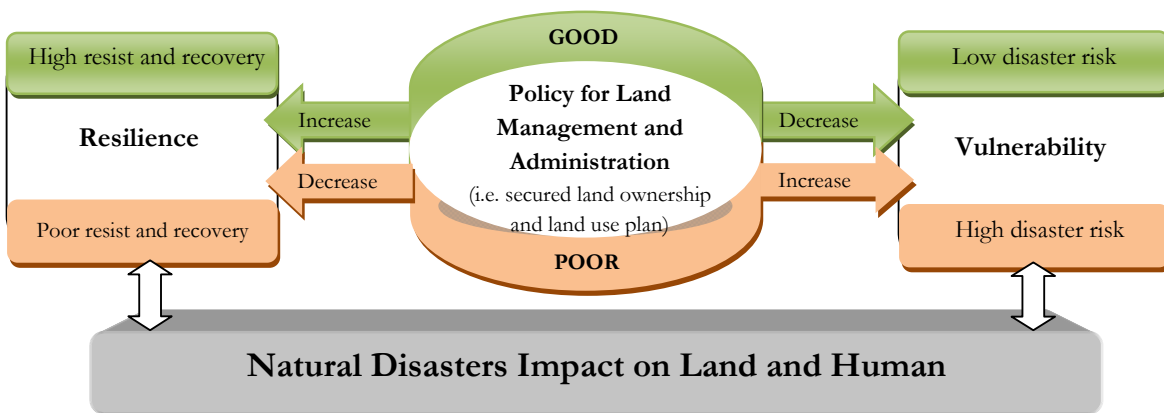


Figure no. 1: The Relationship of policy for land management/administration, vulnerability and resilience in Disaster Risk Management

Secured land ownership/rights and effective spatial planning promote resilience of the community from natural disasters (such as both prevention/mitigation and recovery). On the other hand, the impact of natural disasters on land and people is related with the magnitude of vulnerability. The interaction among land tenure, land use, natural disasters and vulnerability including the resilience of the community is illustrated in Figure no. 1.

According to Pantoja (2002) “disaster risk management is a cyclical, dynamic process that requires continuous adjustments, decision making and interaction at different yet interrelated levels and among a variety of institutions and actors, including individuals, households, communities, non-governmental organizations, market institutions, and government”. From this definition, in theory, one can argue that communities (in particular) are important to be resilient with the help of inter-related institutions and actors in all phases of disaster risk

management. According to the UN/ISDR (2004), the key DRM phases are prevention/mitigation, preparedness planning, response, recovery and risk assessment as shown in Figure no. 2.

Soon after a disaster takes place, rescuing the victims is needed as *response* to save the victims and remaining property. After that, the process is continued by *recovery* to return back to the normal condition as pre-disaster stage. In order to protect the vulnerable group, *risk assessment* concerning related hazard needs to be carried out to manage the damage in case of a similar kind of disaster in future. The *prevention/mitigation* and *preparedness planning* stages are the main stages that require attention to improve the resilience of community. Figure no. 2 below indicates each DRM phase with the combination of land policy implementation elements. In general, secured land rights and appropriate utilization of land in the hazard areas are key to minimize the vulnerability.

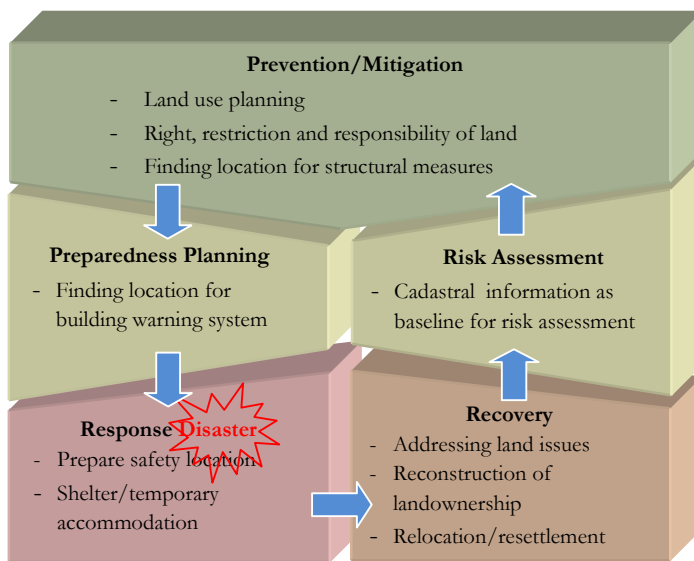


Figure no. 2: Land Management/Administration in Disaster Risk Management

During *response or emergency time*, government (central or local) agencies are responsible for providing temporary accommodation at safe locations without hampering economic and environmental situation. Good land management policy can help finding a safe location for protecting the victims in emergency time. The safe places or shelters must be provided to the vulnerable people in the communities.

Recovery is the period for addressing and reconstructing infrastructures including housing

which depends on the resilience of each community. Good land administration provides the records of land ownership in order to identify the land tenure in a post- disaster. Landowners might claim the rights to their land based on tenure or occupancy. Moreover, land management/administration can support by providing data related to land so that it could be allocated to the right person before reconstruction of housing. It will have a positive effect on expediting the ability of victims to take their normal livelihood back. In case the old location of victims is in the risk zone, land management/administration can find a safe location for resettling and relocating of victims.

Risk Assessment can be conducted based on the cadastral information to estimate the loss of land property in the future. The government needs a land use plan and specific regulation in each risk zone in order to protect people and conserve the resources for the community. Cadastral records, including records of land use and infrastructure information can support in assessing the value and use of land. It is important information for estimating the expected value of loss in case of any disaster in future. The information resulted from risk assessment can identify the risk zones, which may impact on the use and value of land.

Beside structural measures, the activities of *Prevention/Mitigation* related to land issues can also be applied with non-structural measures. Land administration provides specific rights, restrictions and responsibilities of land, based on land use and spatial planning and risk assessment information. The government can impose responsibilities to the landowners in risk zones to insure their house from natural hazards damage. Land administration also provides the information in order to find the suitable location for dikes, dams, canals and pump stations in flood risk areas, etc.

Preparedness Planning is related to building the warning system and training people to cope with disaster during emergency. Land management/administration can support to find suitable locations to build infrastructures of early warning system and provide information for making procedures of preparedness planning in order to inform vulnerable groups. Thus land policy implementation by good land management/administration supports all phases of DRM enhancing the community resilience and reducing the vulnerability of the community.

4. Case studies in Disaster Areas

This section presents the case studies related to land and the resilience issues in two different hazard situations. The first set of case studies are directly concerned with flood disasters. Second set of case studies are related to disasters such as Hurricanes, Tsunamis and earthquakes. Both sets are meant to learn how the situations related to land are managed to have communities resilient in the areas. In this paper only short descriptions and findings are presented.

i) *Case studies in flood disasters* – the four case studies in the Netherlands, Thailand, Germany and Turkey are discussed. Our desk research indicates that these are most relevance to the topic of resilience strategies.

a) *Flooding in The Netherland*: since 1000 years ago, the Netherland has been exposed with serious river floods. In order to protect land the first dikes system was created in Utrecht areas around 13th century. Since then river floods are still a serious concern in The Netherland. In 17th century Dutch Government created prevention contracture system and draining system by which continuous construction and maintenance of many pump stations, canals, ditches, locks and dikes are regularly carried out. After the construction of dikes, dams and other structural measures, people felt safe to live in hazard prone areas. But the height of dikes was never enough to protect land and people, the government always had to increase the heights more and more. Therefore, resilience strategy was developed to allow some areas to be flooded while some areas are protected by the structural measures. So during 1995-2000, many dikes and levees were built along rivers of around 240 kilometres.

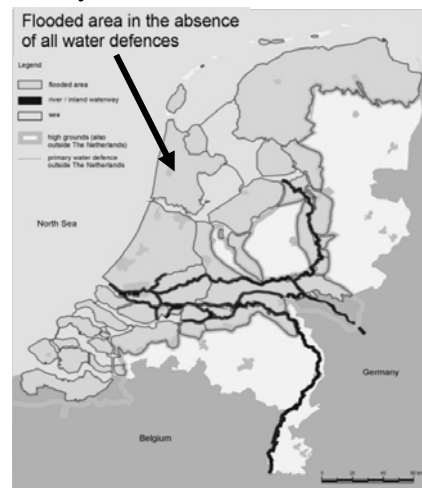


Figure no 3: The Netherlands Flood Area in Case without Protection Systems (Kingma, 2010)

Resilience strategy in the Netherlands basically focuses on the prevention/mitigation phase as well as to avoid the damages and sudden

occurrence (or to speed up recovery) with proper warning system. After flooding takes place, Dutch government pays compensation of damage on land to the affected people, and reconstructs the houses. The people who live outside hazard areas together with the government would help the victims. This strategy includes managing land use by spatial planning. It controls and manages flood areas to protect the life of vulnerable group, and implement recovery program after the events (Bruijn & Klijn, 2002).

b) *Flooding in Thailand:* Chao Phraya River is a main river of Thailand. In the past, the measure against flood in the river, was taken by constructing dykes along the river bank around 300 km in 7 municipalities, which consists of polder system and flood control for protecting the capital city (Bangkok) and agricultural area. One of flood damage mitigation plans is called “Monkey Cheeks”.

This plan has been designed with a safety expected to last for 100 years in urban areas and 10-25 years in agriculture areas (Hungspreug, et al., 2000). As an example of resilience of community, flood risk areas in Chitnat Province are of interesting case. During the occurrence of flood the people always travelled by boats. They had no electricity system and moved to temporary shelters. The flood caused their homes and farmlands being covered with lots of garbage and mud. Water was contaminated with dirt and stench (Wisitwong & McMillan, 2010). The actions that were usually taken by the government during flood disaster are as follows: 1) shutting down the electrical service; 2) supplying food and drinking water to victims; 3) arranging public toilets; 4) providing health service station; 5) draining water; and 6) paying the compensation to victims.

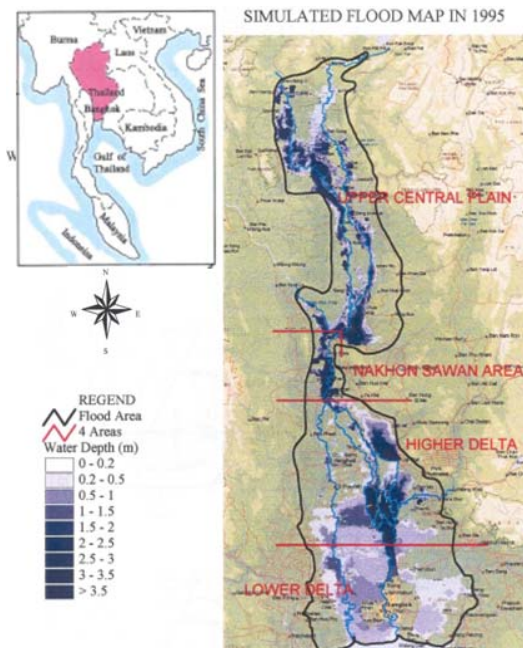


Figure no. 4: Estimated Inundation Map from Chao Phraya River (Hungspreug, Khao-uppatum, & Thanopanuwat, 2000)

A “Land Titling Program” was introduced in order to provide land tenure security and credit facilities on farmland to the people (Nanthanonty & Rakyao, 2007). The Land Titling Program is a 20-year program and achieved the target by issuing over nine million “Title Deeds” or certificates of land rights. Improved income from agriculture sector is a positive result of this program.

The Land Titling plays an important role in disaster prone area. Absence of land registration would exacerbate the impact of natural disaster occurred. As an example of such situation occurred to the Mokaan people. Mokaan is the indigenous community in Phang Nga province of Southern Thailand which lives on state land and private coastal land in tourist areas (Brown & Crawford, 2006). All their land was not registered in a land registration system. After the tsunami in 2004 they had

to leave the areas because they could not prove their right to the land without land certificates.

- c) *Flooding in Germany:* More than 100,000 people live along the bank of Rhine River in Germany. The rising water level was affecting their daily life. One of the important strategies that was applied for damage and risk reduction was by spatial planning for flood prevention measures by relocating existing dikes, changing the land use and consolidating the land as part of flood risk management.

This case study reveals that rearrangement of land use and land ownership/rights by land consolidation process enable the reduction of the land use conflicts, making required land available and secure the result of risk reduction permanently.

Figure no. 5 shows an example of land parcels before and after the land consolidation beside a creek.

The case study also indicates that the landowners together with spatial planning authorities are involved in enabling the program successfully executed (Friesecke, 2005).

The community plays an important role in succession of the disaster prevention activity. Lessons learnt from this case show that the biggest flood dyke project in 2005 could successfully be implemented by involving the farmers located along the river bank through land consolidation (Drees & Sünderhauf, 2006).

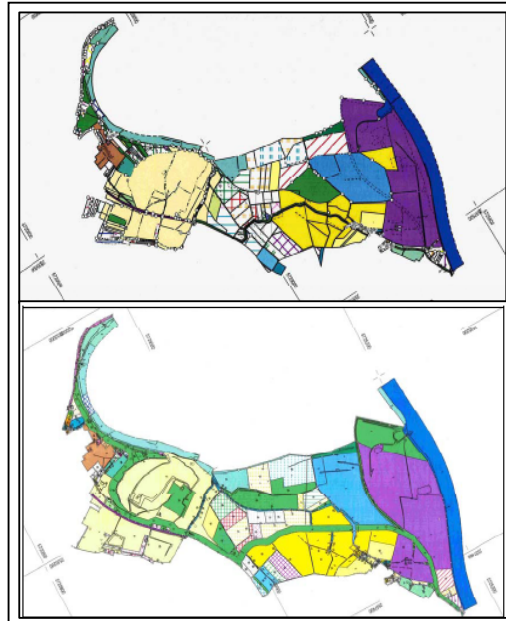


Figure no. 5: The Map of Parcel Before (upper) and after (lower) Land Consolidation Program in the Part of Rhine River Bank

- d) *Flood in Turkey:* This is the case of the north-western part of Black Sea River basins in Turkey. The case study shows that one of the flood management strategies applied here is use of the structural and non-structural measures as solutions. These measures are implemented by slanting structures, flood forecasting and early warning, land-use modification, building public awareness of the floods, and obligatory natural disaster (including floods) insurance. Use of satellite images and GIS is extensively made to facilitate these activities.

Access to information related to flood disaster are provided using a) database of flood inventory; b) giving the clear mandates and responsibility to each organization, especially during emergency time; and c) enabling the obligatory participation for all stakeholders, including local communities in the planning and decision-making process (Gurer & Ozguler, 2004).

- ii) *Case studies on Other disasters* – the following four case studies are chosen to learn lessons how land issues are being tackled in other types of disaster caused by the hurricane, Tsunami and earthquake.

- a) *Hurricane in USA*: In 2005, a hurricane named Katrina killed around 1,500 persons and over 800,000 persons were displaced from the areas of Mississippi, Alabama and Louisiana in USA. An early recovery plan was implemented by compulsory purchase of land from the nearby areas. Later plan was aimed to mitigate the flood risk by implementing safety standards and motivating the people to re-build their houses in safe areas with financial incentives. In Louisiana, the Recovery Authority adopted a strategy related to land tenure element such as paying compensation to rebuild or/and buy a new house in Louisiana or sell properties and move out from Louisiana (Fitzpatrick, 2008).
- b) *Hurricane in Honduras*: A hurricane the “Mitch”, in 1998, killed over 11,000 people and destroyed around 10,000 homes in the Central American country of Honduras. In post disaster phase, land tenure is an important issue to manage boundary conflict and poverty. Private ownership covers around 50% of the parcels, community ownership around 25% (rented to private) and government land covers around 25% in Honduras.

800,000 farmers have 0.5 hectare or smaller farmland and around 250,000 have no land. These conditions were compounded by deforestation and poor land use planning. After the hurricane Mitch took place, people tried to occupy vacated land in high-risk areas illegally. One of the programs that the government implemented was to register the purchase of housing with subsidy in the name of both spouses. This policy was taken in order to protect the women’s right of land and inheritance. Even though the government has already implemented that policy, the housing reconstruction itself could not successfully provide enough opportunity for Honduran people to change their live.

- c) *Earthquake in Iran*: An earthquake in 2003 killed 30,000 people, destroyed 85% of the houses, and made 75,000 homeless in Bam. Many land problems are caused by destroyed boundary markers and loss of land records and documents. It reveals that the widows were often victims who could not get their rights to land belonging to their deceased husband. During the emergency response time around 30,000 tents were built along the city streets. But, the victims moved these tents to their land with the reason to protect their property rights and to get close to their livelihoods. The government of Iran passed the legislation which prohibited land transaction (buying-selling) in order to minimize the ownership disputes during the reconstruction periods (Fitzpatrick,2008).
- d) *Tsunami and Earthquake in Indonesia*: This is the case of tsunami and earthquake that took place in 2004 in Aceh and Nias of Indonesia. Around 667.000 ha of land including 300.000 parcels of private land and 74.000 ha of agricultural land were affected by mud, salt and sand brought by tsunami waves (Fitzpatrick, 2007). In 2005, the Government of Indonesia published the Master Plan, identifying land rights as a key element during the reconstruction phase. Auditing of the physical condition of land (obscured, unsafe and submerged land) and replacement of lost land records were proposed (Indonesian Government, 2005).

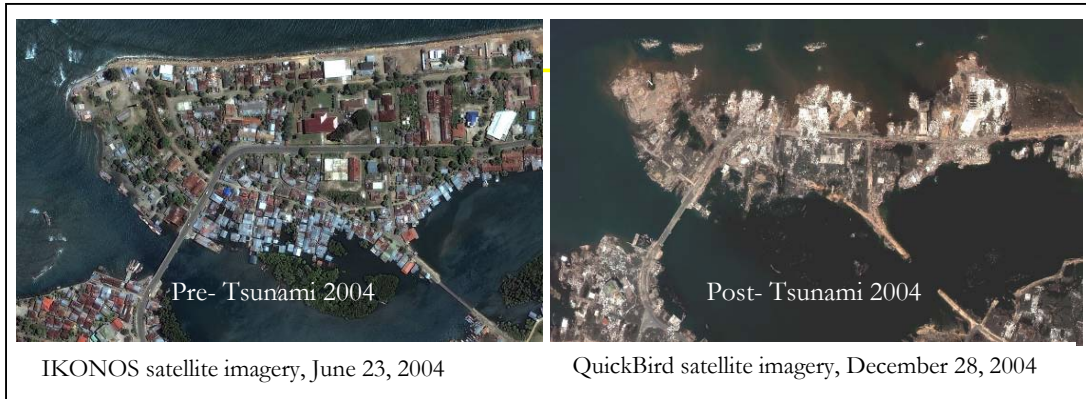


Figure no. 6: Parcels in the west coast of Banda Aceh city (Ulee Lhue, Meuraxa subdistricts) were lost due to tsunami

In early 2005, the land title certification based on community-driven adjudication was implemented under the Reconstruction of Land Administration System in Aceh and Nias (RALAS) project by Indonesian National Land Agency to guarantee the tenure security and to support the housing providers during the reconstruction period. This is the case where the land policy has played an important role in protecting rights of vulnerable groups (orphans, women and poor) during the reconstruction phase.

5. Community resilience elements

Section 4 provides some lessons learnt from real cases of disasters. These lessons are useful to identify elements relevant to communities or citizen to be resilient in disaster prone areas. First of all, the case studies in Germany, the Netherlands and Thailand show that there has always been an implementation of a strategy to prevent the high disaster risk and plan for risk reduction. Non-structural measures for protecting land rights have been well implemented in the Germany by applying land consolidation projects in disaster areas, while in the Netherlands spatial planning approach is used for allowing some parts of high risk areas to be flooded i.e. learning to live with floods. However, in order to reduce the adverse impact of the flooding hazard, both aim to re-arrange land use and to relocate the structural measures (e.g. dike and dam) for increasing the retention capacity of the land.

In the Netherlands case, the landowners have the responsibility to support structural measures by bearing the cost for restoration and maintenance of dikes to protect their communities. Accordingly, the participation of communities is the main factor to the success of the project. If they are aware that they are living in hazard risk areas and perceive the potential damage to land and property, they collaborate to find the required strategy that fits with their communities. The other strategy to increase the resilience of the community in flood risk areas is not only by enabling the participation but also by clear mandate and responsibility among the involved stakeholders and the involvement of the communities in decision-making. This strategy, as an example, is applied in the Turkey case. The community plays the decisive role in this planning process. The government respects and considers the opinion of local people as their knowledge is based on their experiences in facing the flood.

The effectiveness of the policies depends on the appropriate actions for supporting social and economic conditions for the affected people as in case of USA where the compensation is the

most important element to the victims in the post disaster scenario. The people of Mississippi have freedom to re-build, or move to other areas if they feel unsafe in the old location.

Providing and enabling the victims with access to the land is also one of the strategies for increasing the resilience of the community. As an example case, in Honduras, many of victims are landless, homeless and moneyless. The victims try to occupy vacant land, although they realize that all those lands were located in the high risk area. This is one of the causes that have increased the informal settlement and also vulnerable group in disaster risk areas.

In Iran, the land disputes about the boundaries that were destroyed by earthquake were many. To reduce disputes, the government decided to prohibit the land transaction during recovery phase after disaster. In disaster areas (caused by tsunami and earthquake), the case from Indonesia realizes that land registration plays a key role to increase the resilience of the community. Land rights are a key element during reconstruction phase. Land disputes (e.g. boundary disputes) can be reduced by reconstructing the boundary of the affected parcels.

The other impact of implementing land registration is the economic level of the community. This is clearly seen in Thailand case where the Land Titling Program provides secured land rights and increases investment in the agriculture land. The people who receive a “Title Deed” can obtain credit (by mortgages) from the bank, and can invest the money on their business.

The synthesis of the above discussion leads us to the following important elements of land policy implementation to make communities better resilient in disaster prone areas. These are:

- Land tenure security
- Disaster risk management activities
- Land use and land registration
- Stakeholder interaction

With these elements in mind, we conducted an analysis with central focus on communities living in the disaster prone areas using SWOT (Strength, Weakness, Opportunity and Threat) technique. In this research, resilience indicators are then derived from the strategies which are important to improve community resilience in disaster prone areas.

6. Environmental analysis using SWOT technique

SWOT techniques is usually applied for business or organization context to come up with a set of strategies that enhance performance (MindTools, 2010). In this research, considering community (i.e. a group of citizens) as central focus, we see that community resilience is influenced by the internal factors in term of strength and weakness of communities in carrying disaster related activities, while external factors determine if certain communities able to take advantages of certain opportunities minimizing the possible threats in disaster prone areas (Charoenkalunyuta, 2011).

The case studies indicate that communities most often do have opportunities of seeking helps for both structural and non-structural measures from various governmental or non-governmental agencies. There are four opportunities including clear mandate and responsibilities as listed in the SWOT matrix in table no. 1. However, the communities do

experience threats as well, such as no security of land rights and lack of land policy thereby increase informal settlement in disaster prone areas.

Similar analysis also shows that communities have also strengths and weakness as indicated in the table 1.

Table no. 1: SWOT Matrix of Communities' Resilience in Land Tenure Perspective

External Factors (Outside communities) Internal Factors (Inside communities)	<u>Opportunity (O)</u> 1. Clear mandates and responsibilities/roles for land agencies 2. Governments understand and perceive the importance for assuring tenure security. 3. Governments understood and perceive the importance of reducing risk in the disaster area 4. Availability of technology for communication and effective construction in disaster areas	<u>Threat (T)</u> 1. No security of land rights or ownerships 2. No appropriate land policy in the disaster prone areas 3. Lack of land records or land registration 4. Increasing informal settlement areas
<u>Strength (S)</u> 1. People aware the importance of secured land tenure 2. Public participation 3. People's experience from the previous disaster 4. People perceives the risk of disaster	<u>SO Strategies:</u> <ul style="list-style-type: none"> • Guaranteeing the land tenure in disaster risk areas • Defining the role and responsibility of stakeholders clearly • Sharing data between stakeholders with all administration level • Involving among stakeholders and communities in prevention/mitigation and preparedness project 	<u>ST Strategies:</u> <ul style="list-style-type: none"> • Making people feel secure in hazard prone area • Improving land security in case of relocation/resettlement of people from disaster risk areas. • People perceive the importance of land registration in order to support land tenure security
<u>Weakness (W)</u> 1. People re-occupy and return back to live in disaster prone areas 2. Conflict of land boundaries 3. Landless and homeless problem 4. Low education and poverty of people	<u>WO Strategies:</u> <ul style="list-style-type: none"> • Defining appropriate right, responsibility and restriction in disaster risk areas • Making hazard map • Relocating /applying the resettlement of people from disaster risk areas • Applying the structural measures (such as: building dikes, dam, canal, etc.) to protect community and preparing temporary shelter • Required organization which has responsibility for disaster management for the community 	<u>WT Strategies:</u> <ul style="list-style-type: none"> • Making land use plan in disaster risk area • Implementing land registration after re-settlement • Solving land disputes with land registration • Making education program (e.g by training, pamphlet and brochure)

SWOT analysis reveals that at least sixteen strategies are required to improve the community resilience for the non-structure measures specifically from the view points of land policy and land rights or ownerships, although the structural measures such as building dikes, dam, canal, etc are required to protect community temporary shelters at the same time allowing flooding in certain severe areas such that communities have better resilient in livelihood in

the disaster prone areas. The some of these strategies are briefly discussed below within the DRM phases.

Response/Recovery - Post-disaster situations as observed in Thailand and Earthquake followed by Tsunami in Indonesia indicate that people try to re-occupy and live in disaster risk areas again after a disaster took place. This is particularly needed because community or individual citizens lack secured land tenure. Many land parcels were lost and the boundaries of remaining parcels were difficult to be identified in the areas. Thus land issues became a major problem here. While in Honduras, landless and homeless went to settle in the vacant areas after the disaster occurred and created a serious land problem due to informal settlement. SWOT analysis thus indicates that a) people re-occupy and return back to live in disaster areas, b) land boundaries conflict, c) landless and homeless problem and d) low education and poverty are weakness within community. These reflect the negative result and increase vulnerability of community. Other finding such as increment of informal settlement is considered as a threat because the legal framework or activity to avoid the informal settlement is not effective enough. That means these factors influence the resilience of community.

Risk Assessment: During the risk assessment period, government always estimates the damage to be caused by disasters. During this phase it is important that governments (and also citizens) recognize the importance of assuring land tenure in disaster prone areas. The case studies from Germany, the Netherlands and Thailand show that the communities often agree with help of government initiatives to do land consolidation in river flood areas, while case studies (in Germany and the Netherland) also indicate spatial planning as the prevention/mitigation from the disasters. Both availability and access to cadastral land information are vital for such activities.

Both items, a) government understands and perceives the importance of assuring land tenure security and b) government understands and perceives the importance of reducing risk in the disaster area are the opportunity for the communities seeking help from the governments. Similarly, people perceiving the disaster risk and people being aware of the importance of land tenure security are the strength of the communities.

Prevention/Mitigation - During prevention and mitigation in disaster risk areas, all case studies show that stakeholders must have clear mandates and responsibilities/roles. The case studies from Iran and Indonesia show that land issues concern the lack of land records or land registration to make a good land use plan. Therefore, in these areas, lack of land records or land registration and lack of secured land tenure can be classified as threats, but having clear mandates and responsibilities/roles for land management as opportunity because organisations are there for any conflicts in DRM implementation of resilience. Low education and poverty of people are the factors that make the community itself in a weak position.

Preparedness Planning - The people's participation for preparing and training are important during this period because people who lived in risk areas commonly have the experiences during emergency time. On the other hand, the government should also implement land policy/strategies/measures in risk areas. The new technology could be applied for developing early warning system to reduce the vulnerability of the community. These are found in the case studies in Turkey, the Netherlands, and in Thailand. Based on those situations, it can be summarized that public participation and people's experience with the disaster as positive

point for community. The people within community exchange the local knowledge for promoting their resilience. The availability of technology for communication and effective construction in disaster areas could be classified as Opportunity where the government has several alternatives for choosing the proper technology to support the resilience. No appropriate land policy in the disaster area is a threat, because the government cannot provide effective strategy without implementation of land policy to reduce the vulnerability of community.

7. Community resilience indicators and discussion

Having discussed above about resilience strategies as applied at community level, it is important to have a set of indicators (so called community resilience indicators) in order to evaluate regularly for the communities to be resilient in disaster risk areas. Table no. 2 shows the detail indicators.

Table no. 2: Resilience elements, strategies and indicators

Strategies	Indicators
Land tenure security	
a) Making people feel secure in hazard prone area	1. Percentage of people feeling insecure due to loss of their land in hazard prone area
b) Guaranteeing the land tenure in disaster risk areas	2. Availability of the compensation regulation for the people who lose the land after disaster
c) Defining appropriate right, responsibility and restriction in disaster risk areas	3. Availability of additional regulation in hazard prone areas
	4. Clear right, responsibility and restriction of each type of land tenure
d) Improving land rights security in case of relocation/resettlement of people from disaster risk areas	5. After relocation/resettlement, people stay in safe place and have the right of land in new location
Disaster risk management activities	
e) Making hazard map	6. Availability of hazard map
f) Relocating /resettlement of people from disaster risk areas	7. Availability of relocation/resettlement program from hazard prone areas
g) Applying the structural measures (such as: building dikes, dam, canal, etc.) to protect community and preparing temporary shelter	8. Availability of structural measures to protect communities
	9. Availability of sufficient temporary shelter for community
h) Making education program (e.g. by training, pamphlet, and brochure)	10. Percentage of the people having prior knowledge that they are living in flood risk zone or not
	11. Percentage of the people aware of the procedures and practices during emergency times
Land use & land registration	
i) Making land use plan in disaster risk area	12. Availability of land use plan
j) People perceive the importance of land registration in order to support land tenure security	13. Percentage of unregistered parcels in the community
k) Implementing land registration after re-settlement	14. Availability of registration of parcels in resettlement locations
l) Solving land dispute by land registration.	15. Percentage of land disputes after registration
Stakeholders interaction	
m) Defining the role and responsibility of stakeholders clearly	16. Law/policy/regulation, roles and responsibilities among stakeholders are not overlapping
n) Sharing data between stakeholders with all administration level	17. Availability of the regulation and activity for sharing data
o) Involvement among stakeholders and communities in prevention/mitigation and preparedness project	18. Availability of coordination and collaboration among the stakeholders, including international stakeholder
	19. Availability of prevention/mitigation and preparedness project/program which are involving local stakeholders and/or community
p) Required organization which has responsibility for disaster management for the community	20. Availability of organization which has responsibility of disaster risk management for community

To support sixteen strategies within four resilience elements, this research argues that we need at least twenty indicators to assess if a certain community in disaster prone areas is resilient.

Indicators for land tenure security – Five indicators are meant to identify: a) if people feel secure about their land/property and willing to invest in their land with regarding the guarantee of land tenure; b) compensation to guarantee the security of land ownership/rights provided by government; c) the additional regulation such as compulsory insurance policy including the restriction and responsibility can reduce the vulnerability of the community in disaster risk area. In case of flooding, the victims can get compensation of the damage individually. The compensation for different land type gives opportunities for decision if they re-build or choose relocation options to avoid the next hazard; and d) counting number of people staying in a safe place with secure tenure after relocation.

Indicators for disaster risk management activities – There are six indicators that are based on non-structural measures (in addition to structural measures) in disaster risk management. Among them, availability of hazard maps is an important indicator used to inform the community to be aware, and responsible agencies or government can use hazard map as input data in decision-making (risk assessment). Effective resettlement program in a safe place is to protect the vulnerable, and is also an indicator together with indicators of effectiveness of structural measures (e.g. dike, dam, canal, etc.) to protect safe areas where the people can be relocated. These structural measures help also to allow flooding in other areas where flooding cannot be stopped. This is important during emergency and response period. Awareness of information among the people can increase the participation in the mitigation program.

Indicators for land use and land registration – Four indicators are identified here. Firstly developing and implementing land use plan for appropriate use by spatial planning process is a vital strategy in disaster prone areas. This research reveals that such plans depend not only on physical aspects of land but also on tenure type of land. Unregistered land parcels bring uncertainty on the boundary and the land rights. It also shows there should be registration of land in re-located areas to guarantee land rights for the victims. At the same time, there must be efficient dispute mechanism for land registration.

Indicators for Stakeholders Interaction – Five indicators are being proposed here: non-overlapping roles and responsibilities of stakeholders in decision-making in implementing DRM, the efficiency of the cooperation among stakeholders to share the comprehensive information. By collaborating among the different levels, stakeholders can provide the complete data/information to the community. The participation of local stakeholders and communities ensure that the prevention/mitigation and preparedness program work well. The direct interaction between stakeholders in charge of DRM and community can keep the information and response in time.

8. Conclusions

This paper brings several conclusions. First of all, a good policy for land management and a land administration system securing land rights/ownership, and a land use plan in disaster prone areas provides opportunities for recovery activities for the communities to be resilient.

A low impact of natural disasters on land as well as human being can be expected particularly in flooding case.

The SWOT analysis of the various case studies in this paper show that community resilience depends on four elements namely land tenure security, disaster risk management activities, land use and land registration, and stakeholder interaction.

To enable the evaluation of the resilience of community, twenty indicators are presented and these are based on strategies. Fifteen indicators relate to three elements (namely Land tenure security, Land use & Land registration and Stakeholders interaction). Other five indicators relate to disaster risk management activities in which one of them is about availability of structural measures to protect the communities in the areas. This indicator should be seen not only for stopping flood (which is impossible) but to protect living areas and communities by allowing floods in other safe areas providing opportunities for improved spatial planning.

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