CHAPTER 16

Housing Continuum: Key Determinants Linking Post-Disaster Reconstruction to Resilience in the Long Term

Mittul Vahanvati

Introduction

Home constitutes the most basic human need in most societies. At a micro-scale, a house is one of the basic human rights and forms the foundation for a safe, comfortable, healthy and prosperous life. For that reason, people invest a large portion of their earnings in their home making it the most expensive asset they possess. At a macro-scale, the earth is the only home known to humans and non-humans, which sustains us through its ecosystem services like freshwater, air and fertile land. However, there is increasing friction in the interaction between the natural system and the human system (housing and the built environment), resulting in disasters.

M. Vahanvati (✉)
RMIT University, Melbourne, VIC, Australia
e-mail: mittul.vahanvati@rmit.edu.au

H. James et al. (eds.), *Disaster Risk Reduction in Asia Pacific*, Disaster Risk, Resilience, Reconstruction and Recovery,
https://doi.org/10.1007/978-981-16-4811-3_16

Disasters are not ‘natural’. Human society is equally (if not more) responsible for disaster occurrence. Scholars (e.g. Blaikie et al., 1994) argue that disasters occur at the intersection of the human system and the natural system (i.e. hazards). Human society, especially the built environment, has and continues to use and abuse natural resources (like earth, water, wood and fuel) beyond its replenishing capacity, leaving piles of waste and emitting between 37 and 49% of total greenhouse gases (UN-Habitat, 2019). Such an abusive relationship has not only contributed to an increase in global temperature and climate change (i.e. the health of our planet) but has also made us more vulnerable to disaster impacts. Disasters results in loss of lives, economy and psychological trauma. Since the 1970s the number, magnitude and complexity of rapid onset disasters have increased at a steady pace and so has associated economic loss (CRED EM-DAT, 2009). There are broad categories of disasters—(i) rapid onset, which arrives without much warning (e.g. earthquakes, floods, landslide, avalanche) and (ii) slow onset (e.g. climate change-related sea-level rise, desertification, famine). Rapid onset disasters are also termed as sudden shocks and slow onset as chronic stresses.

Additionally, disasters are not ‘neutral’ either. They disproportionately impact people living in the least developed countries (LDCs). Data confirm that over the last 20 years (1996–2016), people living in LDCs bore the brunt of disaster mortality, “almost five times more than the average toll in high-income countries” (CRED EM-DAT, 2016). This quantitative data confirms a direct co-relationship between disaster and development level. Societal development relies on population, policy frameworks, land-use zoning, construction standards for housing and the built environment, passive design, equal distribution of resources for poverty alleviation and cultural rootedness without creating social divisions. Changing the development trajectory requires a multi-pronged approach and investment in pre-disaster preparedness or adaptation efforts, which rarely happens in developing countries due to limited resources. The only hope to bring such change is in the long-term success of post-disaster reconstruction efforts. This research focuses on identifying key determinants in terms of policies, practices and participation approaches during post-disaster housing and settlement reconstruction projects that have helped bring such long-term changes.

The chapter first outlines a review of international discourse on housing reconstruction to highlight what is already known about its long-term effectiveness, in terms of strengthening disaster resilience of affected communities. This is followed by the development of a conceptual framework and discussion of case study research methodology. Findings in terms of processes that enabled building resilience at the macro (government), meso (practitioner) and micro (community) scales are discussed and organised in a new framework. The chapter finishes with concluding notes on this research's contribution to existing knowledge and its global implications.

Housing Reconstruction and Enhancing Society's Resilience

Post-Disaster Reconstruction

Following the Sendai Framework for Disaster Risk Reduction 2015–2030, it is broadly accepted that post-disaster reconstruction offers an opportunity to build back better (BBB) or provide safer housing as well as reorient our societies' development trajectory towards a resilient one. However, our understanding of theoretical concepts such as resilience and practice of post-disaster reconstruction have changed over time.

In the 1900s, the post-disaster response was seen as charity work in response to disasters being considered as acts of God. In the 1960s following World War II, the idea of supporting people after disaster entered the public discourse for the first time. This was evident in the early documented efforts that received external funding as shown by the 1970s avalanche and earthquake in Yungay, Peru (Oliver-Smith, 1979), the 1970 earthquake in Turkey (Ganapati & Ganapati, 2009), the 1976 earthquake in Guatemala and Mexico (Davis, 1978) and the 1977 cyclone in Andhra Pradesh, India (Winchester, 1979). These scholars and a few others (Chambers, 1983; Cuny, 1978; Davis, 1978; Turner, 1976) at the time emphasised the importance of participatory processes as much as the housing product and drew linkages between disaster and development. Apart from emphasis on community participatory reconstruction, there was also a growing emphasis on ecological sustainability. This shift was about a move away from ecosystem 'control' towards the capacity for coexistence—an attribute of resilience.

Until the introduction of the concepts of risk and resilience in the early 1990s, post-disaster efforts and research remained fairly siloed in various fields of studies. Disaster risk was proposed by a multi-disciplinary team of scholars (Blaikie et al., 1994) and represented in a formula as, disaster risk = hazard x exposure x vulnerability/capacities (Blaikie et al., 1994; UNISDR, 2004). Disaster risk is defined as "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity" (UNISDR, 2017, 14). This definition suggests that risk is a 'perceived threat' and is 'continuously present' at a spatial and temporal scale. It also highlights that while hazards *cannot be* reduced, exposure and vulnerability *can* be reduced and capacities strengthened—an attribute of resilience.

The Concept of Resilience

A few scholars claim that the resilience perspective "enhances the likelihood of sustaining desirable pathways for development in changing environments where the future is unpredictable" (Folke, 2006, 254; Handmer & Dovers, 1996; Walker & Salt, 2006).

The concept of resilience has gained traction in disaster reconstruction and recovery management since its introduction in the 1990s (Resilience Alliance, 1999) and lately, in climate change adaption. Its origin lies in the Latin verb *resilire* meaning 'to rebound or recoil' (Holling, 1973; IFRC, 2004). In the context of disasters, the concept introduces the inter-relationship between human and natural systems, that is, coupled socio-ecological system (SES). SES resilience to disasters is defined as "*the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management*" (UNISDR, 2017, 22).

The definition of resilience highlights the few abilities of a system needed for recovery, as shown in Table 16.1. These abilities can be categorised into three typologies: (i) to resist change (engineering resilience), (ii) to absorb or accommodate change (ecosystem or social resilience) and iii) to adapt or transform (coupled socio-ecological systems resilience). The framing of the resilience concept determines the goal of housing reconstruction. Like the concept's definition, varied characteristics and dimensions of SES resilience are identified by a few scholars as listed in Table 16.2. As shown in the table, the four characteristics of SES resilience are: (1) robustness (or resistance), (2) redundancy, (3) resourcefulness and (4) rapidity (or timeliness) (Bevc, 2013; Kapucu et al., 2013). These

Table 16.1 Various meanings of the resilience concept—from the narrow to an integrated socio-ecological systems' interpretation

Various concepts	*Focus on and characteristics*	*States and scales*	*Natural hazards as*	*Timing*	*Related literature*
Engineering resilience	Cope/Resist change Constancy Rapidity/Timely recovery Efficiency	One stable-state Linear Cause and effect	External shock	Post-disaster	(Bosher, 2008; Folke, 2006; Haigh & Amaratunga, 2011; IFRC, 2012; Tobin, 1999)
Social or Ecological resilience	Absorb change Robustness Persistence/Absorb change Maintain functioning People-place connection Eliminate redundancy System memory	Multiple stable states Non-linearity	On-going disturbance	Pre-& post-disaster	(Holling, 1973; IFRC, 2012; Jha et al., 2010; Mulligan, 2012)
Coupled Socio-ecological systems (SES) resilience	Adapt or Transform Attain an alternative system Renewal cycles	Feedback loops Context-specific Non-linearity Cross-scale dynamic interactions Nested scale	On-going process	Pre- & post-disaster	(Berkes & Ross, 2013; Berkes et al., 1998; Folke, 2006; Gunderson, 2010; Lizarralde et al., 2015; Walker & Salt, 2006)

Source Adapted from Vahanvati (2017, p. 53)

Table 16.2 Characteristics and dimensions of disaster resilience from a socio-ecological systems (SES) perspective

Authors	*Resilience of what*	*Characteristics*	*Dimensions of resilience (system of systems)*
Gunderson et al. (2002)	Socio-ecological system (SES)	Renewal Reorganisation Development	
Holling & Walker (2003) ecologist	SES	Maintenance of function Self-organisation/change Buffer capacity Adaptive capacity	Structures & processes Human, social, ecological, economic
Folke (2006) ecological economist	SES	Adaptive capacity Transformability Learning/embedded memory Innovation (contains non-linear dynamics, thresholds, reciprocal feedbacks, cross-scale interactions across temporal & spatial scales)	Ecological, social and economic domains
Smit and Wandel (2006)	SES	Contextual derivation Pertinent conditions or exposures Community sensitivities Adaptive strategies	Local (e.g. kinship networks) General social, cultural, political, institutional Economic system Technological Management
Twigg (2009)	SES	Adaptation or resistance Maintenance of basic functions Recovery or 'bouncing back'	Institutional, environmental (risk assessment) Culture (knowledge) Social (health, wellbeing) Financial (livelihood) Physical, technical

(continued)

Table 16.2 (continued)

Authors	*Resilience of what*	*Characteristics*	*Dimensions of resilience (system of systems)*
IFRC (2012)	Community	Robustness Diversity Equity Redundancy (loss) Being well-located (capacity to learn, adapt and be resourceful)	Human (knowledge, health) Social (organised) Political Physical (housing, etc.) Economic opportunity Environmental assets
Bevc in Kapucu et al. (2013)	SES	Robustness Redundancy Resourcefulness Rapidity of recovery (contains loss, feedback loops, interactions)	Technical, organisational, societal Economic Multiple scales
Kruse et al. (2017) EMBRACE framework	Community	Resources and capacities Action (at multiple scales) Learning	Natural or place-based Socio-political Financial Physical Human Political

Source Vahanvati (2017, p. 53)

characteristics fit squarely within a traditional engineering resilience, but, when combined with a fifth characteristic: (5) adaptive/transformative capacity including learning, embedded memory, place-based or contextual derivations, diversity, relate to SES resilience. Central to the concept of socio-ecological systems (SES) resilience is a systems' approach (multidisciplinary, multi-sectoral), which has many dimensions: multi-scalar (nested or cross-scalar interactions), spatial (context-specific), temporal (time-specific, or evident pre-, during- and long-time after a disaster) and feedback loops between them.

Such varying interpretations of resilience combined with the complexities of the post-disaster context makes the task of operationalising it complicated. Bond (2017, pp. 5–19) and others have proposed frameworks for operationalising resilience. However, empirical evidence supporting whether reconstruction programs/projects have succeeded at enhancing resilience in the long term remains sparse.

Housing at the Centre of Reconstruction and Resilience

Housing stock constitutes the majority of the building stock, globally. The New Urban Agenda (UN-Habitat, 2012) has identified housing to play a central role in efforts to change the development trajectory from vulnerability to resilience. However, cities across the world have a lot of catching up to do. It would require consideration of housing from a whole-of-life and systems approach, which includes consideration for hard assets (e.g. land-use planning, building standards, services and infrastructure, insurance mechanism), soft assets (people-centred) and dynamic assets (nature, climate, disasters). As per the disaster management cycle, a change in the human system needs to be considered as an ongoing process, with pre-disaster preparedness and mitigation efforts as a continuation to post-disaster recovery efforts. Likewise, housing would have to be viewed as a continuum, from—housing production, maintenance to end of life to reconstruction—and beyond.

Since the 'future' environment is changing and unpredictable, it is challenging to prepare for the same. Besides, most LDCs and many cities within developed countries with limited resources struggle to invest in preparedness efforts. Moreover, the majority of international funding is allocated to post-disaster relief and recovery efforts, which provides an opportunity to strengthen resilience. However, there is limited research to substantiate claims about reconstruction's links to building resilience. Nonetheless, there is some emerging scholarship linking reconstruction to SES resilience (e.g. Lyons et al., 2010; Murphy et al., 2018; Wisner, 2017). Limited research on the long-term implications of reconstruction hinders our ability to understand key determinants that serve to build society's resilience. This research seeks to provide an answer to the research question: how does post-disaster housing reconstruction serve to enhance society's resilience in the long term?

Research Methodology

To answer the research question, this research adopts a predominantly qualitative and multi-disciplinary case study method. Four good practice reconstruction projects have been selected from India (for case study selection criteria, see Vahanvati & Beza, 2017). Two case studies are from the state of Gujarat post-2001 earthquake and the other two from Bihar post-2008-Kosi river floods. India is selected because it is one of the transitioning economies, the second-highest populous country in the world, among the top ten countries at high risk of disasters (NIDM, 2001) and has been at the forefront of successful disaster management since the 1990s.

The research methodology incorporates multiple disciplines, multiple scales and longer timeframe, pre-requisites for analysing resilience outcomes. Housing reconstruction is investigated through a longer timeframe or life cycle, including during-, post- and long-term after construction completion (CAPAM, 2004; Lizarralde, 2002). The following four stages of housing are related to the ones proposed by log-frame or LFA—a tool widely used for evaluating development projects (NONIE, 2009):

i. inputs (planning—resolving land rights issues, settlement layout, house design, building standards revision),
ii. activities (construction, skills training, monitoring),
iii. outputs (project closeout, hand-over) and
iv. Long-term impacts (intended and unintended outcomes).

The disciplines of architecture and sociology are combined with the development and disaster studies. Each stage is investigated from the three dimensions, physical, social and financial, within an ecological context to investigate whether the resilience characteristics are attained in the longer term. A conceptual framework (Fig. 16.1) is derived to represent these three dimensions and their linkages to resilience in the long term (Vahanvati, 2017).

An analytical framework is derived from the conceptual framework and logical framework for analysis (LFA) (for the analytical framework, see Vahanvati & Mulligan, 2017). Data collection is done by combining the method of the social sciences as semi-structured interviews and focus group discussions, and architecture as visual documentation. A total of

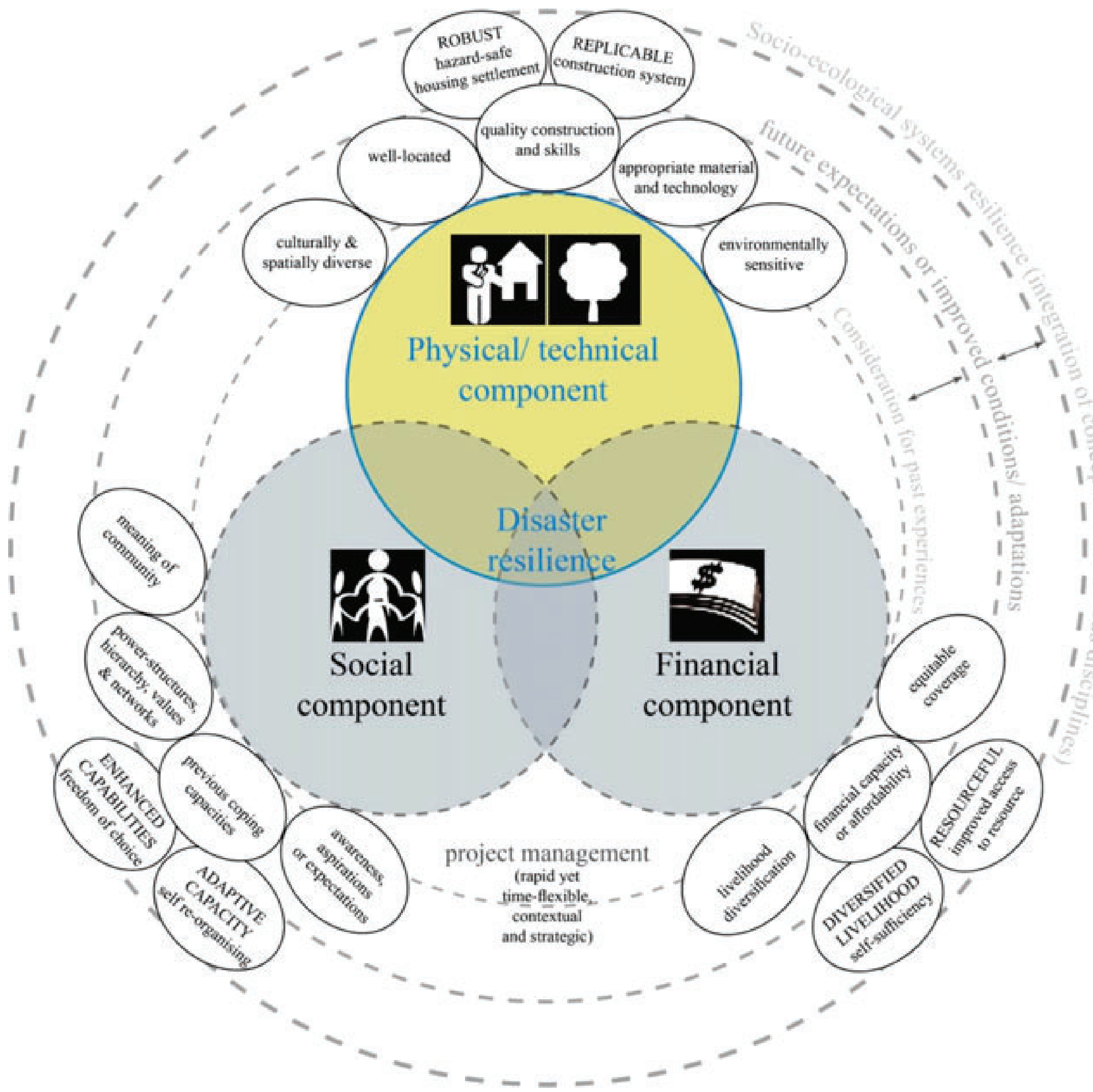

Fig. 16.1 Detailed conceptual framework for post-disaster reconstruction and recovery projects in a spatial and temporal systems' context, with feedback (and feed-forward), loops between past experiences and future expectations. (*Source* Vahanvati 2017)

80 in-depth semi-structured interviews are conducted with three sample groups: (i) 37 beneficiaries; (ii) nine non-beneficiaries and (iii) 34 stakeholders involved in the reconstruction project (government authorities, civil society organisation [CSO], social workers). To be representative of all people and for the purpose of triangulation, these three sample groups are identified purposively based on gender, socio-economic variations and housing condition. Primary empirical data obtained on-site is

complimented by secondary data such as CSO or government reports and other documentation produced at the time of reconstruction. Thematic content analysis is used for the analysis of qualitative data.

Findings: Comparing the 2001 Gujarat Earthquake with the 2008 Bihar Floods

The Impact of the 2001 Gujarat Earthquake

On 26th January 2001—the Indian Republic national holiday—the Western state of Gujarat was hit by an earthquake of 7.9 magnitude, claiming nearly 20,000 lives (UNDP, 2001) and destroying over one million homes (GoI & UNDP, 2011). The earthquake was declared to be the second largest recorded in Indian history (UNDP, 2009). The two case study sites—Hodko and Patanka settlements—were located at the epicentre of the earthquake and a little further away, respectively. Consequently, Hodko suffered 85% of all assets lost (UNDP, 2009) while in Patanka, 60% (Gupta & Shaw, 2003).

The Impact of the 2008 Kosi River Floods, Bihar

In August 2008, heavy monsoonal rains combined with the rupture of the embankment on the River Kosi had devastating impacts (GoB, World Bank, & GFDRR, 2010). The devastation was massive because of the change in the river's natural course, inundating regions that had not experienced floods since 1963. The floods affected over three million people (PiC, 2010), damaged more than 200,000 homes (GoB & ODRC, 2008a) and devastated livelihoods (cattle and crops). The 2008 flood was declared a national calamity. The two case study sites—Orlaha and Puraini—were in close proximity to the embankment that burst and a bit further away, respectively. Consequently, Orlaha suffered 95% of assets lost while Puraini suffered approximately 60% (GoB & ODRC, 2008b).

Post-Disaster Reconstruction Programs in Indian Case Study Sites

The reconstruction and recovery program development (at a macro-scale by government authorities) and on-ground activities (at a meso-scale undertaken by the civil society organisations and a micro-scale by communities) are outlined in Table 16.3 for all the four settlement reconstruction projects. The key differences in case study projects are highlighted in Tables 16.3, 16.4, and 16.5.

At a macro-scale, since the government of Gujarat had adopted an owner-driven reconstruction (ODR) program for the first time and at-scale, the program was in its infancy. This is implicit in the focus of financial assistance was mainly on housing and infrastructure recovery, which can be termed as the narrow framing or engineering resilience perspective (Table 16.3). However, the government was rewarded for successful recovery due to the rapidity of the recovery (CAPAM, 2004). On the contrary, the government of Bihar had developed a highly sophisticated ODR policy informed by prior experiences of and in collaboration with the consortium termed Owner Driven Reconstruction Collaborative (ODRC). In Bihar the financial assistance was allocated for multiple recoveries—housing, infrastructure, access to water, lighting, sanitation, landscaping and loss of livelihoods. Moreover, they had adopted an agile approach to tailor the program to community needs and were set up for decentralised governance (Vahanvati, 2018). Thus, their program framing was broader or from a systems resilience perspective. Despite such a mature program, the government took 10 years (from 2008 to 2018) to complete reconstruction. As per the success metrics of the World Bank (2015)—timely, efficient and fit for purpose—Bihar's recovery program was claimed to be a partial success (Table 16.4). Nonetheless, the World Bank had taken the responsibility of strengthening government capacity for recovery, Kosi river basin management and livelihood recovery (GoB, World Bank, & GFDRR, 2010).

At meso-scale, from 2001 to 2008, the role of CSOs in India got alleviated from mere housing reconstruction implementers to enablers (Table 16.3). While in 2001, in Gujarat, through public–private partnerships a space was created for the civil society organisations (CSOs) to operate freely in the post-disaster context; in 2008, in Bihar, the government involved CSOs from early days as policy advocates. Subsequently, the responsibility for recovery management transferred from CSOs to the state government from 2001 to 2008.

As much as it is admirable for the state government of Bihar to take the initiative, they needed hand-holding support from ODRC—who had vast on-the-ground reconstruction experience. It was evident that when ODRC managed the implementation of housing reconstruction in pilot

Table 16.3 A summary of multi-scalar reconstruction efforts post-2001 and 2008 disasters

	Roles at different scales	**Case-study sites**			
Disaster		**Hodko, post-2001 Gujarat earthquake**	**Patanka, post-2001 Gujarat earthquake**	**Orlaha, post-2008 Bihar floods**	**Puraini, post-2008 Bihar floods**
	Hazard exposure	Earthquake, drought, sandstorms		Floods, cyclone/storm surge, earthquake	
Input and Activities	Governance setup and policy framework at the state level	A nodal agency setup for disaster management (GSDMA 2001a)		✓	
		Top-down and centralised government setup		Decentralised governance setup	
		An owner-driven reconstruction (ODR) policy adopted for the first time in India Allowed for public-private partnerships The state created space for CSOs to operate		A highly sophisticated ODR policy adopted (GoB and ODRC 2008b) A collaborative approach from early days The state took responsibility of recovery	
		Beneficiaries identified by the government			
		Building standards upgraded collaboratively			
		Financial assistance non-uniform package For housing recovery only (narrow framing of engineering resilience) The government encouraged CSOs to top-up funding		Financial assistance uniform package for housing, toilets, solar lighting, and livelihood (systems framing of resilience) Pilot project funded by CSOs Government-funded up-scaling	
		Money transferred directly into the survivors' bank account (in joint name of man and women) and disbursed in three instalments (completion of foundation, walls and entire house)			
	Civil society organisations (CSOs)	Implementation role Selected settlements for reconstruction after signing an MOU with the government		Enabling role Worked on building government capacity through pilot projects in 2 settlements	
		Informal 'Setu Kendras' or shelter hubs established	Ample time given to build trust	Formalised and institutionalised 'Kosi Setu Kendras' setup	
		Brought entire funding	Topped up government funding	Brought entire funding for piloting	Brought entire funding for piloting
		Made minor modifications to government selected beneficiary list			
		Core houses designed with community	Core house design recommended		
		One construction technology proposed		Multiple construction technologies proposed	
		Material banks established		×	×

(continued)

Table 16.3 (continued)

		Mason skills training	✓	✓	✓
		Employed local + nonlocal masons	×	×	×
		Provided supervision, monitoring and hand-holding support			
		×		Built emergency shelter for future	
	Community	Played an active role throughout the recovery process (defining policy, managing housing reconstruction)			
		Collectively resolved land title issues, settlement layout and house location with CSO support			
		×	Designed own house	✓	✓
		×	Sourced some materials	Sourced all construction materials	
		A few participated in skills training	The majority participated in skills training		
		Worked as labourers + employed labourers for their own house building			
		Supervised construction with hand-holding support from CSOs			

Source Author

settlements of Bihar, the process went smoothly and led to multiple outcomes (e.g. robust housing, resourcefulness); however, when in hands of the government who had limited experience, the outcomes were not so desirable.

At a micro-scale, 13 years after the earthquake in Gujarat, minimal behavioural changes are witnessed among the residents and the construction sector in Gujarat's Hodko and Patanka settlements. Hodko residents have incrementally discontinued the use of proposed resilience construction technology, while half of Patanka residents continue to replicate it. Having said that, there is an increase in livelihoods (resourcefulness) in both the settlements of Gujarat, evident in their active investment in a better future (e.g. safe house extensions, children's education) and continual adaptation (e.g. investment in diversifying livelihoods).

On the contrary, in Bihar, 7 years post-floods reveal some successes, especially in the construction sector. For example, a majority of residents in Orlaha and Puraini are replicating one of the few proposed multi-hazard resilient technologies (Vahanvati, 2018; Vahanvati & Mulligan, 2017). However, very few residents have managed to increase or diversify their livelihoods. Potentially, it is early days to determine the project's

Table 16.4 Short-term outcomes post-2001 and 2008 reconstruction efforts

<table>
<tr><th rowspan="2"></th><th rowspan="2">Roles at different scales</th><th colspan="4">Case-study sites</th></tr>
<tr><th>Hodko, post 2001 Gujarat earthquake</th><th>Patanka, post 2001 Gujarat earthquake</th><th>Orlaha, post 2008 Bihar floods</th><th>Puraini, post 2008 Bihar floods</th></tr>
<tr><td rowspan="9">Short term outcomes + continued capacity building efforts</td><td rowspan="2">Government</td><td>Awarded UN Sasakawa award in 2003 (GSDMA 2005) and a Commonwealth award (CAPAM 2004)</td><td>Mentioned as good practice in IFRC (2004)</td><td>×</td><td>×</td></tr>
<tr><td colspan="2">Partnered with training institutions to provide international level certification to masons (GSDMA 2001b, 2001a)</td><td>×</td><td>×</td></tr>
<tr><td rowspan="4">Community</td><td colspan="4">High community satisfaction with every aspect of reconstruction</td></tr>
<tr><td colspan="2">Houses survived the test of the 2006 earthquake measuring 5.6 on the Richter scale (Price and Bhatt 2009)</td><td colspan="2">Houses withstood the test of the 2010 flood and cyclone</td></tr>
<tr><td>Lack of access to resources e.g. mud brick machines</td><td>Good access to skilled masons for house extensions</td><td colspan="2">Good access to few choices of materials, construction technology and skilled labour</td></tr>
<tr><td colspan="4">Some resentment about equitability of financial package</td></tr>
<tr><td rowspan="3">Civil Society Organisation</td><td>130 core houses rebuilt</td><td>300 core houses rebuilt</td><td>41 core houses rebuilt</td><td>89 core houses rebuilt</td></tr>
<tr><td>Continued work beyond for region's development (Kutch Nav Nirman Abhiyan 2013)</td><td>Continued work beyond to develop a model village (Gupta and Shaw 2003)</td><td>×</td><td>×</td></tr>
<tr><td>×</td><td>Mobilised trained masons to form group and link to livelihood</td><td>×</td><td>×</td></tr>
</table>

Source Author

outcomes in terms of behavioural change and adaptive capacities of the residents of Bihar.

Discussion

Nine similar patterns (which are noted as valuable processes/deliverables) are found in all the four case studies, which act as determinants in post-disaster housing reconstruction projects initiating long-lasting change. Out of the nine similar patterns, four are the most significant.

Table 16.5 Long-term impacts of post-disaster reconstruction projects after 2001 and 2008 disasters, from SES resilience perspective

		Case-study sites			
		Hodko, Gujarat	**Patanka, Gujarat**	**Orlaha, Bihar**	**Puraini, Bihar**
Long-term outcomes	Housing robustness & technology replication	x	~	✓	✓
	Redundancy	x	x	✓	✓
	Resourcefulness	✓ Diversified livelihood	~ Increase in the livelihood of all trained masons	x	~ Increase in some trained mason's livelihood
	Rapidity of project	✓	✓	Reconstruction continued for over 9 years (World Bank 2015)	
	The adaptive capacity of society	~ Self-organised in self-help groups; moderate awareness of changing risk, people felt empowered and were capable of investing in a better future	~ Moderate awareness of changing risk	~ Moderate awareness of changing risks, some self-help groups are operational	
			People are continuously improvising their housing, livelihood and challenging the social norms; but, challenges with access to basic needs (e.g. toilets, clean drinking water, roads) is compromising their ability to adapt and forward plan		

Source Author

First, the most significant process was systems design based reconstruction policy formulation, to allow addressing local deep-rooted vulnerabilities. For example, in Bihar, the reconstruction policy was formulated to fund not only housing, but also other systemic issues related to poverty e.g. access to electricity, land titles, loss of livelihood during own house rebuilding. To tailor a localised program, the government and ODRC consortium adopted an agile approach—implementing reconstruction strategy in pilot settlements for improvising (1.3 in Table 16.6). Thus, in Bihar piloting was done before policy formulation which is also considered a safe-to-fail or agile approach.

The second most significant process that ensured social mobilisation and long-term success of housing reconstruction was the set-up of *Setu Kendra (SK)*—meaning bridging centres—shelter and facilitation hubs as one-stop-shop for shelter. SKs were set up during the input stage in both states—Gujarat and Bihar. Each SK comprised of a team that worked in a transdisciplinary manner, including local community members, social workers, built environment professionals (architects, engineers), lawyers

Table 16.6 A novel framework for ODHR projects to enhance the disaster resilience of communities in the long term

PROJECT COMPONENT	PROJECT COMPONENT GOAL (IMPACT)	VALUE DELIVERABLES	ACTIVITIES (INPUTS) BASED ON BEST-PRACTICE CASE-STUDIES & THE KNOWLEDGE GAINED BY TWO INDIAN AGENCIES OVER SEVEN YEARS
1. SYSTEMS DESIGN	To design a contextually appropriate & equitable reconstruction project/ program of projects for reconstruction to have impact beyond robust housing	1.1 Secure government goodwill	i. Determine institutional setup for Disaster Management & governance ii. Advocate for ODR policy where possible iii. Build public-private partnership
		1.2 Define project scope	iv. Incorporate context-specific socio-ecological systems issues (risks and capacities) v. Formulate shared project vision vi. Establish beneficiary selection criteria
		1.3 Test project scope	vii. Refine project scope, technological modifications, financial package and facilitation mode e.g. build model houses; shake-table tests
2. SOCIAL MOBILISATION	To gain and maintain community trust for equitability and enhanced ownership – a foundation for ODHR	2.1 Gain community trust for effective engagement	viii. Understand local meaning of community ix. Assess community needs, priorities and aspirations for housing and settlement x. Learn from communities past coping strategies
		2.2 Mobilise community	xi. Motivate residents to act for themselves and make informed decisions to build back better xii. Raise awareness amd maintain transparency about resident's rights and entitlements
3. TECHNICAL MODIFICATION	To improve multi-hazard resilience of construction system for ensuring pertinence, effectiveness and quality of construction in rebuilt houses	3.1 Provide multiple technological choices	xiii. Design multi-hazard resilient housing for demonstration xiv. Develop and disseminate technical guidelines in locally appropriate manner xv. Legalize local, rural and low-cost technology xvi. Establish or not to establish material banks
		3.2 Up-skill local artisans to rebuilt robust houses	xvii. Assess local mason's existing skills xviii. Provide skills training and employment to locals (masons, labourers, engineers) for building and supervision
4. CAPACITY BUILDING	To enhance disaster resilience of system for sustaining robustness, redundancy, rapidity resourcefulness and adaptive capacities	4.1 Improve residents' access to resources	xix. Provide continued support to trained masons after completion of reconstruction e.g. skills certification and employment
		4.2 Initiate other projects for improved quality of life	xx. Allow ample time to hand-over (to local partner or government); or to continue onto other projects for addressing systems issues and capacity building xxi. Knowledge transition to inform systems analysis of next project in a continuous spiral

Source Vahanvati (2018) and Vahanvati and Mulligan (2017) and financial experts. The SKs provided a conduit for two-way transfer of information and communication between the government and the disaster survivors. It must be noted that the SKs were set up informally in Gujarat and were successful. Hence, they were formalised and replicated in Bihar. It is noteworthy that such a transdisciplinary set-up allowed for gaining community trust, mobilising them and improved engagement, in a way that maintains their dignity—thus being promoted internationally as a key to innovation (Vahanvati & Beza, 2015, 2017). However, the value of a formalised and institutional setup of SKs remains to be examined in the longer term.

The third most significant process was providing households with multiple technical choices. The disaster-affected people in Bihar and some in Gujarat were given the freedom to choose for their settlement layout, house design, material and technology selection, along with adequate skills training, social support and financial support. With such a combination of support, the people felt empowered to make the right decisions—at that time, bearing in mind its longer term implications. These processes were done during the input and activity stages. This process is not just participatory but enabling!

The fourth most significant process was continued capacity development efforts beyond housing reconstruction, which typically lasted more than 7 years post-disaster, or until the communities were self-reliant, resourceful and resilient. These practitioners and policymakers due to their mindfulness of each settlement-based communities' varying needs and capacities were best equipped to translate the community capacities into livelihoods on an on-going basis to link with development.

All these nine processes are grouped into four project components, as (i) systems design (1 in Table 16.6), (ii) social mobilisation (2 in Table 16.6), (iii) technical modification (3 in Table 16.6) and (iv) capacity building (4 in Table 16.6). These findings are organised in a new framework, where they are represented as project components in a table format (Table 16.6) as well as a spiral framework (Vahanvati, 2018; Vahanvati & Mulligan, 2017).

Conclusion and Global Implications

In this research, the author set out to identify key determinants that linked housing reconstruction after the disaster to building the resilience of societies long term in the future. Reconstruction projects as case studies were selected from India as the Indian government has been successfully formulating and implementing owner-driven reconstruction programs, at-scale since the 1990s. Comparative analysis of case studies was conducted from a multi-disciplinary and whole-of-life cycle approach. Findings were derived from empirical evidence gathered from the highly experienced Indian CSOs, government officials, and communities or housing beneficiaries as well as secondary data like organisational reports. Similarities in terms of nine processes or deliverables were identified from the four case studies. Four out of nine deliverables were highlighted as the most significant processes that help in changing the development trajectory and strengthening SES resilience of communities. These four identified processes were (i) formulating a localised, strategic and an owner-driven reconstruction program through agility and flexibility in recovery time, (ii) setting up of transdisciplinary shelter hubs for coordination between government and community giving people political voice, (iii) providing the community with a freedom to choose (as it goes beyond community participation) and (iv) sustaining capacity building efforts beyond housing reconstruction completion for capacity development.

It is noteworthy that freedom of choice or 'human capabilities' coined by Nobel laureate Amartya Sen (1997, 1998) for human development context, proved equally important for the long-term success of reconstruction efforts. Yet, the concept is not mentioned in disasters scholarship. The research also confirms that CSOs played an important role in linking micro-scale (community needs) with macro-scale (government mandates, climate change, or systems thinking). Besides, when CSOs had advocacy role (e.g. involved with the government in program formulation and capacity building in Bihar), the program was mature, and the state did well. Likewise, when CSOs had an implementation role, community satisfaction with the process and rebuilt housing outcome was also high (e.g. Gujarat). Thus, an active role for CSOs is important through all stage of reconstruction, alongside the state, as partners.

All findings are grouped into four project components—systems design, social mobilisation, technical modifications and capacity building, to propose a novel framework.

The most important contribution to knowledge is the proposal of a novel framework that links reconstruction to SES resilience. The framework intends to inform practitioners in a field where lessons from the past have been narrowly documented and long-term project outcomes have largely remained unexamined (Vahanvati, 2018). The framework is intentionally kept abstract to allow for required adaptation to suit a context. The author urges donors, policymakers and practitioners to use the framework as key ingredients rather than a step-by-step recipe; draw from an array of disciplinary expertise to encourage community capabilities during-reconstruction; and sustain capacity building efforts beyond-reconstruction completion, for housing reconstruction to facilitate reorienting the development trajectory towards a resilient one long time into the future.

Acknowledgements Dr. Mittul Vahanvati acknowledges the support she received from the RMIT University's Higher Degree by Research Publication Grant, which supported her efforts in producing this research output.

References

Berkes, F., Folke, C., & Colding, J. (Eds.). (1998). *Linking social and ecological systems: Management practices and social mechanisms for building resilience*. Cambridge University Press.

Berkes, F., & Ross, H. (2013). Community resilience: Toward an integrated approach. *Society & Natural Resources, 26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Bevc, C. (2013). Introduction to conceptual insights and applications of resilience. In N. Kapucu, C. V. Hawkins & F.I. Rivera (Eds.), *Disaster resiliency* (pp. 15–20). Routledge.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (1994). *At risk: Natural hazards, people's vulnerability and disasters*. Routledge.

Bond, C. A. (2017). *Resilience dividend valuation model: Framework development and initial case studies*. Rand Corporation.

Bosher, L. (2008). *Hazards and the built environment: Attaining built-in resilience*. Taylor & Francis.

CAPAM. (2004). *CAPAM International Innovations Awards Programme 1998–2004*. Commonwealth Association for Public Administration and Management.

Chambers, R. (1983). *Rural development: Putting the last first*. Taylor and Francis.

CRED EM-DAT. (2009). Disaster Classification. CRED, Emergency Events Database (EM-DAT), Belgium.

Cuny, F. (1978). Disasters and the small dwelling: The state of the art. *Disasters, 2*(2–3), 118–124.

Davis, I. (1978). *Shelter after disaster*. Oxford Polytechnic Press.

Em-Dat, C. R. E. D. (2016). *Poverty & death: Disaster mortality, 1996–2015*. CREDCrunch.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global Environmental Change, 16*(3), 253–267. https://doi.org/10.1016/j.gloenvcha.2006.04.002

Ganapati, N. E., & Ganapati, S. (2009). Enabling participatory planning after disasters: A case study of the World Bank's housing reconstruction in Turkey. *Journal of the American Planning Association, 75*(1), 41–59.

GoB, & ODRC. (2008a). *Reconstruction and rehabilitation of Kosi flood affected regions in Kosi division: Memorandum of understanding (MOU)*. GoB, ODRC, Patna, India.

GoB, & ODRC. (2008b). *Workshop on owner driven reconstruction and rehabilitation for Kosi flood affected regions. Government of Bihar—Department of planning and development*. Owner Driven Reconstruction Collaborative, Patna, India.

GoB, World Bank, & GFDRR (2010). *Bihar Kosi Flood (2008) Needs Assessment Report*. World Bank, Geneva, Switzerland.

GoI, & UNDP. (2011). *Disaster Management in India*. edited by Government of India Ministry of Home Affairs. Nation Centre for Disaster Management, New Delhi, India.

GSDMA. (2001a). *About Gujarat State Disaster Management Authority (GSDMA)*. Government of Gujarat. Retrieved 10 March 2015 from www.gsdma.org/about-us/introduction.aspx

GSDMA. (2001b). *Masons training/certification programme*. Government of Gujarat. Retrieved 10 March 2015 from www.gsdma.org/key-projects-programmes/masons-training.aspx

GSDMA. (2005). *Grit and grace: The story of reconstruction Gandhinagar*. GSDMA, Gujarat.

Gunderson, L. (2010). Ecological and human community resilience in response to natural disasters. *Ecology and Society, 15*(2), 18. https://doi.org/10.5751/ES-03381-150218

Gunderson, L., et al. (2002). In Memory of mavericks. *Conservation Ecology, 6*(2). https://doi.org/10.5751/ES-00423-060219

Gupta, M., & Shaw, R. (2003). PNY report. In *Patanka Navjivan Yojana: Towards sustainable community recovery*. Sustainable Environment and Ecological Development (SEEDS), Patan, India.

Haigh, R., & Amaratunga, D. (2011). *Post-disaster reconstruction of the built environment rebuilding for resilience*. Wiley-Blackwell.

Handmer, J. W., & Dovers, S. (1996). A typology of resilience: Rethinking institutions for sustainable development. *Industrial & Environmental Crisis Quarterly, 9*(4), 482–511. https://doi.org/10.1177/108602669600900403

Holling, C. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics, 41*(1), 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245

Holing, C., & Walker, B. (2003). Resilence defined. Internet encyclopedia of ecological economics. *International Society for Ecological Economics*. http://isecoeco.org/pdf/resilience.pdf

IFRC. (2004). *World Disasters Report 2004—From risk to resilience—Helping communities cope with crisis*. International Federation of Red Cross & Red Crescent Societies (IFRC), Geneva.

IFRC. (2012). *Understanding community resilience and program factors that strengthen them: A comprehensive study of Red Cross and Red Crescent Societies Tsunami Operation*. International Federation of Red Cross & Red Crescent Societies (IFRC), Geneva.

Jha, A. K., Barenstein, J. D., Phelps, P. M., Pittet, D., & Sena, S. (2010). *Safer homes, stronger communities: A handbook for reconstructing after natural disasters*. World Bank.

Kapucu, N., Hawkins, C. V., & Rivera, F. I. (2013). *Disaster resiliency* (pp. 15–20). Routledge.

Kruse, S., Abeling, T., Deeming, H., Fordham, M., Forrester, J., Jülich, S., Karanci, A., Kuhlicke, C., Pelling, M., Pedoth, L., & Schneiderbauer, S. (2017). Conceptualizing community resilience to natural hazards—The emBRACE framework. *Natural Hazards and Earth System Sciences, 17*(12), 2321–2333. https://doi.org/10.5194/nhess-17-2321-2017

Kutch Nav Nirman Abhiyan. (2013). *About us*. Retrieved 23 January 2015 from www.kutchabhiyan.org/about-us.html

Lizarralde, G. (2002). Organizational design, performance and evaluation of post-disaster reconstruction projects. In *Proceedings of conference on improving post-disaster reconstruction in developing countries*. Montreal.

Lizarralde, G., Valladares, A., Olivera, A., Bornstein, L., Gould, K., & Barenstein, J. D. (2015). A systems approach to resilience in the built environment: The case of Cuba. *Disasters, 39*(s1), s76–s95. https://doi.org/10.1111/disa.12109

Lyons, M., Schilderman, T., & Boano, C. (2010). *Building back better: Delivering people-centred housing reconstruction at scale*. Practical Action.

Mulligan, M. (2012). Rebuilding communities after diasters: Lessons from the tsunami diaster in Sri Lanka. *Global Policy, 4*(3), 278–287. https://doi.org/10.1111/17585899.12038

Murphy, R., Pelling, M., Adams, H., Di Vicenz, S., & Visman, E. (2018). Survivor-led response: Local recommendations to operationalise building back better. *International Journal of Disaster Risk Reduction, 31*, 135–142. https://doi.org/10.1016/j.ijdrr.2018.04.009

NIDM. (2001). *The report of high powered committee on disaster management*. National Centre for Disaster Management New Delhi.

NONIE. (2009). *Impact evaluations and development: NONIE guidance on impact evaluation. The network of impact evaluation (NONIE).*

Oliver-Smith, A. (1979). The Yungay Avalanche of 1970: Anthropological perspectives on disaster and social change. *Disasters, 3*(1), 95–101. https://doi.org/10.1111/j.1467-7717.1979.tb00205.x

PiC. (2010). Kosi Reconstruction and Rehabilitation Project. In *People in Centre Consulting* (Ed.). Owner Driven Reconstruction Collaborative, Ahmedabad, India.

Price, G., & Bhatt, M. (2009). *The role of the affected state in humanitarian action: A case study on India*. Overseas Development Institute (ODI)/Humanitarian Policy Group (HPG).

Resilience Alliance. (1999). *About Resilience Alliance*. Retrieved 14 October from https://www.resalliance.org/about

Sen, A. (1997). Human capital and human capability (Editorial). *World Development, 25*(12), 1959.

Sen, A. (1998). Human development and financial conservatism. *World Development, 26*(4), 733–742. https://doi.org/10.1016/S0305-750X(98)00002-3

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change, 16*(3), 282. https://doi.org/10.1016/j.gloenvcha.2006.03.008

Tobin, G. A. (1999). Sustainability and community resilience: The holy grail of hazards planning? *Global Environmental Change b: Environmental Hazards, 1*(1), 13–25. https://doi.org/10.1016/S1464-2867(99)00002-9

Turner, J. (1976). *Housing by people: Towards autonomy in building environments*. Marion Boyars.

Twigg, J. (2009). *Characteristics of a disaster resilient community*. University College London.

UN-Habitat. (2012). *Housing at the centre of the New Urban Agenda*. UN-Habitat. Retrieved 20 March 2019 from https://unhabitat.org/housing-at-the-centre-of-the-new-urban-agenda

UN-Habitat. (2019). *Planners for climate action: Call for course manuals*. UN-Habitat. Retrieved 20 March 2019 from https://www.planners4climate.org/courses-repository

UNDP. (2001). *From relief to recovery: The Gujarat experience*. United Nations Development Programme.

UNDP. (2009). *Kosi Floods 2008: How we coped! What we need? Perception survey on impact and recovery strategies*. United Nations Development Programme.

UNISDR. (2004). *Living with risk: A global review of disaster reduction initiatives*. United Nations International Strategy for Disaster Reduction Secretariat (UNISDR).

UNISDR. (2017). Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction. In *UNISDR Sustainable Development: Disaster Risk Reduction*. UNISDR.

Vahanvati, M. (2017). *Owner-driven housing reconstruction as a means of enhancing disaster resilience of at-risk communities in India* (Doctor of Philosophy Thesis). RMIT University.

Vahanvati, M. (2018). A novel framework for owner driven reconstruction projects to enhance disaster resilience in the long term. *Disaster Prevention and Management, 27*(4), 421–446. https://doi.org/10.1108/DPM-11-2017-0285

Vahanvati, M., & Beza, B. (2015, July 15–17). Owner-driven reconstruction in India: A case-study of Kosi river floods in Bihar. In *5th International Conference on Building Resilience*. Newcastle, Australia.

Vahanvati, M., & Beza, B. (2017). An owner-driven reconstruction in Bihar. *International Journal of Disaster Resilience in the Built Environment, 8*(3), 306–319. https://doi.org/10.1108/IJDRBE-10-2015-0051

Vahanvati, M., & Mulligan, M. (2017). A new model for effective post-disaster housing reconstruction: Lessons from Gujarat and Bihar in India. *International Journal of Project Management, 35*(5), 802–817. https://doi.org/10.1016/j.ijproman.2017.02.002

Walker, B., & Salt, D. (2006). *Resilience thinking: Sustaining ecosystems and people in a changing world*. Island Press.

Winchester, P. (1979). Disaster relief operations in Andhra Pradesh, Southern India, following the cyclone in November 1977. *Disasters, 3*(2), 173–177. https://doi.org/10.1111/j.1467-7717.1979.tb00222.x

Wisner, B. (2017). "Build back better"? The challenge of Goma and beyond. *International Journal of Disaster Risk Reduction, 26*, 101–105. https://doi.org/10.1016/j.ijdrr.2017.09.027

World Bank. (2015). *Bihar Kosi Flood Recovery Project*. World Bank, Bihar, India.