Chapter 11
Post-Disaster Housing Reconstruction in Indonesia: Review and Lessons from Aceh, Yogyakarta, West Java and West Sumatera Earthquakes

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Abstract The post-disaster situation offers opportunities to rebuild liveable environment for achieving safer communities in the future, and housing reconstruction plays a crucial role in rebuilding the communities. In the past decade, Indonesia has experienced several major destructive earthquakes causing severe damages to infrastructures and human settlements. An ex-post review of the past experiences and challenges in post-disaster housing reconstruction after earthquakes in Aceh (2004), Yogyakarta (2006), West Java (2009) and West Sumatera (2009) reveals some strategic issues in implementing safer housing reconstruction that have to be addressed in the future for achieving "build back better" post-disaster reconstruction programs. Past experiences showed that training and capacity building of construction personnel and home-owners, through the dissemination of guidelines and manuals as well as building codes and standards for anti-seismic design, which have been implemented in the housing reconstruction programs by the national and local governments, NGOs and aid agencies have improved the practices by builders and masons in the areas that had experienced major earthquakes, but in general the attitudes of the building industry as well as local government building administrators in ensuring the housing earthquake safety still need to improve. Nevertheless, some good practices have been observed in several post-disaster housing reconstruction programs that shed the light to the development of better strategies for achieving earthquake safer housing, through the introduction of various supporting policies such as better project delivery systems, better mechanism for providing supervision and technical advices, more down-to-earth training and capacity building mechanism

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as well as smarter financing and incentives system, supported by appropriate technology approaches. Awareness building program is an important part of the mechanism and should be taken out seriously as it affect significantly the risk perception of the stakeholders, which is one of the key elements in the decision making process in investing for safer housing.

Keywords Anti seismic design • Awareness raising and training • Build back better • Building administration • Housing recovery

11.1 Introduction

Indonesia, the world's largest archipelago, is prone to earthquakes due to its location in the Pacific Ring of Fire. As four tectonic plates interact within the boundary of the country with approximately 240 million inhabitants, earthquakes of M 5.0 or larger can be recorded almost daily (Pribadi et al. 2008). In the last decade, several major earthquakes have caused massive destructions, such as the earthquakes in 2004 in Aceh (which has caused the killer Great Indian Ocean Tsunami), 2005 in Nias, 2006 in Yogyakarta, 2007 in Bengkulu, 2009 in West Java, and 2010 in West Sumatera, and claimed hundreds of thousands of lives and damaging half a million structures in total, mostly from the housing sector.

Experience shows that most of the casualties and economic losses in the earthquakes were due to damages in the housing sector. In many cases, houses in Indonesia are built as non-engineered structures, based on traditional practices of the building trades. Despite the existence of manual and guidelines for construction of earthquake resistant housing, many of them performed poorly during the earthquakes due to inadequate design and construction practices, which include poor materials and workmanship (Pribadi et al. 2008). Nevertheless, previous disaster events provide some opportunities to learn from previous mistakes and to rebuild a safer community against earthquake hazard. Considering the seismicity of Indonesia as one of the most earthquake prone area in the world, it is very important to ensure that all buildings, existing and newly reconstructed, perform well under earthquake loading. Improved house construction is needed to reduce vulnerability and to avoid worse impact in the next occurrence of earthquake.

Recovery process has become one of crucial steps that must be implemented after a disaster. Housing reconstruction is a critical factor in the recovery processes, whether one is addressing the phenomenon at the household or community level (Peacock et al. 2007). It is important because without establishing home, the ability of a household to carry out normal activities and to re-establish routine becomes limited and hampered. Delay in housing reconstruction and rehabilitation could delay other recovery effort, such as psychosocial, social and economic recovery (Barakat 2003; Lindell and Prater 2003). In addition Barakat (2003) noted that housing reconstruction and related activities can enhance communities' capacity by strengthening their physical, emotional and practical abilities to survive the disaster

Table 11.1 Recent earthquake disasters in Indonesia

No	Earthquake event	Magnitude	Loss of life	Homeless people	Damaged houses (units)	Destroyed houses (units)
1	Aceh earthquake and tsunami, December 26, 2004	M 9.4	110,000	700,000	57,137	69,932
2	Nias earthquake, March 28, 2005	M 8.6	850	40,000	71,891	12,010
3	Yogyakarta earthquake, May 27, 2006	M 6.8	5,700	100,000	260,000	154,000
4	Bengkulu earthquake, September 12, 2007	M 8.5	35	–	390,825	19,375
5	West Java earthquake, September 2, 2009	M 7.4	81	178,490	216,424	46,697
6	West Sumatera earthquake, September 30, 2009	M 7.6	1,117	–	249,833	114,797

Source: Bappenas 2007; Bappenas 2009; Bappenas 2010; Bappenas 2006; BRR and International Partners 2005

and facilitate reconciliation; improving institutional resources and informal social relations; increasing pride and self-esteem through participatory and stakeholder programming; and enabling disaster-affected people to look forward and invest in the future.

On the other side, housing reconstruction has been challenged not only by the limited lack of capacity in the technical or engineering aspect of the construction, but also by issues such as: (1) poor and chaotic planning and coordination between actors; (2) scarcity of resources and supplies in the time where projects and numerous aids are being launched simultaneously; (3) lack of knowledge and experience in providing and building settlements after disaster; (4) social-cultural consideration; and (5) appropriate beneficiaries' expectation and need (Barakat 2003; Davidson et al. 2007).

The recent post-earthquake recovery experiences in Indonesia, i.e. Aceh (2004), Yogyakarta (2006), West Java (2009) and West Sumatera (2009) (see Table 11.1) provide important lessons learned which are useful for developing better understanding and better guidelines on the housing reconstruction process. A review of the past experiences and challenges in the post-disaster housing reconstruction programs is conducted to identify the problems and strategic issues to be addressed in the future post-disaster reconstruction programs. The main question is: to what

extent the experiences of post-disaster housing reconstruction provide effective lessons learned to the stakeholders?

The following sections outline the theoretical background that becomes a basis for analysis in this paper. This is followed by an explanation of the approach and methodology. Findings will be discussed with the reference to the theoretical background and the case study of four provinces in Indonesia affected by earthquake disasters. Finally, the paper suggests some conclusion and recommendation in developing sustainable housing reconstruction process.

11.2 Theoretical Background

Disasters leaves physical environment destruction, social disruption, and economic stagnation which have critical impact to human lives. Avoiding greater human, physical, and financial losses in the future, policy makers and praticioners are challenged to recover from those major impact. Despite the challenges attendant to the recovery process, the recovery phase offers important development opportunity to restore, rebuild, and reshape the affected area that it could reduce future vulnerabilites and affect sustainable development outcomes (Berke et al. 1993; Smith and Wenger 2007; Olshansky and Chang 2009). The influx of aid and assistance in the affected area can be used to build and support the recovery effort.

Appropriate reconstruction approach could provide a monumental window of opportunity to rebuild damaged structures stronger than before the event, reshape the existing social and economic system, and enhance disaster resilience. Many strategies can be opted, such as the repair and improvement of damaged buildings and infrastructure, stimulating local economic, enhancing public capacity and awaraness toof hazard, etc. The failure in the approach to establish the recovery goals can lead to poor reconstruction quality, a loss of jobs, a reduction in affordable housing stock, missed opportunities to incorporate mitigation into the rebuilding process, and an inability to assist the neediest recover (Smith and Wenger 2007). Oliver-Smith (1990), in his recovery study in Peru, found that sustainable recovery objectives, such as addressing issues of social inequality and the adoption of hazard mitigation practices during recovery, can be achieved when the strategies meet local needs, local capacity are considered by the donors and agencies, and the community understand programmatic assistance requirements (Smith and Wenger 2007).

Housing is fundamental for most societies because it relates to their well being (Barakat 2003; Peacock et al. 2007). As an asset, housing plays role in promoting family lifelines, such as health, education, economic, security, and social. It also generates social interaction, prides and cultural identity, and also political and economic resources (Barakat 2003). On the other hand, housing is also vulnerable asset when it is exposed to threats from natural hazards (earthquakes, landslides, floods). Approximately 97.7 % of the world's disaster homelessness occurs in developing countries (Gilbret 2001). After a disaster strikes, community needs a place to restart the business and proceed again for sustaining the economic activities.

Without adequate housing, individuals will have difficulties to start the economy and reopen businesses (Peacock et al. 2007).

After disaster strikes, housing usually get the main attention to restore back the community sustainability (Gilbret 2001). Depending on the scale of disaster, housing rehabilitation starts a few weeks until few months after the emergency phase and continues until the permanent houses are completed. In this stage, the housing need is solved by temporary shelters while taking time to confer with stakeholders and plan the reconstruction properly (Jha and Duyne 2010; Peacock et al. 2007). Government proposes post-disaster recovery planning based on the result of Post Disaster Need Assessment (PDNA) because if the reconstruction process is not well planned and implemented, further vulnerabilities might increase (Chang et al. 2010). Thus, five domains of strategy in disaster recovery is needed: (1) Institution, (2) Finance, (3) Community Participation, (4) Reconstruction Approach, and (5) Risk Management (Barakat 2003; Jha and Duyne 2010). This is followed by the common term of "Building back better" after a disaster (Monday 2002). Hence, a disaster recovery process can be seen as an opportunity to empower and promote community capacity in housing reconstruction.

At the outset, in the process of housing recovery, it is crucial to recognize all the involved stakeholders, the coordination structure and who will implement (Barakat 2003; Jha and Duyne 2010). In developing countries, various stakeholders may participate in the process, such as the community, local government, private sector, non-governmental organization (NGO), the United Nation (UN) agencies, etc (Barakat 2003). Jha and Duyne (2010) suggest that it is important to have a clear understanding of stakeholders' intentions and involvement, and how they can contribute to the reconstruction process. The involved stakeholders need to develop partnerships and coordination which is normally led by government officials. If necessary, it is important to enact laws, responsibility, regulations, and institutional arrangements which are used as guidance for coordination. The institutional strategy must also include monitoring and evaluation of the capabilities of the organizations involved and decide how their activities will be coordinated (Jha and Duyne 2010).

Barakat (2003) proposes several financing schemes in housing reconstruction process. These include outright gift, partial contribution combined with community self help, and loan. Outright gift is provided for very vulnerable communities by granting money to the beneficiaries as full recipient, without any requirement to return the fund in the future. In contrast, partial contribution provides the beneficiaries with only some limited funds, i.e. for provision of building materials and technical guidance, and supported by the community's source and, if needed, some long term special loans, with or without interest. Loan may also be provided normally through small amount of interest rate to help the community to carry out the construction. Jha and Duyne (2010) noted that the biggest challenge in housing reconstruction is to manage and control the financial spending. This is a complex set of decisions that have social, economic, and logistical implications.

Many stakeholders take community participation as their approach where the community is involved in contributing to project design, influencing public choices,

and holding public institutions accountability (Davidson et al. 2007; Jha and Duyne 2010). Jha and Duyne (2010) said that participation can be seen as the direct engagement of the affected population in the project cycle—assessment, design, implementation, monitoring, and evaluation—in a variety of forms. On the other hand, others consider participation as an operating philosophy that puts affected populations at the heart of humanitarian and development activities as social actors with insights, competencies, energy, and ideas of their own (Jha and Duyne 2010). Community-based approach needs a different programming flow, one that begins not with assessment, but with mobilization of social groups and communities, which is then followed by a community based assessment (Jha and Duyne 2010). Davidson et al. (2007) found that some research showed that the beneficiaries of a housing project—depending on how it is organized—can, with proper, disinterested guidance, intervene at the levels of design decisions, material selection and preparation, construction, management and even financing. NGOs, local government, and national government can mobilize the beneficiaries and communication plays important role in a successful participatory process.

Reconstruction approach addresses how physical reconstruction will be taken out at the community level (Jha and Duyne 2010). Building back better becomes the goal which improves the safety and reduces the vulnerability to future hazards for the reconstructed housing. However, it depends on the role of households and reconstruction agencies and the forms of support, whether it is finance, training, or community facilitation (Jha and Duyne 2010). There are many ways to reach this goal, such as developing standards design and construction of housing, developing land use plan, relocating housing location, etc.

Housing construction and design become one of the main dilemmas in post-disaster housing reconstruction process. The common specific obstacle is related to the quality or quantity of material and construction specifications, which is also primarily caused by funding limitations, the people knowledge as well as the phenomenon of unplanned housing (Steinberg 2007). In terms of construction, Olshansky et al. (2006) also explain that in some cases and conditions of reconstruction process, the partial housing construction (or improvement) type is considered to be more efficient compared to the total housing construction (or rebuilding) type. Further during its development, housing construction, in the context of post-disaster recovery, is not only always identified by the technical approach, but also by the perception approach. This is supported in research conducted by Green (2008) in Istanbul, which states that externally, the confidence level to the various stakeholders such as governments, NGOs, and even engineers could ultimately affect the perception of impacted people in determining their own construction planning.

The housing location is also one of post-disaster recovery instrument that can also provide opportunities for the future disaster risk reduction effort (Usamah and Haynes 2012). On the other hand, impacted people certainly have their own discretion to determine the location of their damaged housing rebuilding, based on factors ranging from financial ability to even the possession of social capital. In some cases and post-disaster conditions, housing site selection may become a full responsibility

of the government. It means that the government has the authority to choose the location of the rebuilding of the houses and also to relocate if necessary, or better known as re-settlement. However, despite the role of government in this regard, there are still many cases related to the rejection of relocation, with several contributing factors such as incompatibility with livelihood, limited access, or inappropriate condition to conduct economic activity (Dikmen 2006). In order to support the successful relocation scheme, as proposed by Ozden (2006), public involvement should be considered as a key factor in its planning and development. Jha and Duyne (2010) also pointed out risk management that need to be considered by policy makers in the housing reconstruction process. Poor management of the risks could result in unexpected outcomes, delays, and loss of credibility for the actors involved. Establishing a culture of risk management in reconstruction is crucial to mitigate future risk.

11.3 Method

The research is based on the review of the post-earthquake and tsunami housing reconstruction process in four cases in Indonesia that took place between the years of 2005–2012, namely Aceh, Yogyakarta, West Java and West Sumatera Provinces (Fig. 11.1). Documents for each of the cases were obtained from government officials, UN agencies, and previous research studies. In addition to the documents as the main information sources, the authors have had the opportunity to conduct field surveys and observation in the recovery areas, conducted interviews and some

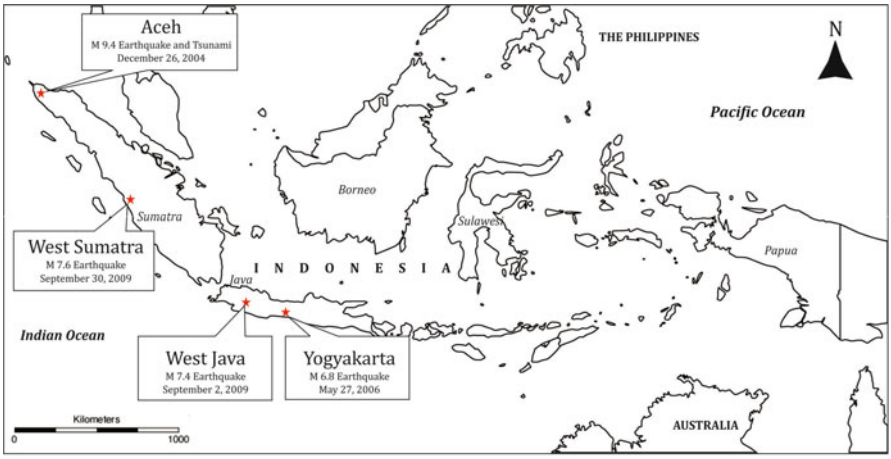

Fig. 11.1 Location of study area

focussed group discussions. The analytical method in this research is mainly qualitative, carried out through the discussion of the main issues and problems experienced in the cases, supported by some field as well as secondary data, followed by synthesizing the lessons learned, in line with the theoretical framework discussed in the Sect. 11.2. However, the depth of discussions in each case study varies due to limited information available in some issues in the case studies.

11.4 Housing Reconstruction in Four Affected Areas

The following discussion portrays the housing reconstruction processes and depicts the issues and problems experienced in the four affected areas in Indonesia, each of the case studies provides discussion on institution and finance, community participation and technical issues.

11.4.1 Aceh

On December 26, 2004, an M 9.4 earthquake struck the northern part of Sumatera and triggered a tsunami which swept the coastal areas of Aceh and North Sumatera Provinces in Indonesia. The tsunami wave affected also southern Thailand, Sri Lanka, Maldives, and some parts of the coast of Somalia in Africa (Steinberg 2007). The widespread destruction in Indonesia has been massive and larger than in other countries. The tsunami affected about 500 km of coastal areas along north part of Sumatera and swept away all physical objects along Aceh's western and north coastal line, flattening houses, infrastructures, and many other facilities (Ochiai and Shaw 2009). The districts of Aceh Jaya, Aceh Barat, Aceh Besar and Banda Aceh were identified as the most suffering area (Jayasuriya et al. 2010). The earthquake and tsunami caused more than 110,000 loss of life, 12,000 missing and 500,000 people became homeless (BRR and International Partners 2005). Total damage and losses were estimated at US$ 4.45 billion, the same amount of the total Gross Domestic Product (GDP) of Aceh province in 1 year. It was estimated that 127,000 houses destroyed (BRR 2005) and the housing sector was the most affected, suffering up to US$ 1.4 billion losses (BRR and International Partners 2005). In Banda Aceh, the capital city of Aceh, the local and regional governments were paralyzed and lost their function.

11.4.1.1 Institution and Finance

The Government of Indonesia, through its sector ministries, took immediate effort with financial and practical assistance when the mega-disaster occurred. An earlier

housing policy was taken by Bappenas[1] and KPU.[2] However, since local government administration collapsed and central government had limited capacity in becoming operational on the ground, NGOs had become the "real" actor who drove emergency aid, rehabilitation and reconstruction (Steinberg 2007). There were 120 NGOs contributing to housing reconstruction. Further, many agencies and donors worked without coordination so that it led to a chaotic reconstruction environment (BRR and International Partners 2005; Telford and Cosgrave 2007).

Later, the Government of Indonesia appointed Bappenas to develop a master plan (Jayasuriya et al. 2010). It aims to coordinate, synchronize and integrate plans of various sectors, the business community and the community (stakeholders) in an action plan based on timeframes, locations, funding sources and the parties in charge (Bappenas 2005). However, many NGOs and Aceh local government refused the master plan's idea. They denied establishing a new agency to coordinate recovery activities. They insisted that this new agency would lead to centralized approach. In other words, it could add new layer of bureaucracy to the problems of working in Aceh and all of the construction work would be tendered in Jakarta, capital city of Indonesia, without proper local needs and involvement (Jayasuriya et al. 2010).

Hence, those who refused the master plan prepared their own reconstruction programs although it was not clear how they could be compatible with it (Jayasuriya et al. 2010). Many NGOs had been engaged in housing reconstruction work, but some of them were also inexperienced in this field (Steinberg 2007). According to Steinberg's (2007) field observation, they were still involved in housing reconstruction because they had available money from grant or their government fund and saw it as a good opportunity for them to exist. However, they worked without proper coordination between them, and there were competitions among them, such as: (1) competition to having beneficiaries; (2) competition in the completeness of the services; and (3) competition due to conflicting programs (BRR and International Partners 2005; Chang et al. 2011; Soelaksono 2009). Multilateral development banks (Asian Development Bank and World Bank) also delayed their housing assistance because of budgeting problem and procurement procedures (Steinberg 2007).

The central government realized that it needs more decentralized coordination and they still kept their mind to establish a new agency to solve this problem (Jayasuriya et al. 2010). In May 2005, BRR[3] was established by cabinet decision to coordinate agencies and donors in reconstruction work (Steinberg 2007). Further, BRR itself did not fully refer to the master plan when conducting its activities because it was felt that the plan did not ensure local involvement in many aspects (Jayasuriya et al. 2010). BRR changed its policy and completed a new housing policy in 2006. The approach gave opportunity to the community to participate in decision-making about where, how, and by whom houses were reconstructed (Jayasuriya et al. 2010; Steinberg 2007). However, the new policy still left debates

[1] Bappenas: *Badan Perencanaan Pembangunan Nasional* (Ministry of National Development Planning)

[2] KPU: *Kementerian Pekerjaan Umum* (Ministry of Public Works)

[3] BRR: *Badan Rekonstruksi dan Rehabilitasi* (Rehabilitation and Reconstruction Agency)

between housing reconstruction actors, such as site location criteria for resettlement and procedures of repair assistance (Steinberg 2007). After the establishment of BRR, Steinberg (2007) observed that the chaotic reconstruction environment still existed and BRR was overloaded with responsibilities including coordinating 120 NGOs contributing to housing reconstruction. BRR became less focussed in coordinating the large amount of actors when they were appointed by the Government of Indonesia to be involved in building houses (Jayasuriya et al. 2010). The recovery funding were allocated by domestic source of the Government of Indonesia, private sector funding, and foreign government aid, totalling about US$ 9.1 billion for 2005–2009 (Jayasuriya et al. 2010). Approximately, US$ 760 million were provided through different channels and accounts to reconstruct houses for 66,700 displaced families. Two hundred thousand houses were to be built or rehabilitated (BRR and International Partners 2005). The Government of Indonesia and donors allocated US$ 976 million assuming a 36 m^2 house with the cost estimated at US$ 3,000 per house (BRR and International Partners 2005; Jayasuriya et al. 2010). However, the cost of construction work was escalating in Aceh during the recovery phase. Lack of sustainable and legal building materials, increasing labour and building material cost, escalating transportation cost, and lack of access to affected area influenced the situation and slowed the progress of housing reconstruction work in Aceh (BRR and International Partners 2005; Chang et al. 2011). The situation was worsened by the fact that local manufacturing and supply facilities in Aceh were widely damaged, many labour died, and many affected areas were located remotely. Building material and labour were shipped from outside Aceh. Thus, by early 2006, BRR increased their estimation that a 36 m^2 would cost US$ 4,000 (BRR and International Partners 2005). In 2008, BRR estimated that 110,000 houses had been built and 70,000 houses had been rehabilitated (BRR 2008).

11.4.1.2 Community Participation

As noted before, BRR introduced in the master plan the new approach that local communities were to participate in housing reconstruction. Many agencies and donors offered to rebuild several houses in some villages, started discussing with local leader, and discussed the design of houses with the beneficiaries. Even though the Acehnese share the Indonesian tradition of having strong association between community members and community-related activities, it was not easy to drive this policy. Many agencies and donors had difficulties to drive the community in participatory planning because the mega-disaster has also affected the community structure and cohesion, as many local community leaders died and many communities were separated into barracks and tents which contributed to the weakening of the community's cohesion (Steinberg 2007). As BRR and International Partners (2005) observed, building communication between community and external parties took times and necessitates facilitators working with the communities. Trauma from personal losses and the losses of their family members and their personal belongings became obstacles in the participatory process (Steinberg 2007). Thus, some of them

showed frustration and no interest in further community consultations. These factors hampered the facilitating and empowering the community in the reconstruction process and slowed down the housing reconstruction progress.

Chang et al. (2011) observed that community participation driven by donors was limited and failed in some particular affected areas. In the community participation based construction, the community or beneficiaries were asked to participate in the design and to partly manage the construction of their own houses (Boen 2006a). Lack of understanding, experience and knowledge of the way in which the community-based reconstruction can be organized has influenced the outcome (Dercon and Kusumawijaya 2007). In some cases, the community voiced discontent and were confused because many NGOs came to them and proposed to deliver similar assistance with community participation concept (BRR and International Partners 2005). Some NGOs scaled back the pace of their housing programs through community contracting mechanisms, including training local people in construction and supervising construction by themselves (Steinberg 2007). However, the initial response showed fast construction progress, but lacks of supervision and technical support produced low quality construction by the agencies (Boen 2006a; Steinberg 2007). The condition in Aceh was far from ideal for the implementation of community-based processes and the successful community participation for the local affected depends on the readiness of both aid agencies and the local communities (Chang et al. 2011; Steinberg 2007).

11.4.1.3 Technical Issues

Boen (2006a) observed that the collapsed buildings in Aceh by the 2004 Indian Ocean earthquake and tsunami are mostly non-engineered buildings. Non-engineered buildings are buildings that are built traditionally with very little or no assistance from qualified engineers (Okazaki et al. 2010). There were two types of non-engineered house buildings that collapsed due to the earthquake and tsunami: one or two stories confined masonry buildings and timber construction (Boen 2006a). These structures often do not follow minimum requirements for a good confined masonry building, and many of them use locally available materials to give a "masonry-like" feature, which are in fact very vulnerable to ground shaking (Boen and Pribadi 2007). Masonry buildings built with good quality materials and good workmanship will have better chance tosurvive in an earthquake, although they may not survive the tsunami generated by the earthquake. Okazaki et al. (2010) found that although only few existed prior to the earthquake, traditional timber construction demonstrated good performance under seismic loading. However, it could not survive the tsunami wave.

All of involved institution in the housing reconstruction process learned from the previous mistakes and rebuilt safer community for the future earthquake. Unfortunately, they did not have a clear housing reconstruction policy that could be referred to. In January 2005, Bappenas and KPU announced that all of the earthquake and tsunami victim households would receive housing reconstruction and

Fig. 11.2 A post-tsunami housing reconstruction project (*source*: Field Observation in Banda Aceh 2006)

rehabilitation, including a free 36 m^2 house for eligible households or house repair for partially destroyed houses (see Fig. 11.2) (Steinberg 2007). Soon, there was a debate about specifications and they did not reach any agreement. Many agencies and donors did not take serious responsibility at the housing design and planning process. They were successful in delivering housing reconstruction assistance, but as some of them were inexperienced in housing reconstruction , they had failed to deliver quality housing construction in term of good and permanent construction materials, earthquake-resistance building, and supporting infrastructures (Boen 2006a; Okazaki et al. 2010; Steinberg 2007). Many donors and agencies had also done poor and inadequate site engineering and feasibility study of the site area, which led to lack of supporting infrastructures (such as road, public transportation, electricity network, water supply, and sanitation) and lack of community livelihood consideration (Boen 2006a; Matsumaru et al. 2012; Okazaki et al. 2010; Steinberg 2007). Many relocated beneficiaries experienced this situation in the relocation site and they also faced a totally different environment from their original sites. Those units soon were refused, uninhabited, or abandoned by the beneficiaries (Okazaki et al. 2010; Steinberg 2007).

On the building safety aspect, many of those houses were constructed with poor quality materials and poor workmanship (inappropriate mixes of mortar and concrete, poor brick laying, poor detailing of reinforcement etc.) (Boen 2006b; Okazaki et al. 2010). The structures were also lacking in structural integrity, due to insufficient connections between each structural component (Boen 2008; Okazaki et al. 2010). Many projects demonstrated that the workers were not adequately skilled for the job (Boen 2008; Okazaki et al. 2010). For example, aggregates for concrete making were not sieved, stirrups were made without seismic hooks, concrete curing were not done, bricks were not soaked prior to laying, too much water in concrete mixture, etc. They just simply did what they thought as the easiest way for building construction with no concern about the quality because they were not equipped with knowledge of proper construction methods nor basic concepts of quality in structures.

11.4.2 Yogyakarta

An M 6.8 earthquake struck in the south part of Java Island on May 27, 2006. The earthquake directly affected the provinces of Yogyakarta and Central Java. The two most severely affected areas are Bantul District in Yogyakarta Province and Klaten District in Central Java Province. The affected areas were located in relatively poor rural and urban-fringe areas south, east and north-east of the city of Yogyakarta. As the earthquake struck in the early morning hours, many people were trapped in their homes. The earthquake had taken over 5,700 human lives. Injury estimates range from 37,000 to 50,000, and hundreds of thousands had been rendered homeless (Bappenas 2006). The damage was very heavily concentrated on housing and private sector buildings. Private homes were the hardest hit, accounting for more than half of the total damage and losses (US$ 1.5 billion). An estimated 154,000 houses were completely destroyed and 260,000 houses suffered some damage (Bappenas 2006). More houses will have to be replaced and repaired than in Aceh and Nias at a total cost of about 15 % higher than the damage and loss estimate of the tsunami. The high level of damage is mainly due to the high density of the population (1,600 persons/km^2) and the almost complete lack of seismic design provisions (Elnashai et al. 2006).

11.4.2.1 Institution and Finance

The recovery activity started 1 month after the disaster impact. In July 2006, after the Preliminary Damage and Loss Assessment was produced, Bappenas had released the Action Plan for Rehabilitation and Reconstruction for Post-disaster in Central Java. Three objectives were prioritized in the action plan: rehabilitation of housing and residential areas, rehabilitation of public facilities, and reactivation of the economy. Minister of Finance also invited multiple donors from various countries to mobilize support through a multi-donor trust fund. The aim of this strategy was to build on the ability to rapidly develop, finance and implement projects; coordinate international resources around common objectives; avoid duplication of effort; create synergies and reduce transaction costs for both donors and the recipient (World Bank 2012).

In October 2006, Java Reconstruction Fund (JRF) was established and contributed about US$ 94 million from seven donor countries. The JRF's work was coordinated by Bappenas, coordinator of the reconstruction, and adopted a phased approach to reconstruction in line with the action plan. On the other side, the central government set up approximately US$ 1,613 was allocated for each household by the central government (Resosudarmo et al. 2012). The earthquake survivor households were not given new houses constructed, but they were expected to reconstruct or renovate their collapsed houses using the funds provided. However, the lightly

damaged houses were not given any housing support (Resosudarmo et al. 2012). In June 2008, the government had spent US$ 57 million on housing, and the JRF had spent US$ 60 million on various activities (mostly housing) (Resosudarmo et al. 2012). The JRF and the government had built more than 215,000 earthquake resistant houses in Java in less than 2 year. They claimed it as the largest and the fastest housing reconstruction after disaster in the world (World Bank 2012).

The Governor of Yogyakarta said that the beneficiaries should not only receive the government housing aid as it is only enough for the main structure of the houses—foundation, columns and beams, and roof main structure—which should be earthquake resistant, but also should receive all outside supports and funding sources as far as they are not loan (Ikaputra 2012). As Ikaputra (2012) observed in Bantul District, the beneficiaries also used fund from other sources, such as their own money, relatives, donors, NGOs or even from bank loan. They became alternatives because of the slow process of fund disbursement by the government (Raharjo 2007).

Some international NGOs started to collaborate with local NGOs (Raharjo 2007). Many of these international NGOs were also actors who were involved in housing reconstruction in Aceh (MacRae and Hodgkin 2011). To avoid the past experience in Aceh, they employed skilled and experienced local staff and also an increase in the proportion of international staff with in-country experience. They also recruited local university students and faculties, especially civil engineering and architecture, to conduct statistical surveys on the damage and number of victims and also as facilitator (MacRae and Hodgkin 2011; Raharjo 2007). Later, they introduced the concept of T-Shelter (Temporary Shelter) to be occupied by the community in the transitional phase of recovery while the government plan for preparing permanent shelter progresses. However, slow progress of funding disbursement and unclear formal coordination between the government and NGOs have caused uncoordinated and sporadic T-Shelter distribution in the affected areas (MacRae and Hodgkin 2011; Raharjo 2007). Further, as Ikaputra (2012) observed in Bantul, the beneficiaries had not only the reconstructed house, but also T-Shelter in their yard (Fig. 11.3).

11.4.2.2 Community Participation

The housing reconstruction policy adopted community-driven approach. In early August 2006, the Government's Decree instructed that reconstruction implementation must be organized and be implemented by the local community group—*Kelompok Masyarakat* (POKMAS) which made up of 10–15 families (Jha and Duyne 2010). They took the decision on how to distribute funds and chose which members should receive housing first (i.e. poor household, elderly household, large family household, etc). Training was provided to POKMAS members and local workers to ensure earthquake-resistant construction (Jha and Duyne 2010). The leader or other members from each group would attend trainings or workshops to improve their knowledge about earthquake-resistant housing and building materials. Later, they

Fig. 11.3 Dome houses in Ngeplen village, Sleman, Yogyakarta (courtesy of Prof. Sarwidi, UII Yogyakarta)

would convey what they had learned to the rest of their group. They worked together and helped each other in reconstructing houses.

To control their task, POKMAS must be provided technical assistance through facilitators (Raharjo 2007). *Lurah* (the head of the village) had the important role as technical coordinator for the distribution implementation on the ground. Facilitators are expected to assist *Lurah* in managing the process of funds utilization by POKMAS (Raharjo 2007). Facilitators were recruited and villages elected boards of trustees who organized community meetings and supervising implementation. Their tasks included (1) identifying beneficiaries and prioritizing the most vulnerable; (2) establishing POKMAS, who chose their leaders and a treasurer; (3) developing detailed plans to use the construction grants for each group; (4) opening group bank accounts for disbursed fund; and (5) obtaining approval of plans, disbursement in tranches, and group procurement, construction, and bookkeeping (Jha and Duyne 2010). Hence, the facilitators took important role because they had to ensure effective communication and adaptability of the program to local situations as well as compliance with program principles.

11.4.2.3 Technical Issues

In the affected areas, almost all of the collapsed buildings were non-engineered housing structures (Jha and Duyne 2010). They are masonry structures consisting of adobe, brick masonry, stone masonry, and RC frames with masonry infill (Meguro 2008). Many of them did not fulfil the earthquake resistant building requirements, used low quality building materials, lacked wall confinement elements, and lacked proper joints or have improper detailing (Pribadi et al. 2008; Satyarno 2009).

Nevertheless, Narafu et al. (2008) observed that the impact of the 2006 earthquake had increased the seismic safety in the affected areas due to provided technical guidelines and technical supervision by JRF and local university (See Fig. 11.4). Almost all the reconstructed houses implemented confined masonry.

Fig. 11.4 A reconstructed house was built according to earthquake resistant house manual by a local university in Yogyakarta (*Source*: Pribadi et al. 2008)

Regarding mortar for brick laying, using cement mortar is rare before the earthquake and it becomes to be almost 100 % after the earthquake. There is significant improvement in construction works. These prove that appropriate technical intervention could be accepted by people for enhancing seismic safety. However the technical interventions still need improvement especially from the view point of efficiency/ease of construction work (Narafu et al. 2008).

However, Narafu et al. (2008) and Suarjana and Sengara (2008) still found the problems related to detail in construction, such as insufficient compaction of concrete using simple tools like steel bars (not as effective as vibrators), inadequate lateral support for walls, congested rebar within small section of RC elements, etc. Suarjana and Sengara (2008) observed that these incorrect details were similar to what have been found in Aceh. They argued that it can be influenced by: (1) Contractors tend to chose minimum material quality and simple design for fast construction time that earn maximum profit, (2) Lack of tight supervision by engineer, and (3) Engineers and masons have minimum knowledge on earthquake resistant design.

Another emerging issue was found in dome housing in Ngeplen Village, Sleman Regency (Ikaputra 2008; Pandelaki and Shiozaki 2008). The technology was applied by an international NGO assisting the local people to rebuild their houses which were damaged by the earthquake triggered landslide. It was a new technology housing approach introduced as anti-seismic design house, providing an *iglo*-like concrete building casted as a single and integral structure which is supposed to be stronger, energy efficient, and cost effective (see Fig. 11.3) (Ikaputra 2008). In fact, the 38 m^2 circular houses which provide basic house need and the supporting infrastructure did not meet local need and local culture. Ikaputra (2008), Pandelaki and Shiozaki (2008), and Kondo and Maly (2012) found that the beneficiaries gave negative comments regarding the donated houses, such as the absence of ventilation, roof, terrace and eaves which are necessary in tropical house culture, the absence of living room, kitchen, garage, etc, and even it is difficult for them to construct a cattle shed in the site. Traditional habit, such as taking care of cow for

livelihood, using wood for cooking in the traditional kitchen, welcoming guest and family in the living room, etc, was exchanged with modern family home (Ikaputra 2008). Using limited available material and construction capabilities, the beneficiaries had to adapt and expand some improvement on it, such building kitchen and extension room in the backyard of their house, add some eaves, canopy and veranda to be like their previous houses (Pandelaki and Shiozaki 2008). As the solution for their daily livelihood, later, the local government built cattle shed in the north part of the site location. It seems that the dome houses neglect the peoples' housing recovery needs to sustain their living.

11.4.3 West Java

West Java was hit by an M 7.4 earthquake on 2 September 2009, the epicenter was in the Indian Ocean. The earthquake caused damages and casualties in 15 districts/cities in West Java Province. Eighty one people loss their life while 1,917 people were injured and 50,964 families were displaced (194,719 inhabitants). Over 10,000 houses had been affected with various degree of damage (Yasaditama and Sagala 2012). The worst damage and loss due to the earthquake was suffered by the housing sector. From the total damage and losses estimated at Rp 7.9 trillion, the housing sector suffered Rp 6.9 trillion damage and losses.

11.4.3.1 Institutions and Finance

The West Java Earthquake was declared a national scale disaster event due to the large scale impact caused by the earthquake over seven districts and cities. However, not long after the earthquake, Government of Indonesia shifted the emergency phase into early recovery on 16 September 2009 to speed up the process of recovery (UNOCHA 2009). Bisri (2012) noted that provision of temporary shelter was the highest recorded number of post disaster activities while achievement on the housing reconstruction related activities located in Bandung District, Tasikmalaya District and Bandung City was limited. The small number of activities was particularly due to that all the budget for reconstruction process was solely dependent on government. The government allocated 15 million IDR/each heavily damaged house from annual national budget (APBN), 10 million IDR/each medium damaged house from annual provincial budget (APBD *Provinsi*) and 5 million IDR/each lightly damaged house from annual district budget (APBD *Kabupaten*) (1 USD equal approximately IDR 9,800 at the time of the writing of this article). The money in fact is not sufficient to reconstruct a decent house for each household. Thus, some people have to borrow money from banks or their relatives. Some people who have better savings were able to combine the money they obtained from the government with their own money to build earthquake resistant houses.

In term of coordination, the distribution of the money was conducted through community group (hereafter is called POKMAS). POKMAS is formed by the community and legalized by a formal letter from the Head of District. The funding was distributed through the POKMAS which consist of one chairperson, one treasurer and around 15–30 members representing the households that were affected by the earthquake.

11.4.3.2 Community Participation

Community participation observed in West Java post-earthquake recovery, particularly in hard to reach remote areas, where the communities were involved in the post disaster damage and loss assessment. In Pangalengan, a sub-district in Bandung District, West Java, where a lot of houses were damaged by the earthquake, the POKMAS participated in assessing the damage using the government provided criteria for the four damage levels: heavy, medium, light and no damage. However, in the reconstruction process, other than POKMAS activity, the community participation is still limited. Within the community, reconstruction works tend to be implemented individually by households. A small number of households with better economic saving were able to hire house builders to reconstruct their houses. However, most of the communities tend to rely on government grant to reconstruct their houses. Due to the limited amount of money provided by the government, the communities used some old materials to reconstruct their houses. In the sub-district, a large number of households are landless and most of them work at farms and large plantations as labors and thus have very limited economic capacity to recover from the disaster.

The Indonesian Red Cross (PMI) and the International Federation of Red Cross and Red Crescent Societies (IFRC) were involved in a lot of temporary shelter reconstruction, where the communities contributed in in-kind resources in the form of labors while PMI helped in the construction techniques, supervision and material provision.

11.4.3.3 Technical Issues

A survey conducted post 2009 West Java Earthquake showed that there have been some attitudinal changes observed in building houses in the affected areas. Observation in some examples show that some house owners would want to have better construction of houses that are more compliant to earthquake resistance house guidelines. Some households now have a general knowledge of the government directions about earthquake-resistant housing technical guidance. Response to questionnaire to some high and moderate damage level house owners indicated that they have followed the earthquake-resistant housing technical guidance in their own house rebuilding process despite their previous opinions which argue that the amount of government assistance was not enough to rebuild their houses. It was

Fig. 11.5 Housing Reconstruction in West Java (Left Picture – *source*: Field Observation in Tasikmalaya 2010 & Right Picture – *source*: Field Observation in Pangalengan 2006)

found that most of reconstructed houses have used shallow plate foundation or rock filled concrete pile foundation as well as columns and beams to confine the wall (see Fig. 11.5). Further the survey indicated that in the reconstruction process, people trusted the engineers who come from or recommended by the people in the village. On the other side, house builders suggested that until currently only a small number of people who follow the guidelines on earthquake-resistant house. Financial limitation as well as livelihood problems has constrained the people to implement cheaper housing construction techniques which are less resistant to earthquake. As estimated by Nazara and Resosudarmo (2007), the costs of construction materials went up due to limited availability of the materials. Therefore, to meet with the financial limitation, some strategies in reducing the construction cost through the adjustment of quality and quantity of materials, such as minimizing the reinforcing steel quantity or size or using an alternative material such as bamboo reinforcement, resizing of foundation (Yasaditama and Sagala 2012).

Alternative choice for replacing material actually had been highlighted in the Aceh Tsunami reconstruction (Steinberg 2007). In the West Java earthquake case, the people's financial condition was essential in the decision for alternative construction material selection. As the authority and responsibility for the use of alternative construction material were on the hands of the house owners, there were no difficulties in implementing the alternative solutions.

11.4.4 West Sumatera

On 30 September 2009, an earthquake of M 7.9 struck the coast of West Sumatera. The earthquake has caused a significant number of loss of lives and major setback in socio-economy aspects due to damage of structures and infrastructures. The official data reveals that in the city of Padang alone, the earthquake has damaged 9,635 buildings and houses and caused the death of 316 lives and injured 606 people, as well as damaging other infrastructures (Pribadi et al. 2011). Immediately after the

quake, rapid emergency rescue teams arrived and aid organizations started assessing the damage and providing emergency relief.

11.4.4.1 Institution and Finance

Recovery in West Sumatera took place in November 2009, 2 months after the disaster (interviews with various Red Cross staffs). The UN Cluster approach was applied in the ground and some NGOs took on respective responsibilities for aid based on the coordination guidelines and the Sphere Standards. The funding for the West Sumatra Earthquake Recovery was received from four sources: Foreign Grant, National Budget, Provincial Budget and District/Municipality Budget (Bappenas 2009). The allocation of financing follows the Government Regulation number 22 Year 2008 on the financing and management of disaster aid. Similar to West Java, the government provided 15 million IDR/each heavily damaged house from annual national budget (APBN), 10 million IDR/each medium damaged house from annual provincial budget (APBD *Provinsi*) and 5 million IDR/each lightly damaged house from annual district budget (APBD *Kabupaten*).

11.4.4.2 Community Participation

There are several types of approaches in the housing recovery process found in West Sumatera. One common approach is to apply what happened in previous successful program as in other post-earthquake recovery, such as in Yogyakarta Earthquake (see previous sub section on Yogyakarta Earthquake). However, NGO workers admitted that these approaches did not work successfully as some of the T-Shelter houses were not used by the earthquake survivors. One argument on this was due to the lack of collective action (*gotong royong* in Bahasa Indonesia) among the communities (Vanhoebrouck and Sagala 2010). As Indonesia has a large number of cultures and ethnic groups, it should be understood that there are various ways to approach the community. In the study by Vanhoebrouck and Sagala (2010), community participation occured successfully in particular through sub-ethnic approaches, which mobilize the roles of formal, religious and cultural leaders. Some Minang people rely on self-help process to reconstruct their houses, which can be considered as valuable social capital. The self-help process is also supported financially by the diaspora of Minangkabau (West Sumatra ethnic) people who have migrated elsewhere in Indonesia or even abroad.

11.4.4.3 Technical Issues

There were three reconstruction practices in general implemented by the communities in the housing reconstruction, namely repair, retrofit, and rebuild (Pribadi et al. 2011). In repairing practices, the buildings were partially reconstructed and the

Fig. 11.6 Earthquake damaged houses in Padang Pariaman, West Sumatra. The house on the *left* was rehabilitated by the owner with own fund, while the one on the *right* waited for the disbursement of government aid (*source*: Field Observation in Padang Pariaman 2006)

reconstruction did not change the structural strength, thus the new structural strength is similar to the strength prior to damage. In retrofitting practices, the buildings were partially reconstructed, with the design and construction practice intended to increase the strength of the buildings, thus the reconstructed building should be stronger than before. In rebuilding practices, the buildings were totally demolished and reconstructed, hence for this practice there were two possible outcomes, i.e. strengthen the building or just maintaining the previous strength of the structure. The observation by Pribadi et al. (2011) suggested that 43 % of the surveyed respondents repaired their old houses, 49 % retrofitted while only 8 % implemented rebuilding. This is particularly due to some financial limitation in the community (See Fig. 11.6).

The recent program of "build back better" for post-disaster housing reconstruction in West Sumatera indicates that the role of building material supply stores played in this campaign was important. It clearly shows the critical role that these shops can play in ensuring that the general public has a better understanding about earthquake safe building standards. The previous evaluation by IDEP (2010) showed that not everyone knows exactly what materials they want before they go to material shops which were found at five different building supply stores in Solok District, Padang City, Padang Pariaman District, Pariaman City and Agam District.

There has been some changes on the attitude of house builders towards more earthquake resistant compliance. A (trained) house builder plays the role to explain the importance of building earthquake resistance house to the house owner which causes changes in the preference of construction types and use of materials (IDEP 2010). Therefore, house builders can be considered as agents of changes that communicate and influence the house owners to improve the housing quality. House builders explain that at least there are two reasons why people do not adhere to the earthquake resistant manuals. *First*, the cost of a normal house using cheaper materials and inadequate structural elements is cheaper. *Second*, some house owners are not aware of the method for preparing earthquake resistant structural design and details.

Study on non-engineered construction in Padang City (Pribadi et al. 2011) showed that most of house owners rely on the masons and carpenters for repair and rebuilding works of the damaged houses in Padang City. In most of the cases, the masons and carpenters were not trained properly to construct earthquake safer houses. They usually work using knowledge and skills obtained informally in the past experiences, and in many cases do not comply with the requirements for earthquake resistant construction. Providing the masons/carpenters with the appropriate skills and knowledge for safer houses becomes priority to improve the safety of houses in Padang city during the reconstruction process.

11.5 Discussion

This study attempts to examine processes and lessons learned from four case studies across provinces that have been affected by large earthquake and tsunami disasters in Indonesia. Limitation on the data availability in some of the case studies made differences in the depth of the analysis of each case.

In Aceh Province, which has sustained armed conflict for years before the Great Indian Ocean Tsunami struck, the local governments collapsed during the disaster. Therefore, the Agency of Rehabilitation and Reconstruction (BRR) had to develop not only physical reconstruction but also rebuild and strengthen the local governments in the post-disaster and post-conflict situation. The disaster has provided an opportunity to develop and strengthen the local governments and community as well as to restore peace in the province. In Yogyakarta Province, the post-earthquake reconstruction process has been used to implement better earthquake resistant standards for building houses, which before the earthquake were not known by the local population. In addition, as the local governance system was relatively intact during the disaster, the opportunity to involve the community in the recovery process resulting in better community participation in village development process has been well benefitted. On the other side, the example of the iglo-like construction which failed to include people's perception on housing seems to be problematic. In West Java, the earthquake has not been able to be used as an opportunity to change the behavior of the people towards better preparedness against earthquake risks. Many cases showed that people still built their houses in similar ways as they used to. In West Sumatra, the opportunity has been used to train local engineers and technicians as well as masons and carpenters to understand better earthquake resistant construction.

The experiences have provided a wealth of lessons learned for many actors in the housing reconstruction process on what have been working well and what have not worked, what to promote and what to avoid for better result. The review has showed that many factors have to be considered for an effective post-disaster housing recovery, which include not only technical or engineering factor, but also issues such as actors' planning, implementation, and coordination; aid and assistance mechanism; community participation; and risk management.

In the post-disaster housing recovery program, NGOs are essentials as operational actors who can drive reconstruction program straight to the community, in particular when the local authority effectiveness is hampered by the disaster impact while the central government has limited capacity in operational ground. However, a huge number of NGOs could bring a chaotic and uncoordinated reconstruction environment when there is no strong leadership. Experience in Aceh housing reconstruction showed that NGOs were working with different ways and different principles, even competing with each other to have beneficiaries and project location. The absence of a strong leading actor, strict regulation, and a reference plan contributed to this chaotic situation. However, the establishment of a new agency does not always promise better coordination. Limited communication, time, and involvement in planning process led to no clear policy and agreement on repair assistance.

The issues of the speed of physical delivery and financial management becomes another problem that most assistance agencies faced when providing aid. Many survivors need to settle so that they can carry out normal activities. In Aceh, the aid was provided through different channels and accounts of many agencies so that fund disbursement was very complicated. Learning from the Aceh experience, the government applied better funding mechanism in Yogyakarta case, where aid funding for physical work was provided through an appointed bank and distributed into facilitators' accounts. The facilitators have had the responsibility to manage and use the fund wisely with the consent of the beneficiaries. Nevertheless, slow and delayed aid disbursement by the government and NGOs in the various cases showed that it is important for affected community to have other resources, such as savings, relatives, donors or bank loan, which can be used to initiate the repair or the reconstruction of their houses. Increasing labour and building material cost, escalating transportation cost, and building materials avaliabilty are also issues that can delay the implementation of the housing recovery program. Using maximum local labour and local materials can be a strategy to minimize the spending and anticipate the increasing cost. This strategy has also the advantage of helping to move the local economy, needed for the economic recovery of the community.

11.6 Conclusion

Many actors have provided understanding on the factors influencing the outcome of the post-earthquake housing reconstruction program. Since the housing reconstruction work in Aceh, the community based approach has been introduced to the community. However, it met many challenges and has changed overtime since Aceh post-disaster reconstruction. Low interest in community participation, lack of supervision and technical support which led to low quality construction became the main challenges in Aceh. Many foreign experts and foreign agencies who had limited local experiences and local knowledge as well as little experience in housing reconstruction program have added to the complication of the process.

It is understood that many stakeholders have been involved in the training and capacity building of construction personnel and home-owners through the dissemination of guidelines, manuals, building codes and standards for anti-seismic design. The stakeholders include national and local governments, NGOs and aid agencies, local universities, and local communities. Tighter technical supervisions have been applied in Yogyakarta and West Java experience. Facilitators who are local expert, local university students, or local people supervised small groups of the beneficiaries in order to adapt the housing reconstruction program to local situation. They became the key actor to control the detail of construction work and shared their knowledge to the community. Nevertheless, the investigation shows varying progress in the change of the attitude toward construction practices among builders and masons, as well as among the local government building administrators in ensuring the earthquake safety in the housing reconstruction programs.

An important aspect that needs to be strengthened is the awareness and perception of the house builders and house owners as well as relevant government officials on earthquake safety issues. This paper suggests that it is important to influence the decision making process in investing for safer housing by carrying out disaster education for improving earthquake risk perception among those stakeholders so that mitigation efforts can be accepted at all levels. Inspections and quality controls should be conducted throughout the construction stage to guarantee that the structure will be built according to the design and earthquake safety guidelines. Combined efforts and coordination of government and research agencies, construction developers, construction personnel (contractors, technicians, masons and crafts) and the community are necessary in improving building performance towards future earthquakes.

Despite the problems found in housing reconstruction process in the four case studies, good practices have been observed in some of the programs which can contribute to earthquake safer housing. Crucial issues for improving housing reconstruction programs include better project delivery systems, better mechanism for providing supervision and technical advices, more down-to-earth training and capacity building mechanism as well as better financing and incentives system, supported by appropriate technology approaches. Stakeholders' coordination in some cases has proved to be difficult and lack of effectiveness due to the large number of stakeholders who were involved in housing reconstruction process. The recovery plan should build up the communication and agreement among the stakeholders that can provide specific or assigned types of assistance. The government can be a pioneer of post-disaster efforts and convene to engage in policy making. They can utilize all of available capital to establish a recovery policy framework.

The recovery policy should achieve sustainable development goals, integrated with disaster mitigation program. For example, it should consider risk mitigation in repairing the damaged houses by implementing anti-seismic house design and choosing lower risk locations for the rebuilt houses. It also need to facilitate disaster resilience, which implies an ability to "bounce back" more quickly following a disaster. Policy makers are often not aware of the need to build disaster resilience and its role in achieving sustainable development. The multi-stakeholders

cooperation can bring massive capital to enhance communities in adopting disaster resilience approaches through risk communication and appropriate disaster risk reduction technology.

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