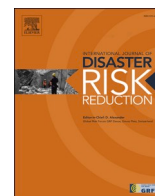


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Progression through emergency and temporary shelter, transitional housing and permanent housing: A longitudinal case study from the 2018 Lombok earthquake, Indonesia

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ABSTRACT

Increasing quality while reducing the time and costs of progressing disaster-affected populations from emergency shelter to permanent housing is key for improving post-disaster resilience. However, targets set around quality and time are often overly optimistic; the process is complex and factors affecting the progression of shelter and housing through the initial weeks and months following a disaster are diverse and not well documented. To identify which contributors are key to recovery efforts and at what stages in the process they can help or hinder, we need to study post-disaster environments over time. This longitudinal study of the shelter and housing evolution over the first eight months following the August 2018 Lombok earthquake helps to provide some insight. We argue that unrealistic expectations over timelines and standards were set. We consider the humanitarian response through aid and grants, the role of individual actors, and wealth and location of those affected. Hampering overall recovery efforts were a lack of transitional housing policy, an overly complex grant process for permanent housing construction, and a failure to declare a national disaster in a politicised environment. Conversely, shelter vulnerability reduction (people moving into more secure shelter then housing) at household level was marginally affected by wealth, proximity to a regency centre, being in an urban location or receiving additional shelter aid in the first few months, but less influential four months following the disaster. Most households self-recovered, with those recovering fastest being the most proactive and adaptable, who were supported by an effective village leader.

1. Introduction

Disaster shelter and housing recovery can be used as a proxy for overall recovery as shelter closely connects with other recovery indicators such as livelihoods, health, dignity and the re-establishment of communities [1–4]. Recognising its importance, minimum standards for shelter among disaster-affected populations exist to guide the international humanitarian community and advise on planning, the provision of services, space requirements, use of local materials and labour, as well as appropriateness for local contexts [5]. When evaluating post-disaster shelter and housing, quality (both construction quality and cultural and climatic suitability), speed, and budget are key considerations (e.g. Refs. [6–8]). Expectations for and comparisons between shelter and housing recovery following disasters must consider both the severity and scale of the disaster and the pre-disaster context in terms of a region's year round, general construction capacity [8]. If expectations for recovery are overly optimistic, frustration with and criticism of the managing authorities

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can arise among those affected. Progressing through the stages of emergency shelter, transitional housing and permanent housing can be complex (e.g. Refs. [9,10]; many factors can slow the overall recovery as well as affect the relative rates of recovery among affected populations, some of which are clear and observable, others proving more difficult to quantify. Studying the progression through shelter and housing over time allows the factors affecting people's movement at various points to be identified, so that hindrances potentially slowing recovery or increasing vulnerability can be addressed in future transitional shelter and housing policy and practice.

Setting goals throughout the relief, transitional and recovery process is important for maintaining momentum and ensuring progress, but in an ever-changing environment, these must be dynamic and incorporate flexibility. While expectations regarding the pace and quality of shelter provision and housing reconstruction can play a key role in post-disaster evaluations [8,11], they can be set too high as delays and complications often arise (e.g. Ref. [12]). Unrealistic recovery timelines can be set for various reasons, including to demonstrate to both national and global audiences that the situation is under control and manageable, but it can have an adverse affect on perceptions and satisfaction with recovery when these timelines invariably slip. Crucial for timely recovery success is a clear and accepted strategy, accurate data and consistent communication, buy-in and support for participation among those directly affected, close collaboration between key actors embedded in communities, alignment of national and local government priorities with those of the international NGO community, weaving disaster risk reduction principles into everyday life, sufficient overall resources and expertise, and equality in access to economic resources such as aid and government loans [13–25]. Common factors slowing recovery include lack of finance and complex or insufficient government grants (e.g. 2015 Nepal earthquake [26], poor planning and project management (e.g. 2004 tsunami, Sri Lanka [27], land ownership complications (e.g. Haiti earthquake, 2010 and Gorkha earthquake, Nepal, 2015 [26,28], inappropriate shelter and housing design for the local context (e.g. 2004 tsunami, Aceh [29], insufficient construction quality (e.g. Cyclone Sidr, Bangladesh, 2007 [30], lack of labour, skills and equipment (e.g. Pakistan earthquake, 2005 and Tohoku earthquake, 2011 [19,21], and corruption (both actual and perceived) (e.g. 2009 L'Aquila, Italy, earthquake, [31]. Aid in the form of relief items, cash handouts, housing materials, expertise and other forms of assistance typically distributed by the humanitarian community can help those losing homes and assets to fill gaps, however governments may refuse or restrict international aid due to political, constitutional or economic reasons, as seen in Chile after the 2010 earthquake and Myanmar after Cyclone Nargis in 2008 [32–34]. Thus, disasters can easily become politicised and used as leverage, especially if they allow strong public opinion to be expressed or to push political and institutional change [35–37].

Post disaster shelter has broadly been categorised into four phases: emergency shelter, temporary shelter, transitional housing and permanent housing [38,39], but these should not be considered as distinct phases with uniformity in timelines across all populations following any one disaster, particularly in low-income environments (e.g. Refs. [10,39]). Emergency shelters, both pre-assigned buildings (usually officially designated by authorities) and community buildings chosen ad hoc for their perceived safety, typically provide refuge for the first few days following the initial effects of a disaster [40]. Priorities at this point are for this type of shelter to provide physical safety, accessibility and the storage of food, water and medical supplies [41]. A move then to forms of temporary shelter allows people further refuge where the provision of water, food and other essentials continues to be provided. "Temporary" should refer to the relatively short period of time for which these shelters are typically expected to be used [42], while those using them are yet to re-establish their regular work or household routines [40,43]. Emergency shelters can become temporary shelters for protracted periods of time, meaning that considerations for longer term use of emergency provisions should be factored into planning, including any interference with or impact on the usual building function [41]. Transitional housing often comes next and can be designed to last between six months and five years (although time frames vary considerably in theory and practice). "Transitional" typically refers to "a process that bridges a gap" [42] and "housing" typically suggests more robust structures and better living conditions than a shelter, allowing residents to return to everyday activities such as education and income generation [7,44]. Transitional structures take many forms, from relatively sturdy tents to prefabricated structures, flat-packed structures, and owner-constructed structures using salvaged debris combined with any materials given in humanitarian (or development) assistance or purchased [45]. The transitional phase of recovery and transitional housing are contested concepts. While transitional shelter or housing can provide the rapid, relatively inexpensive protection that displaced populations may need following a disaster in the short to medium terms, it may not always provide an actual transition into permanent housing or recovery [46]; it has been criticised for diverting valuable time and resources away from more permanent reconstruction and development efforts and thus delaying or inhibiting them [16,31,47,48]. Building and rebuilding permanent housing is the final, most costly and most complicated phase, and building back better presents very real challenges, not least because it requires year-round commitment to preventative measures of reducing disaster risk that often demand systemic change.

Learning from each previous experience is critical for improving recovery efforts [49,50], however a relatively limited number of longitudinal studies of post-disaster shelter progression exist (Kotani et al., 2020). Observing this progression through phases in varying disaster contexts allows the potential influence of pre-existing factors such as location and wealth on recovery to be examined over time. Longitudinal investigation has highlighted that movement through shelter and housing does not follow a clear, progressive and linear path, but instead can involve significant movement back and forth into more and less vulnerable positions on the journey towards recovery, especially for lower-income households [39,51]; Kotani et al., 2020; [10]. Some longitudinal studies have provided insight on how the housing preferences of those affected change during the recovery process [9,52], but these have not determined how underlying factors influence the progression from emergency shelter through temporary shelter and transitional housing to permanent housing at different stages during the recovery.

The relative success of recovery, including the time taken and quality of build at different stages and locations, can be affected by both tangible factors such as location accessibility, aid distribution, wealth, and factors harder to quantify such as the role of individual official and unofficial leaders at local to national scales (e.g. Refs. [21,53–55]). Location-based factors such as accessibility of and proximity to administrative centres as well as population density has been noted to impact aid received, particularly in the early

emergency phase. Accessibility includes distance, presence or damage of roads, bridges, and natural barriers such as rivers and landslides. Urban and rural centres can experience disparity in aid provisions, as noted following the Nepal earthquake in 2015, leading to more remote districts feeling isolated [56]. In general, shelter and housing assistance provided by governments and the aid community reaches less than half of those affected by disasters within the first year, therefore many are left to self recover [108,109]. Self recovery, a term encompassing numerous types of household-led building efforts with varying levels of external support [3], is generally supported as a means of empowerment and self-determination. However, it can also entail households rebuilding entirely by themselves with no material input or construction expertise, and in such cases, the same or even greater weaknesses can be rebuilt into the new structures. This is a critical factor when supporting lower-income areas and informal housing in particular, where self-recovery is often very prevalent. However, the extent to which high vulnerability leads to low resilience, a lack of adaptive capacity and slow recovery is debated [57,58]. The role of individual actors in both policy making and implementation capacities, as well as individuals within communities is difficult to quantify. How such actors can be better supported through for example government initiatives and grants, would benefit from closer examination.

In this paper, we provide a longitudinal assessment of shelter progress over the first eight months among displaced populations in seven villages damaged by the 2018 Lombok Earthquake. We consider the overall process of the shelter recovery, identifying the different stages, whether expectations set were reasonable, and what factors hampered efforts leading to targets being missed. We consider how shelter recovery was affected at different points in time by focussing on selected underlying factors including location and wealth, the roles of agency and actors, as well as government support mechanisms and policies relating to transitional housing, aid and grants.

2. Background to the case study area

Lombok is located in a region where the Australian and Sunda plates converge, as part of the ‘ring of fire’ and thus exposed to the risk of earthquakes, volcanoes and tsunamis. Lombok and Sumbawa from the Indonesian province of West Nusa Tenggara (Fig. 1), which has an economy based primarily on agriculture and tourism and, in February 2018, had average monthly income of Rp1,988,358 per month (c.US\$140) [59]; with 14.7% of households living in poverty (as of March 2018) it is one of Indonesia’s poorest provinces (Indonesian average 9.7%) [60].

The July 29, 2018 Mw 6.4 and 5th August Mw 6.9, and 19th August Mw 6.9 earthquakes were the largest on record in Lombok (Fig. 1). East Lombok was damaged by the first event, while the majority of housing damage in North and West Lombok was caused by the second earthquake. In total, 417,619 people were displaced, 71,729 homes were destroyed and 552 died [61]. The hardest hit of Lombok’s five Kabupaten (regencies) was North Lombok, where 178,122 people (over 80% of the population) were displaced and 80% of houses were destroyed [61]. There were also over 100,000 internally displaced persons (IDPs) in East and West Lombok. The earthquakes occurred during presidential election campaigning, scheduled for April 17, 2019, which increased the domestic political focus on the response by the government. However, when the Sulawesi earthquake and tsunami occurred in September 2018, attention and resources were diverted away from Lombok [62].

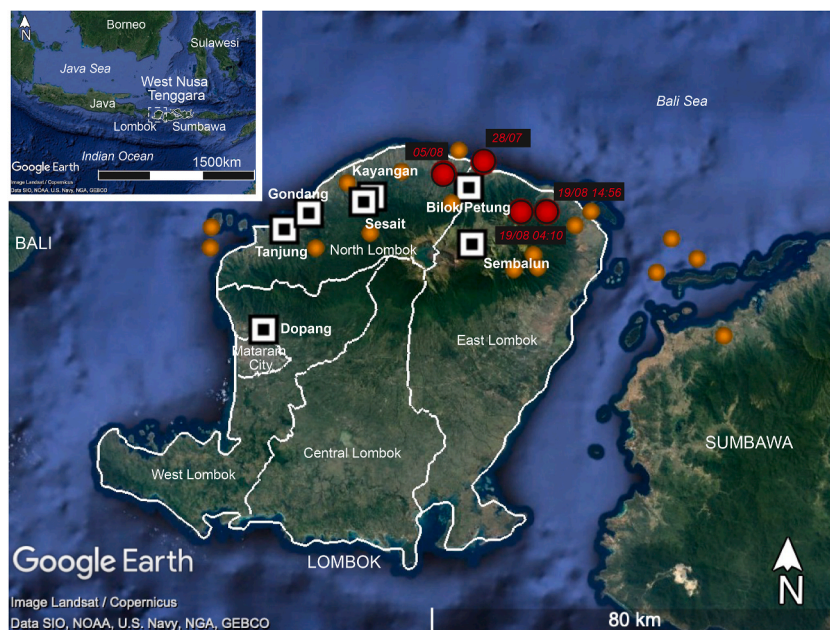


Fig. 1. Study location map, with insert showing location of zoomed map as dashed white box. Lombok earthquakes July–August 2018 (main events > Mw6 shown as red circles, associated earthquakes with Mw5–5.9 shown as orange circles [105]). Locations of the seven survey locations are shown as white and black squares. Note the main government operations and distribution centre was in Tanjung.

Table 1

Desa surveyed. See Fig. 1 for location map. * Source: [97] ** Value shown is for the aggregated total of the urban and rural areas as we did not have the disaggregated data.

Regency	Desa	Urban/ Rural	Distance from regency capital (km)	Surveys completed	# people covered by survey	# households within Desa *	# households destroyed within Desa *
North Lombok	Tanjung	Urban	0	21	97	2651	1186
	Gondang	Urban	7	27	115	2989	2800**
		Rural	15	22	84	561	
	Kayangan	Rural	25	19	77	1443	1112
	Sesait	Urban	30	23	85	1229	1021
		Rural	30	15	61	1650	1514
West Lombok	Dopang	Urban	20	21	94	1002	860
East Lombok	Sembalun	Urban	50	21	86	632	213
	Bilok	Rural	60	26	98	885	308
	Petung						
TOTAL				195	797		

Disaster Management in Indonesia is coordinated through the Badan Nasional Penanggulangan Bencana (BNPB) at the national level, and the Badan Penanggulangan Bencana Daerah (BPBD) at the Provinsi (province) and Kabupaten (regency) levels. Significant improvements to disaster planning and disaster management have been made since the 2004 Indian Ocean tsunami through the disaster management law 24/2007 [63] which set up the BNPB, and a five-fold increase on disaster management spending between 2010 and 2014 [64]. Indonesia adopted the Hyogo and Sendai frameworks [65], and encouraged community management of recovery through the 23/2014 law on decentralisation, which created the BPBDs. Successful community programmes occurred in Aceh in 2004, Yogyakarta in 2006 and Padang in 2009 [66] where critical success factors for post-disaster housing reconstruction included accountability, having a clear strategy, community participation, capability of facilitators, good coordination and communication, sufficient funding and clear beneficiary identification [67]. However, the size and diversity of the country brings challenges to decentralisation [68].

Despite progress, there remained significant challenges identified before the 2018 Lombok earthquakes. These included inadequate local preparedness for disaster, planning deficiencies such as only 15% of kabupaten having an emergency plan, and insufficient disaster risk reduction education and knowledge sharing [65,66]. This was compounded by poor-quality construction with a lack of building regulation enforcement: as seen in Yogyakarta over a decade before [66], people in Lombok had stopped using traditional building methods and materials such as bamboo, wood and dried banana leaves in favour of brick and concrete housing. However, a prevalence of poor construction practices including shallow foundations, a lack of bracing, and poor quality or non-existent rebar, was a factor contributing to 80% of all houses in North Lombok being destroyed in the 2018 earthquakes, with many of those still standing made of traditional materials.

The emergency response to the 2018 July and August earthquakes was managed by the BNPB, with a diverse range of Indonesian NGOs, the Indonesian Red Cross (PMI), the Indonesia Army (TNI), and Indonesian corporations assisting with the immediate needs of the affected population. Despite domestic and international pressure, the Indonesian government did not request international assistance. Furthermore, initially the government did not support transitional housing, however, one month after the earthquakes, Jakarta allowed transitional housing projects.

The central government created a 26-step process for residents to obtain a grant to rebuild homes, which was managed by the regency offices in Lombok with a commitment of over Rp4 trillion (US\$280 M) to homeowners to rebuild or repair their houses. Rp50 M (c.US\$3500), Rp25 M (c.US\$1750), and Rp10 M (c.US\$700) was allocated for a house destroyed, moderately damaged and partially damaged respectively [69], along with a commitment to rebuild all houses within three to six months. The aim was to get money to households quickly and to reduce future risk by providing a selection of designs for 'earthquake resistant' houses. The government-designed and recommended version, RISHA, was made from a modular concrete frame. Other designs were RIKKA (wooden frame), RIKO (wood and concrete frame) and RISBA (aluminium frame). The perception of concrete buildings being more vulnerable led to many residents wanting to return to traditional materials for rebuilding their homes, and hence wanting the "RIKO" design. However, due to the grant regulations on wood grade, there were delays in availability and inflation, especially on teak leading many households to opt for the "RISHA" design as this provided a faster solution. Unfortunately, poor construction resulted in several buildings under construction being damaged by a Mw5.6 earthquake on March 17th 2019. Responsibility for the execution of the rebuilding projects was devolved to the regency governments in Lombok using a similar model to previous Indonesian disasters in Yogyakarta in 2006 and Padang in 2009 [70]. Another aspect of the grant process was it included safeguards against corruption and fraud.

In 2019, the government announced a doubling of the annual Indonesian disaster response budget to Rp15 trillion (c.US\$1.05 billion) with more money focused on preparedness and education, and new strategic options such as catastrophe bonds being investigated [71].

3. Methods

A total of 195 household surveys encompassing 797 people were conducted within seven desa (villages) in Lombok between 22nd March and April 10, 2019 (Table 1). Participants were asked about the evolution of the household's shelter provision since the earthquake (including type and time in each), aid received, financial situation, employment, progress through the grant process and opinions on the recovery process. The desa were selected in a wide range of locations in order to gain a more comprehensive overview of the entire disaster zone, and to allow comparison of different locational variations, such as including different regencies, a variety of distances from the regional capital, and both urban and rural settings (Table 1). Households were selected after an initial assessment to provide a representative sample of different locations, construction types, and levels of damage within each desa. The surveys were conducted in Indonesian or Sasak with the use of a translator (a former English teacher, native Indonesian and Sasak speaker, and familiar with the disaster response), often accompanied by the local KaDus (village leader). The Rotary Club of Mataram co-ordinated translation, logistics, and access to senior officials managing the disaster. Most surveys took place where the household was residing.

Forty-one semi-structured interviews were conducted in March, April, and August 2019 with three senior politicians (March–April), seventeen local government leaders including seven KaDes (regency) level and ten KaDus (village) level (March–April, with three follow ups in August), nine business owners (seven in March, two in August), four senior NGO representatives (three in March–April, one in July, and one follow-up in August) and eight disaster response leaders (four in April, one in July, three in August). These all included the same starter questions and followed the same structure. covered recovery strategy, finance, resources, key recovery factors, and the impact on infrastructure, businesses, public services, and the economy. A wide variety of interviewees were chosen to provide a balanced overall view.

A tour of each desa was conducted to visually survey the overall damage, the current shelter provision, and the progress on rebuilding permanent housing, with over 800 photographs taken as evidence.

The Government data including official but unpublished data on the number of households destroyed, progress through the government housing grant process, and rebuilding was obtained from desa and regency offices.

Shelter has been classified into six categories (a-f) according to location and type (Fig. 2): (a) no shelter/sleeping in the open, (b) basic temporary shelters constructed by the local community at a posko (informal camp set up in the immediate days after the earthquake, housing between fifty and two thousand people), usually hastily constructed from tarpaulin, bamboo, wood and rope (c) temporary shelter at the households homesite, made from basic materials including tarpaulin, bamboo, wood and rope, usually constructed by the home owner, (d) transitional housing with a roof made from corrugated galvanised iron (CGI), hardboard, wood or extra-strong tarpaulin, with walls made from hardboard, wood, recycled door frames or extra-strong tarpaulin in a long-term transitional camp, usually constructed and funded by an NGO or Corporation, such as a bank (e) transitional housing (as in (d)) at a household's homesite, usually constructed by the home owner and (f) permanent housing usually at the household's original homesite.

The time scales regarding shelter recovery are based on the date that the household's residence was destroyed. In East Lombok, this was the 06:47 29th July Mw 6.4, while for North and West Lombok, it was the 18:46 5th August Mw 6.9.

Definitions and categorisations of aid, location, savings and income are given in Table 2. Wealthy households, defined as being one of the 6% of Indonesian households with a car [72] and including senior politicians, owners of large businesses and expatriates, were not included in the survey. Ten of these households however, formed part of the semi-structured interviews.

4. Results

4.1. Summary of results

Overall, the recovery was not as successful as aimed, with lengthy delays in obtaining grant approval, and a shortage of labour and materials. In the first few weeks, wealth, proximity to a regency centre, being in an urban location or receiving additional shelter aid, to some degree all helped IDPs more quickly find a form of shelter, access to transitional housing, and return to their home site. However, after four months, none of the above factors impacted the speed of recovery. The main challenges in reducing shelter vulnerability became those factors that complicated the grant process for permanent housing, including difficulties in identification and land ownership verification, and local administration being unable to cope with the process quickly and efficiently. Land ownership verification was often difficult because many transfers of land, for example, from a father to his children, was informally done and not documented. The government's initial rhetoric about re-housing everyone after three to six months was over optimistic with only 19.7% of all houses being rebuilt after one year [73,74]. Many households were therefore living in transitional housing for longer than anticipated.

4.2. Emergency shelter

In East Lombok, where the earthquake occurred in the morning (06:47 local time), a smaller proportion of surveyed residents spent the first night with no shelter than in North and West Lombok, where the damaging earthquake was in the evening (18:46 local time) (68% and 94% of surveyed households respectively). In North and West Lombok, 44% of surveyed households evacuated to hilltops for fear of a tsunami, showing a high level of awareness of this threat. 28% of households spent more than two nights in the open, with a mean of 2.4 nights and median of 1 night across all households.

The KaDes's (town leaders) of Tanjung and Gondang acknowledged it was a 'definite advantage in the first few weeks' being close to the disaster operations centre in Tanjung, and BNPB interviewees confirmed that in the early stage of the emergency, shelter relief fanned out from Tanjung, and focussed initially on urban populations. With an average of 3.3 nights, rural households spent longer without shelter after the earthquakes than urban households, at 1.7 nights (Table 3). Households further from the disaster operations

centres in Tanjung spent longer sleeping without shelter (3%, 9%, and 45% households surveyed spent 7 or more nights in the open living at <15 km, 15–40 km, and 40 km respectively from the regency centre). In addition to location, household wealth affected emergency shelter vulnerability, with 23% of low-income households spending one week or longer in the open versus 3% of mid and high-income households.

4.3. Temporary shelter

Generally wealthy households lived in stronger buildings with less damage, had insurance cover, and repaired their houses without waiting for an insurance payment or a government grant. Some also rented alternative accommodation while their houses were being repaired, or temporarily relocated outside Lombok.

194 of 195 surveyed households initially managed to construct a temporary shelter, generally made of tarpaulin, wood, bamboo and rope, and located at either a spontaneously constructed camp (posko, Fig. 2b), or their home-site (Fig. 2c). On average, households spent 3.6 months in temporary shelter (Table 3, the median is also 3–4 months).

A total of 83% of households were in a posko one week after the earthquake, remaining there for a few days up to over eight months with an average duration of 2.6 months (of those who entered poskos, 64% and 95% spent less than 3 months and 5 months in them respectively) (Table 3). Most poskos were located in a sports field, agricultural field or an open area within a few kilometres of the homes of those displaced, with households sleeping in communal shelters accommodating between ten and one hundred people. Poskos provided shelter from the weather and facilitated distribution of food, water and medical supplies from the BNPB and NGOs, however households reported that they lacked privacy and had inadequate water, sanitation and hygiene (WASH) facilities. Similar to Sri Lanka after the 2004 Indian Ocean tsunami [75], many camps were sweltering during the day and flooded when it rained heavily. While living in poskos, only 12% started working, almost half of whom were government workers. As with the spontaneous camps constructed after the 2005 Pakistan earthquake [76], poskos were unsuitable for more than a few weeks of habitation. Facilities to support the elderly or disabled were generally not provided, similar to issues faced in Japan following the 2011 earthquake and tsunami [77]. Vector-borne diseases increased, and on 12th September, a state of emergency was declared in West Lombok following the detection of 128 cases of malaria [78].

4.4. Transitional housing

Once the initial emergency had been stabilised, people's focus was to return to their home site, encouraged by the town councils (Desa), and upgrade their shelter to a more robust transitional housing solution. The transitional houses were either provided by NGOs or pieced together from rubble and debris supplemented by the gift or purchase of additional materials. The structures were generally made from wood, plasterboard, and CGI (Fig. 2d and e).

Initially the government actively discouraged transitional housing, favouring a direct transition to permanent housing. Illustrating the tension this policy caused, two BNPB officials gave contrasting views, the first reported that “not all stakeholders followed the rules, they thought they knew better and went ahead with their approach, like ACT”, while another said “I was so angry that Jakarta did not allow transitional shelter, I was shouting at them to see sense” (based on interviews). With the rainy season approaching and the inadequate facilities in the poskos, some form of transitional housing became a real need. By the end of August, due to pressure from the local government officials, NGOs and the BNPB, as well as a recognition that full recovery would take longer than three to six months, the government allowed transitional housing to be constructed. However, there was still no official government policy or plan for it. Evolution to transitional housing and the return to home sites accelerated from September to December. A total of 27% of surveyed households were living at their home site at the end of August (including temporary shelter (solid green, Fig. 3) and transitional housing at homesite (solid blue, Fig. 3), increasing to 89% by the end of December (Fig. 3). A total of 9% of surveyed households were in transitional housing six weeks after their homes were destroyed and by the end of December, 79% were living in transitional housing and 3% in permanent housing (Fig. 3). An added urgency by this time was the fast approaching rainy season. From



Fig. 2. Examples of the classifications of post-disaster shelter and housing within this paper: (a) sleeping outside, (b) temporary shelter at a Posko, (c) temporary shelter at home site, (d) transitional housing in camp, (e) transitional housing at home site, (f) rebuilt permanent home.

Table 2
Categorisation of aid received, location, savings, and income.

Aid	
Basic aid	Food, water, blankets, tarpaulin or medicine.
Shelter aid	Money for building materials (>Rp1M = c.US\$70), huntara (lightweight transitional housing, often made from plasterboard with a lightweight CGI roof), building materials, place in a transitional housing camp, robust tent
Location	
Urban	A continuous built-up area with at least 500 households
Rural	Not urban (see definition above), dominantly farming
Savings	
Savings	A household who answered yes to the survey question 'do you have personal savings that you could use to rebuild your house?'
No savings	A household who answered no to the above question
Income Categorisation	
All households were asked what the main occupation was of all members of their households. Local members of the Rotary Club of Mataram (a club mainly made up of local business people) were asked to stratify these occupations into 'low', 'mid' and 'high' income	
Low Income	Under Rp2M (US\$140) per month. Occupations included: farm labourer, ojak (motorcycle courier), fisherman, street seller, security guard, shop assistant, garage mechanic
Mid Income	Between Rp2M (US\$140) and Rp4M (US\$280) per month. Occupations included: carpenter, shop owner, KaDes, building labourer, tourism worker (cook, hotel reception, housekeeping), office worker, tailor
High Income	Over Rp4M (US\$280) per month. Occupations included: business owner and skilled government employee (e.g. teacher, water engineer, land registry officer)

Table 3
Impact of savings, income, location and aid received on time in a temporary shelter and time in a posko (source: household survey). 159 of 195 households stayed in a Posko. 194 of the 195 households surveyed stayed in temporary shelter. (note average time in posko and temporary shelter only includes households that did stay in a posko and temporary shelter respectively).

	# Surveyed HHs	Average nights in open	# HHs direct to home site	# HHs stayed in Posko	Average time in a posko (months)	Average time in temporary shelter (months)
<i>Savings</i>	28	2.4	9	19	2.6	3.8
<i>No Savings</i>	167	2.4	27	140	2.6	3.6
<i>Urban</i>	113	1.7	23	90	2.5	3.4
<i>Rural</i>	82	3.3	13	69	2.7	3.9
<i>Distance from regency capital:</i>						
< 15 kms	70	1.8	19	51	2.9	3.0
15-40 kms	78	2.2	10	68	2.1	3.5
>40 kms	47	3.6	7	40	2.9	4.7
<i>Low Income</i>	124	2.8	22	102	2.5	3.7
<i>Mid Income</i>	53	1.3	9	44	2.9	3.6
<i>High Income</i>	18	2.2	5	13	2.2	3.3
<i>East Lombok</i>	47	3.6	7	40	2.9	4.7
<i>West Lombok</i>	21	1.0	0	21	2.9	3.6
<i>North Lombok</i>	127	2.1	29	98	2.4	3.2
<i>Basic Aid</i>	107	2.4	11	96	2.5	3.8
<i>Significant Aid</i>	88	2.4	25	63	2.6	3.5
Population	195	2.4	36 (18%)	159	2.6	3.6
Average						

October, the shelter aid provided by NGOs generally helped with upgrading transitional housing at home-based sites. Moving out of poskos and into transitional housing at their home site allowed IDPs to re-establish community networks, more efficiently prepare their home site for rebuilding, and supported their return to work.

Households with greater financial capacity and living in urban locations close to the emergency operations centre at Tanjung were more likely to create a temporary shelter at their home site, rather than spend time in a posko. It was observed that those with savings often lived on larger plots, which provided extra space for temporary shelter, enabling them to return home faster. Although wealth affected how likely a household was to go into a posko, on average, no locational, financial, or provision of aid factors made a material difference to the duration. Being a recipient of an NGO intervention within the first 4–6 weeks (for example, the ACT transitional camp at Gondang was operational after six weeks) allowed a household to move to transitional housing within the first couple of months. Conversely, in some rural communities, the lengthy disruption of water supplies caused by the earthquake meant that due to drying up springs and damaged water pipelines, households faced WASH challenges. These most commonly included water collection for domestic use and delays in returning to farming due to lack of irrigation, which left less time to source materials and construct more robust housing; a similar scenario to that of Nepal in 2015 [79].

There is evidence that households further from the regency capital spent longer in a temporary shelter (Table 3), but no other investigated factors, including receipt of aid, appear to have made a significant impact on average times spent in temporary shelter. Note that 79% of households in an urban area within 15 km of a regency capital received substantial shelter aid, compared with only 11% of households in a rural location further than 40 km from a regency capital. While this aid helped some households secure some form of shelter more quickly, overall, households that did receive transitional housing, materials or finance from an NGO did not have

less time in temporary shelter than those that did not. This is because shelter aid was distributed over many months, during which time, households who received no shelter aid, self-organised materials to move to more robust transitional housing at a similar pace.

Where NGOs did have a significant impact was in supplying emergency food and medical supplies, shelter, psychological support, and provision of temporary schools, mosques, and WASH facilities. ACT, Muhammadiyah and PMI were the most cited NGOs providing this support among respondents. There is no evidence that more vulnerable households were targeted with shelter aid, although some aid agencies were reportedly targeting the elderly, disabled or pregnant mothers. A total of 95% of households said most useful to their recovery was the support from NGOs, with one stating “If it had not been for the NGOs I do not know what we would have done. Perhaps we would have died” (based on interviews).

4.5. Permanent housing and the government grant system

From January 2019, the focus shifted to the government grant process and building permanent housing. Around 92% of surveyed households cited the complexity or lack of speed and flexibility of the government grant scheme for house rebuilding as the biggest problem in their recovery.

The grant process missed its overly ambitious target of re-housing everyone within three to six months. Eight months after the earthquakes, 94% of households surveyed said their house had been assessed by the government, 58% of households had a grant bank account opened, 31% said their rebuild had begun but were still in the early stages with only foundations completed or building materials having been delivered. One year after the earthquakes, only 19.7% of all houses eligible for the full Rp50 M (US\$3500) rebuilding grant in Lombok and Sumbawa had been rebuilt (17%, 9%, and 39% in West, North and East Lombok respectively), and a further 52.3% were under construction [73,74]; Fig. 4). The number of government approved prototypes of earthquake resistant houses increased from the initial three to 18 by one year later, due to shortfalls in supply of materials for some of the earlier designs [80]. By the end of April 2020, 21 months after the earthquakes, 80% of housing had been rebuilt (67%, 79%, and 98% in West, North and East Lombok respectively), with a further 19% under construction. By January 2021, two and a half years after the earthquakes, almost all homes that were destroyed had been rebuilt (95%, 100%, and 100% in West, North and East Lombok respectively, Fig. 4, [73]. However, regency and BNPB officials raised concerns on the lack of adequately trained building inspectors, and a wide range of quality in workmanship and materials were observed.

The regency, whether the desa was rural or urban, and the distance from the regency capital had little bearing on the progress through the grants system. Officials at West Lombok and North Lombok BPBD confirmed that more vulnerable households were not prioritised, stating that progress through the system was based on a ‘first come, first served’ basis. Key factors influencing the speed of progress, as identified by householders and local government officials, were proving identity or land ownership, availability of builders, building material shortages, inflation in some building material costs, a shortage of government facilitators, poor coordination between different levels of government, and the lack of a robust, central database of beneficiary data.

Local leadership in recovery was observed as a key enabler, where a wide range of skills, behaviour, honesty and competence was observed in desa leaders. Leadership responsibility was evidenced by long working hours, having an in-depth knowledge of the details of the recovery without needing to refer to notes, and not prioritising their own homes for rebuilding. In contrast, some village officials exaggerated progress and had difficulty in locating household data, while survey respondents frequently mentioned ‘mistakes’ in building assessment.

In addition to the pace of processing grants, seven respondents explicitly claimed they had been incorrectly assessed, and there were earlier protests at Desa offices. Public discontent at the speed, efficiency and accuracy was observed in Tanjung and Sembalun in the form of organised demonstrations at desa offices. In East Lombok, many respondents had been awarded Rp10 M (c.US\$700) when

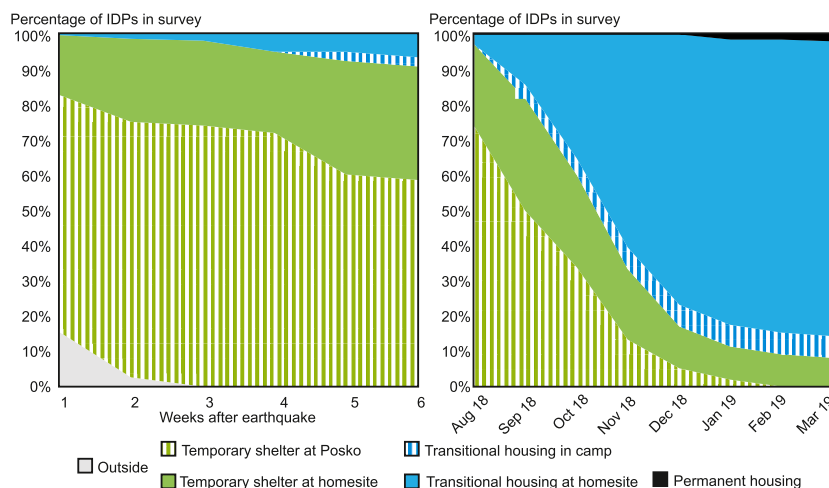


Fig. 3. Evolution of shelter and housing during (left) weeks one to six weeks after the earthquake, and (right) the first eight months. Dates given correspond to the end of the week or month. If multiple categories were relevant at the same time, the IDPs were located in the category where they spent the night.

their buildings were deemed irreparable, but they should have been awarded Rp50 M (c.US\$3500). When KaDes were challenged on this, there were admissions regarding mistakes from the assessors, but it was stated that the issue had been rectified and the households had been informed; however “as they were only farmers, they did not understand” (quotation from interview). Alongside these clerical errors, desa and regency offices demonstrated a vast range in clerical abilities and understanding, with some being familiar with the numbers in their paperwork, while many being very inefficient, exaggerating progress compared to the actual data, or simply incompetent with key paperwork apparently misplaced.

Different adaptive capacity and proactivity were observed at an individual household level. Most households questioned appeared resigned to waiting for the system to guide their recovery path. In contrast, other households took far greater control of their circumstances; in Dopang for example, every member of one extended family was mixing concrete, setting foundations and bending rebar. Their neighbours however, were sitting on their plot complaining that the government rebuilding process was too slow and too bureaucratic. In Kerurak, a small rural village near Gondang, a group of households had formed a pokmas (co-operative of 15–20 households to coordinate the housing grant application and rebuilding) and decided to self-build their properties, under the guidance of a builder in their group. As well as building their properties back more quickly, they would also get paid out of the government grant as ‘contractors’, supporting their recovery in multiple ways.

Almost all interviewees commented on the role of politics, including the decision not to declare a national emergency so as to appear in control, and the presidential candidate visits to the region, over-promising regarding the proposed recovery timelines.

5. Discussion

The target of a three to six month recovery period by the government following the August 2018 Lombok earthquake set unrealistic expectations, leading to a failure to meet those targets and inevitable dissatisfaction among the affected populace. However, it should be noted that despite many shortcomings in both the temporary housing policy and the grant system, the recovery process was rapid and successful when compared to other post-disaster contexts (e.g. Ref. [8]). The presence of a grant system, which could be reactivated (with suggested adaptations - see Table 4), allowed funds to be immediately available to households able to navigate the system. This meant that rebuilding was almost complete within two and a half years [74], with the added advantage of generally increasing the standard of housing. Almost all government officials interviewed were open and honest about the deficiencies in the planning, emergency response and recovery processes, and showed a desire to learn from their experiences to improve Lombok’s preparedness for future hazards that could lead to disasters. Based on the findings from this study, we make the following assertions and suggestions relating to influences on progression through post-disaster shelter and housing, and particularly in the context of self-recovery:

- (1) Avoid overly optimistic goal setting: disaster planning and decision-making should be conducted with minimal political entanglement and with realistic consideration of timelines, budget and quality assessment capabilities from previous disasters.
- (2) Transitional shelter: planned for or otherwise, it is likely to be constructed and therefore evidence must inform how good practice should be followed, including coordinated approaches across all agencies involved.
- (3) Longitudinal studies: these allow influences on shelter and housing recovery to be observed at more than one period in time following disasters. Studies over elongated periods are aided further by the availability of official records in the study location, as well as access to key informants for questioning, both of which are foundational to building reliability into longitudinal data.
- (4) Post disaster financial assistance: government grants designed to assist post-disaster rebuilding cannot be overly complex and unintentionally exclude those with the most urgent need, especially if this is the primary mechanism for assisting them.
- (5) Emerging individual actors: informal local leaders can often play central roles in community organising, safeguarding and rebuilding efforts. Enterprising solutions and life-saving leadership qualities among these actors should be supported, developed and scaled where appropriate.

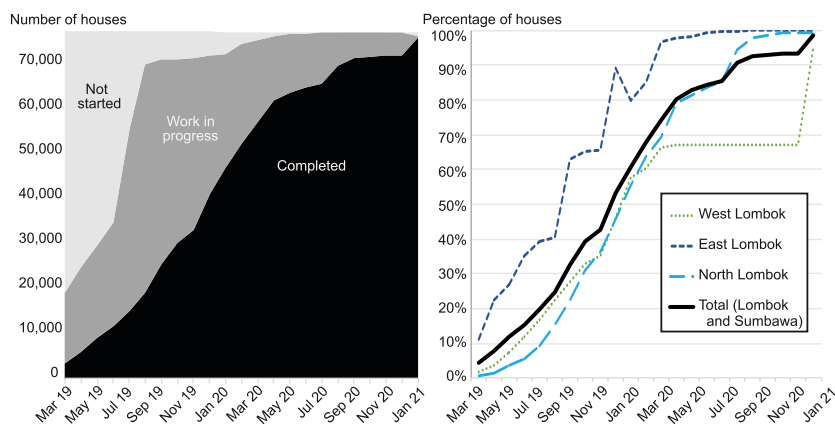


Fig. 4. Rebuilding progress of destroyed homes. (left) The number of destroyed houses that have been completely rebuilt, have started rebuilding and have not started rebuilding in Lombok and Sumbawa, (right) percentage of houses that have been completely rebuilt for selected regions and across all Lombok and Sumbawa (source: BNPB).

Although the Indonesian government set recovery goals beyond what was realistically achievable with the personnel and resources available, their actions varied in helpfulness. Rapidly making available a fund for rebuilding and devolving decision making to local regencies affected appeared to work well. On the other hand, declaring a national emergency and allowing international assistance sooner could have helped address the shortfall in assistance and alleviate internal stresses. It was suggested that international assistance requests may have been delayed due to the highly-charged political environment preceding the presidential elections in April 2019, and having an opposition party in control in North Lombok. On a local level, the North Lombok BPBD was not sufficiently prepared to deal with a crisis of this scale, even with an emergency plan in place; the 62 personnel were mostly affected by the earthquake themselves and therefore subject to capacity limitations.

Transitional housing policy should define the roles, responsibilities and coordination of government, NGO agencies, private sector and individual actors. In Lombok, a lack of this transitional housing policy led to chaotic, diverse and often substandard transitional housing, causing a politically tense environment with a breakdown in coordination between the central government, local government, and NGOs. While the government preferred households to move directly to permanent housing, other humanitarian actors directly involved expressed that the three to six month timeline for achieving this was simply not realistic. Once Jakarta did allow transitional housing projects, there was no government policy or coordination strategy to guide it, and while shelter cluster members conferred over location, not enough NGO-supplied transitional housing was available. Preparatory coordination and training between larger NGOs such as ACT and smaller, less resourced local organisations, could help in developing a more unified, shelter strategy. Similarly, desa and dusun leaders could help inform improved urban planning, evacuation routes, the identification of possible posko locations in advance, and advise on how to limit dangerous building practices. Most households began self-recovering initially, so the shelter aid provided by NGOs in August and September was pivotal in enabling households to leave poskos. In contrast, 90% of

Table 4

Simplified government grant scheme and key issues with possible solutions at different stages identified in this study. The grant scheme was a 26 step process which has been simplified to steps A-F in this table.

Simplified step	Processes involved	Key issues	Potential solutions for future disasters
A	Property assessed by Government inspectors	Requirement of every property being assessed causes delays as there is rarely capacity to do this.	Simplified classifications of damage by area could be presumed and then adjusted where needed.
B	All IDPs form a co-operative ('Pokmas') of 15–20 households to coordinate the application and rebuilding process. Pokmas leader nominated.	Formation of some Pokmas was slow as it required HHs to create their own Pokmas rather than it being assigned. Creation of a Pokmas allowed a smaller number of applications, however did lead to inefficiency in setting up Pokmas, and the whole Pokmas going as fast as the slowest HH. Note the slowest HHs were those who could prove land ownership or identity.	Local leaders should create Pokmas Consider whether a Pokmas is necessary, and instead have every HH submit their own grant request.
C	Pokmas leader finds a builder, then submits a plan with design, budget, proof of identity and land ownership to the government for approval.	Difficult to prove land ownership in post-disaster scenarios, especially where formal records may not be common, can cause delays to recovery. No central database or system made the process very manual and time consuming. Local administrators' lack of efficiency or lack of computer literacy delayed the process. Difficulty in finding a builder to provide a plan, design and quote.	Improve database of land ownership prior to disaster. Empower local leaders to use their judgement on land ownership paperwork. Create a nation-wide digital system and process for managing beneficiary data for use in all disasters. Train local officials on efficient use of computers and basic programs like excel. Start immediately to source builders and building materials from other parts of the country.
D	A special bank account is opened for each household to receive funds which can only be used for rebuilding. Funds enter the account.	The opening of bank accounts could help include those excluded from financial systems, but during the recovery this step caused delays and was unnecessary given only the pokmas leader had access to the funds.	Consider alternatives to everyone opening a bank account e.g. builders invoices paid directly from a government held fund.
E	Building materials delivered and building commences, with stage payments made from special bank accounts.	Delays in timber availability due to strict grading requirements and concerns about illegal logging. Insufficient early planning regarding sourcing materials and labour from elsewhere in Indonesia.	Start immediately to source builders and building materials from other parts of the country. Be pragmatic regarding timber grades to get an appropriate balance between quality and timeliness.
F	Building completed and assessed by Government inspectors for safety and quality control.	Availability of builders. Adequate quality control checks. Building is a time consuming process.	Start immediately to source builders and building materials from other parts of the country. Train more local officials in basic building quality control assessments, so there is sufficient capacity when required.

respondents cited the government's rebuilding process as the single most significant barrier to their recovery, however this is likely more of an expression of the disappointment felt due to poor expectation management around unrealistic recovery targets than an actual assessment of performance.

At household level in the first few months, individual wealth, proximity to a regency centre, being in an urban location or receiving additional shelter aid was found to have a marginal effect on reducing shelter vulnerability; however, these factors played less of a role in shelter vulnerability four months later. In the early stages following the Lombok earthquake, Typhoon Yolanda in the Philippines (2013) and the Nepal Earthquake (2015), rural communities and those more distant from disaster operations centres took longer to find temporary shelter, received less aid, and maintained higher shelter vulnerability for longer than close urban communities [81]. However, unlike Nepal and the Philippines, the location differences in shelter recovery observed in Lombok were short-lived; as of November 2018, there were no observed differences in shelter vulnerability based on geographical location and individual wealth. We note that this is likely due to comparatively fewer and more readily solvable logistical challenges in Lombok. For example, while a significant landslide in a river valley at the border of North and East Lombok caused a short-term, overland blockage to remote mountainous areas around Sembalun, the overall damage to the road and communications infrastructure was repaired within a week. In contrast, in Nepal, where about 13% of the transport network was damaged, some rural areas were still not contactable a month following the earthquake [82]. The high rate of widespread self-recovery efforts in Lombok may also have played a role in location differences not progressing into the long-term.

The government grant process, aimed to be a mechanism for supporting a quick and quality 'build back better' process, comprised 26 stages and was widely criticised for its complexity and bureaucracy. Instead, it led to slow assessment and rebuilding progress, particularly for those excluded from formal financial systems and who were missing the required documentation relating to land ownership (Table 4). A successful example of simplified damage assessment for the quick release of funds followed the Great East Japan Earthquake and Tsunami in 2011, where insurance companies agreed that houses would fall into one of three designated damage levels based on the location (full, half or partial); payments were then issued according to this [83]. A number of obstacles to a process such as this existed in Lombok however: central authority mistrust in local governments, to whom authority was devolved, meant that grants came with stringent, inflexible conditions that made the application process cumbersome and time-consuming. Additionally, a bank account had to be opened for every beneficiary but only the pokmas leader could access the funds, not supporting an inclusive financial system that encourages improved access to formal finance among low income populations [84,85]. The inability to verify identification and land ownership rights caused further delays, similar to Aceh where only 10% of land ownership was registered with the National Land Registry [86]. Given that land ownership documentation in Lombok is not always readily accessible or easy to produce, flexibility should have been exercised if the local desa office was able to verify household claims.

Regulation around damage assessment and the acquisition of building materials also meant that significant delays were experienced. Off-the-shelf designs for earthquake-proof buildings should have helped a speedy recovery, but fear of illegal logging meant that the wood had to be imported from Kalimantan or Sumbawa, despite there being a supply of wood on Lombok. This all had to be checked and passed by an authorised official [85]. Greater support on assessing building damage from Jakarta and provinces that had experienced similar schemes, like Yogyakarta, could have helped streamline the entire process. A more sophisticated, centrally-coordinated information management system could have supported this information sharing, as opposed to the more disparate, location-specific and ad hoc system used, that did not account for quality or standardisation controls. Compounding these challenges was the suspicion of corruption and fraud; although no evidence of this was directly observed, serving 'self-interests' was deemed influential in the process by many. This is commonly reported post-disaster, including in Sri Lanka in 2004 and L'Aquila in 2009 [31,87]. While the convoluted, bureaucratic grant process aimed to protect against corruption, it also led to lengthy delays in the rebuilding process. Table 4 summarises the suggestions we propose for simplifying the grant process while maintaining essential aspects of fraud detection and building quality control.

While local government leaders and household proactivity in self recovery appeared to have the most impact on relative shelter recovery, these factors were not fully utilised in the grant process. There were notable differences in the speed of the government grant dispersal, the building process and the building approaches among households. The quality of the desa personnel, especially the KaDes, the teamwork between neighbours in setting up a pokmas, having a builder in the pokmas, the availability of building materials and builders locally, and the ability to prove identity and land ownership were all further factors that supported the reduction in shelter vulnerability. The administrative burden of the grant process, the overly centralised control of funds, the (imposed) preoccupation of Desa leaders with facilitating data needs and requests from regency offices and the lack of involvement in and powerlessness of the Dusun leaders to influence the recovery process, all proved to be weaknesses in the system. This was a missed opportunity to leverage the local knowledge and enthusiasm of local leaders to ensure that the needs of local people were being met.

6. Conclusion

The Indonesian government set overly-optimistic expectations in communicating a three to six month timeline for housing recovery, leading to unnecessary additional dissatisfaction in the recovery process among those affected by the Lombok earthquake. Consideration of delays that commonly occur during disaster recovery, as well as those specific to the local context (e.g. geography, resources, pre-existing systems and data management) must be included when devising timelines, and expectations among those affected need to be managed.

In the emergency phase, the households surveyed following the Lombok earthquake spent an average of 2.4 nights with no shelter and 88% spent the first night out in the open, indicating a need for better emergency evacuation shelters and planning. The surveyed households spent an average of 3.6 months in temporary shelter either at a posko, or their home-site, or both.

There was no transitional housing strategy and an overly complicated government grant scheme for house rebuilding, however the activities of Indonesian NGOs in the recovery following the Lombok earthquake were a notable relief to affected households. The off-the-shelf design for earthquake-proof buildings, anti-corruption measures, and the swift transfer of funds to Lombok all supported recovery efforts, but after a year fewer than 20% of destroyed houses had been rebuilt. Self-recovery dominated as the authorities demonstrated inadequate planning and resources, partly due to the decision not to call for international assistance in the highly politicised environment. We emphasise that in many post disaster contexts there is a need for a transitional phase and in particular transitional housing strategies that include coordination and buy-in between relevant agencies acting at different levels from local up to national and international.

The survey of residents affected by the Lombok earthquake showed that the households that had some savings, a higher income, or were in urban areas closer to the main administrative centres were marginally better placed to acquire some form of shelter in the first few months. This was amplified when certain combinations of factors were present, in particular, urban households with savings who lived on larger plots of land. These advantages were short-lived as most households started self-recovering by building make-shift transitional housing and waiting for the government grant to rebuild their permanent housing. This suggests that it is in the early, emergency phase that fast and effective aid can make the most difference, however further study is needed assessing the effect of aid during the emergency and transitional phases for long-term recovery and improvements in housing.

In Lombok, among the households recovering the quickest were those who were most proactive and adaptable, supported by an effective KaDes. The rebuilding process was also aided if identification and land ownership documentation could be presented and a builder exhibiting strong leadership skills was present in a pokmas. The need to organise and digitalise land ownership documentation is perhaps not prioritised as high as it should be in disaster preparedness, given its importance to resettlement claims and building rights. There is also a need to train key individuals on how to access and act upon current and future information on grants or other financial assistance, so that efficient responses to new initiatives in the event of a disaster can be executed.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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