

Resilient Living Environments: Identifying a Design Approach to Creating Housing Suited to Culture and Context

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The Asian Conference on the Social Sciences 2017
Official Conference Proceedings

Abstract

This paper's focus is on identifying a system for devising and implementing a culture and context specific planning and design approach to creating the right low cost housing solutions for mitigating the effects of floods and flood related disasters. Two sites will be explored, one in Kundasale, Sri Lanka and the other in Nanjing, China. The paper first identifies key issues leading to unsuitable developments that exacerbate the natural phenomenon of flooding. It then presents the culture and context specific approach for each location. While one takes a more direct design practice focused approach, the other takes a more theoretical and academic approach. Each approach is defined by the designer's own cultural background, knowledge, and understanding of the local context, culture and people. The intention of this comparison is to highlight the uniqueness of each contextual situation and the significance of having a specific solution, appropriate to site, and driven with awareness of the designer's own limitations and strengths. A robust planning and design guideline will act as a checklist for designers, while for community stakeholders it is a means of ensuring development projects are culturally and contextually suited and sustainable, and aligned with international policy recommendations for disaster risk reduction, building resilient communities and reducing vulnerability to poverty.

Keywords: Resilience, Flood, Disaster, Housing, Adaptable Design

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Introduction

The occurrence of floods, the most frequent of all natural disasters, has increased exponentially since the 1970s (Jha, 2012, p.19). This has meant a significant rise in flood related disasters resulting in an increase in the number of people affected and the cost of flood damage. In 2010, a year of severe flooding, 178 million people worldwide were affected incurring losses of over US\$40 billion (Jha, 2012, p.19). The highest fatalities related to flooding are from emerging nations, and particularly from amongst the poor and socially disadvantaged segments of society (Jha, 2012, p.20). The major contributing factors to this problem in addition to the rapid growth of urban communities is construction techniques that are inappropriate and insensitive to natural phenomenon and hazards, the alarming decrease in impermeable surfaces, and the lack of forward looking infrastructure to support and sustain the environment and communities and mitigate the effects of the resulting floods as population growth takes place (Berman, 2010, Parkinson, 2005; Shaw, 2016;).

Today, disaster risk reduction and building resilience to disasters is a priority for national and international development and economic organisations, and is written into policy at both levels with the focus of achieving this at grass roots level. The United Nations World Conference on Disaster Reduction in Sendai in 2015 and its 1994 and 2005 predecessors, the efforts of The Global Facility for Disaster Reduction and Recovery, and the multiple guidelines published for policy makers and stakeholders by the World Bank on the topic demonstrate the ongoing urgency of this issue and the commitment to address it at a global level. In 2015 a commitment was made by state representatives at the Sendai World Conference to act ‘with a renewed sense of urgency within the context of sustainable development and poverty eradication, and to integrate, as appropriate, both disaster risk reduction and the building of resilience into policies, plans, programmes and budgets at all levels and to consider both within relevant frameworks’ (UNISDR, 2015, p.9).

Problem

While these commitments demonstrate the urgent need to prioritise the issue of disaster risk reduction in a sustainable manner in all development and poverty eradication agendas (UNISDR, 2015), rarely is disaster risk reduction implemented to an extent that achieves the long term results desired. More often than not policies fail to filter down to stakeholders working at community level or are ignored at the planning, design, and construction levels by developers, funding bodies, planners, and designers, particularly in post disaster situations. Additionally, the governing bodies established to monitor the design and implementation of development projects, such as urban and local councils may fail to take account of these well-meaning policies. Much of the reason for this, particularly in the emerging world, seems to stem from the lack of accountability amongst stakeholders (Sanghi, 2010), coupled with a lack of understanding of the significance of these policies and in-depth knowledge backed by education on sustainable building methods, materials and practices. Sometimes there is also a lack of moral commitment amongst stakeholders that prevents the materialisation of policy aims; this may be informed by their focus on short term outcomes and personal gains rather than the long term greater good (Sanghi, 2010). In addition most vulnerable communities are unaware of the existence of such policies at either international or local government levels or of policy intentions which are

aimed at benefitting them and their communities, primarily by ensuring their wellbeing. Hence vulnerable communities are easily exploited by developments intended to benefit them in the short and long term but that fail to do either.

Impacting this situation further is the transplanting of westernised generic development approaches and models on vernacular communities (Oliver 1992; De Sylva 2011). A common scenario and one privileged by governments in a disaster situation is to abandon the affected site and relocate communities to new developments (Oliver, 1992; Oliver-Smith, 1992; De Sylva, 2011). The community preferred (Oliver-Smith, 1992; Quarantelli, 1985a, 1998b; De Sylva 2008), and often the sustainable solution from a social, psychological, economic and environmental sustainability point of view (Brown, 1992; Oliver, 1992; Oliver-Smith, 1992; Quarantelli, 1985a, 1985b; Riad, 1996; Steinglass, 1990; De Sylva, 2008, 2011) is to redevelop damaged sites utilising creative and contextually appropriate infrastructure and innovative building techniques to mitigate or minimise the risks from future disasters. An issue often overlooked by policy developers at national and international levels and engineering and architecture professionals is that every new development has the potential to exacerbate a natural hazard and contribute to future disasters. This situation has resulted in the World Bank in the last seven years proactively producing post disaster development handbooks (Jha, 2010) and operational guidance for disaster risk management (Jha, 2012), not only for policy makers but also for nongovernment organisations, the private sector, project managers and concerned community members (Jha, 2010, 2012).

Potential Solutions

Innovative and safe solutions combined with culturally and contextually suited development methods are capable of supporting and sustaining communities in adverse situations, particularly in terms of safeguarding lives and livelihoods and facilitating a quicker recovery (Berman, 2010; De Sylva, 2011; Oliver, 1992 ; Zbigniew, 2002). In some situations traditional or vernacular infrastructure solutions and non-westernised attitudes to occupying an environment prove far more effective and sustainable, and must be given greater consideration rather than being dismissed as primitive, unsafe or temporary (De Sylva, 2008, 2011; Oliver, 1992; Sanghi 2010; Zbigniew). Berman (2010) reflecting on westernised attitudes to land and water and modern infrastructure developments, following Hurricane Katrina, states ‘we have come to realize that our highly orchestrated, static levee flood control systems, intent on constraining and neutralizing the environmental fluctuation impacting our cities, have also been partially responsible for unintentionally amplifying urban and ecological risks’. Since 2005 Berman (2010) has advocated for a more fluid geographical approach to these two natural elements, a concept potentially applicable to most traditional riverine and coastal communities.

A case in point are the traditional communities that have lived for generations in homes built on stilts up to 6m high and in vertically floating environments in the flood zones of the Tonle Sap Lake in Cambodia (Grundy-Warr, 2016; Morris, 2014). This lake floods extensively annually and is inundated with flood water most of the year. Having over time established a way of building and living on water these communities depend on the flood for the rich benefits it offers for food sourcing and livelihoods (Grundy-Warr, 2016; Morris, 2014). This is a response to a natural hazard

clearly at odds with more westernised attitudes, for as Berman (2010) points out ‘in the western design realm, infrastructure tends to barricade society from the uncertainty of the nature of water’. This preventive rather than adaptive approach to flood and the effects of climate change is increasingly contributing more large-scale infrastructure constructions like static sea walls, dams and levees (Berman, 2010) and is behind relocation of communities to higher ground by developing new sites. In turn, these contribute to deforestation, reduction of permeable surfaces, ground instability and flooding. This flawed thinking justified as reducing risk to disaster and vulnerability to poverty is a short term view, but is exploited by local politicians and developers who advocate forced relocations and redevelop unstable sites for commercial gains (Cornea, 2004; Oliver-Smith, 2009). Several studies on the Tonle Sap Lake communities and the Meekong River which partially feeds annual Tonle Sap Lake flood bring attention to the potential dangers posed by built infrastructure developments like hydraulic dams and commercially oriented projects to the sustainability of the lake environment. This includes the ecology of the flood zone, the wellbeing of traditional riverine communities, the negative impact on food sources and food production and likely increase in tropical diseases (Grundy-Warr, 2016; Morris, 2014 ; Zeigler, 2013).

Methodology

This paper is based on the first author’s experience of dealing with stakeholders in housing developments ranging from urban councils, planning and design professionals, to corporate sector funders, and the knowledge gained from research into post disaster development projects that have failed to adhere to international sustainable development agendas and policy. Having researched the implications of these failures on communities, it is necessary to both question how policies can be translated and applied in practice more effectively and to identify a means of ensuring accountability at multiple stakeholder levels to ensure suitable developments. As a potential solution there seems value in developing a planning and design guide for ensuring effective translation of policy and its creative application in practice. The intention being to maintain commitment to the Sendai Framework (UNISDR, 2015) and further the efforts of the World Bank to improve the quality of post disaster developments (Jha, 2010) and better manage flood risks and disaster (Jha, 2012). Such a guide must to be designed so when used by funding agencies, developers, planners and designers of development projects, it acts as a project monitoring method for stakeholders, including local communities. As such the intention of the research is to identifying through case study projects a system for developing a robust and universal design guide which can be tested further and analysed for viability against project goals.

Hence the key question driving this research project is can a universal design guide produce culture and context specific designs for large scale community and housing developments? Essential to this research but beyond the scope of this paper are related questions such as the robustness and transferability of the system or planning and design process, and the possible shortcomings of a universal design guide. Would a regional design guide be more appropriate? How can the benefits of a design guide in terms of its suitability for culture and context and meeting policy aims be measured?

As an initial step two case study projects located in the unique cultural and contextual environments of Sri Lanka and China were analysed. Focused on disaster risk reduction and building resilience the goal of each project was to contribute to the body of research on community development, increasing resilience to disaster and poverty and sustainable development and as such they align with the goals of this project. This was a necessary criterion for potential case study projects used in the analysis.

The design process followed in each project is based on the contextual knowledge and experience of the designer. Having first identified limitations in existing knowledge planning and design processes were altered to fill gaps in knowledge so as to achieve a comprehensive and contextually suited design outcome. The research involved comprehensive study in order to understand culture and context, the histories of relevant traditional and vernacular building techniques, local responses to past disasters, and analysis of current rebuilding trends and the impact of these on communities. In addition contemporary and innovative technological solutions and systems were identified and analysed for suitability and adaptability to local conditions. Design processes and outcomes have only been tested within the design studio and have not been presented for community feedback and analysis. However each process is based on knowledge gained from the analysis of previous post disaster redevelopment projects, and research findings from studies conducted across several different sites that involved both community interviews and empirical studies.

Case Study Projects

Project One: Architect's Approach

Background: Sri Lanka's vulnerability to regular floods and droughts present the most significant threat to the long term development and progress of the country. As a small island nation located in the Indian Ocean, Sri Lanka is exposed to two monsoonal periods of high rainfall. The extreme effects of climate change have contributed to an increase in rainfall and more severe flooding in most parts of the country. Aggravating this situation and contributing to the disastrous outcomes of the flooding is the extensive urban and rural development, unsuitable, insufficient and inefficient infrastructure, deforestation, cutting of hillsides, mining of riverbeds and increasing populations. From 2000-2010 flooding cumulatively affected over 8.5 million people. The most recent destructive flooding and landslides occurred in May 2016 with over 301,000 people affected across 22 of the 25 Districts in the country. More than 128,000 houses were impacted with over 30,000 needing repair or reconstruction. In addition over 25,000 businesses were impacted.

Problem 1: Because of government policy and the availability of donor organisation funding, the rebuilding of homes and communities after a disaster often involves the relocation of affected families and entire communities to locations perceived as safe (Cernea, 2004; Oliver-Smith, 1992, 2009). Rarely do post disaster developments focus on the reoccupation of a disaster damaged site through its rehabilitation and that of its surrounding context, by improvements and innovations in infrastructure and building techniques to prevent exacerbation of future floods or minimise damage from these. New and relocation sites are usually developed using planning techniques, building methods and materials that lack adequate consideration for the flood

mitigation infrastructure needed to safeguard against future disasters (De Sylva, 2011; Zbigniew, 2002). Often insensitive to contextual conditions these developments compromise the land and safety of surrounding communities thereby increasing the susceptibility of multiple communities and even entire regions to future disasters (Sanghi, 2010; Zbigniew, 2002). Given the ongoing issue of widespread clearing of forests and agricultural land for development and relocation of displaced people, this is often not a sustainable solution.

Problem 2: With increased urbanisation both Sri Lanka's major cities and smaller rural towns have grown significantly, with suburbs rapidly springing up on any surrounding land available for human occupation. Often forests, hillsides, agricultural lands, paddy fields and wetlands are claimed for housing with no consideration for the environmental impacts of development. Without infrastructure to ensure permeability, drainage and ground stabilisation as part of sustaining the rapid growth of cities and towns, and with the ongoing loss of wetlands, the natural 'sponges' of the land, surface flooding as well as the flooding of rivers, canals and drainage systems is a serious and growing issue.

Project: The brief was for the development of 2-3 bedroom homes and community facilities for public servants on an 11 acre peri-urban site in Kundasale, in the hill capital district of Kandy. The approach is an architectural practice approach directed by the designer's familiarity with local cultural needs and practices, knowledge of contextual conditions and topography, architectural traditions, availability of material resources and a personal drive for a sustainable architectural solution.

Project Aims, Site and Context: Located on a hillside the developer's aim was for maximum housing numbers while the designer's aim was to minimise the contribution of the development to future flooding, landslides or similar potential disasters, while remaining suitable for the needs of the community at socio-cultural, economic and environmental levels and creating the framework for a self-sufficient community. Formerly farming land belonging to the government, the site sloped down to paddy fields that linked up with others to create a valley of gradually terraced fields stretching out for a vast distance. These fields were irrigated by natural waterways and streams that flowed down to the valley where they linked up to form a substantial feeder to the river several kilometres away. These waterways, streams and river sustain not just the paddy fields but other types of cultivation, livestock, industries, wildlife, flora, and also supply water for bathing, washing, and cooking to neighbouring communities and those further downstream, as well as being used for hydro power. Preventing contamination of this water and not exceeding the holding capacity of these waterways and ultimately the river was another high priority.

Design Aim: An architecture that treads lightly on the land was the driving concept of the project. This was seen as a way to maintain minimum impact on the environment, with its natural terrain and natural resources. While the choice of construction materials, methods and architectural design and detailing was aligned with this concept, when it came to mitigating the short and long term effects of a large development on the site, neighbouring sites and the wider local environment the ideas translated into a carefully considered plan for housing, landscape and infrastructure. The latter drew knowledge from environmental design disciplines such as architecture, landscape architecture, urban design, and civil and services engineering.

Design Solution: Maintaining the natural porosity and permeability of the ground and preventing the inundation of the land meant identifying methods for collecting, controlling, filtering, treating and recycling water and careful consideration of the finishes for ground surface treatment of roads, walkways, car parks and play areas. Respecting the natural terrain meant minimum cutting and terracing of the hilly site. This led to the design of low rise terraced buildings that appeared to float and were supported by foundations that trod lightly on the land. Community gardens at ground, rooftop and in between levels and green belts, parks and gardens woven through built areas served multiple functions including food production and sustaining natural ground conditions. Treatment of blackwater and greywater on site was a key design priority. Ecological engineering and landscaping were a significant focus of the project's design and detailing.

Project Two: Theoretical Approach

Background: The increased danger of flooding within China and the effect of this on river-related infrastructure and poor riverine communities suggests a need for new urban typologies and innovative adaptable solutions. Positioned on the expansive Yangtze River Delta, the city of Nanjing encompasses a complex mix of historical reverence and progressive tendencies, which encourage experimental approaches, including design for coping with flooding. The aim is to provide a safe, adaptable and affordable response to recurrent flooding, through in depth historical, cultural and philosophical analysis of the social, spiritual and architectural landscape within China as a whole, and in Nanjing. Although Nanjing remains the central focus of the research, the intention is to develop design concepts and solutions that could be abstracted and applied across similar cultures and environmental conditions within Asia, and even beyond.

Problem 1: Barbara Chabrowe (1974) highlights western views of architecture as a solely permanent construct and its separation, even if unintentionally, from all the construction and structural oeuvres by non-western cultures. This tendency toward marginalisation of architectural traditions has excluded the ephemeral constructions of most vernacular communities and non-western cultures, and continues to dominate current approaches to development and housing in non-western nations. Hence the ongoing replacement of ephemeral vernacular architectural solutions such as the floating homes or stilt houses of the Tonle Sap communities discussed earlier in the paper with permanent and static developments which are mostly unsustainable.

Problem 2: The inherent cultural divergence between the designer and the project's client community required approaching disaster mitigation design using a binary research framework. While western pedagogy is predicated on the quantifiable and calculable, with a particular emphasis on the physical, non-western cultural traditions consist of explorations into the intangible, such as the principals of Feng Shui, and seeks to generate physical causality from its application. These differing approaches are inextricably linked to the various aspects explored in this work, and are therefore necessary for achieving a holistic understanding and rationalisation of the overarching situation within the site and the discipline of architecture. Understanding the complex systems that inform living environments and unifying their respective applications

generates a cohesive exploration into the incorporation of culture and vernacular agency into 'resilient' and adaptive design.

Problem 3: The 1931 flood along the Yangtze River Delta exemplifies the extreme outcomes of heavily industrialized river edges and isolation of communities by flood waters. The annual catastrophic flooding of this highly polluted river during monsoon periods, further aggravated by expanding urban development continues to afflict riverine settlements severely even today. Due to the extensiveness of the flooding and the high levels of flood water a primary concern for endangered communities, in addition to health, damage to property and infrastructure, is that of connection. During flood disaster situations, entire groups become isolated from one another and most significantly from all forms of infrastructure and services. Large-scale cities, such as those within China (Nanjing) are incapable of supplying the necessities of all affected inhabitants, and therefore, the solution resides within smaller formal and informal community groups to devise solutions for mitigating the effects of floods and organise relief (Maki, 2008).

Project: The project has two development stages. The first is an architectural solution to reducing the effects of flood disaster on vulnerable communities and devise a culturally and environmentally suited economical solution to housing for the poor. The second takes a more theoretical look at the notion of the city as a growing organism increasingly affected by climate change, and particularly flooding. The latter, therefore, incorporates practical discussion of the former but seeks to expand on the idea of informal communities, with priority given to self-organisation.

Project Aims, Site and Context: The project aim was for a practical and immediate solution to both problems, lack of safe and affordable housing and increasing susceptibility to flooding. The test site for the project is a low income informal development in Nanjing that sits on the water's edge of the Yangtze River

Design Aim: Having recognised the dangers of the site, the aim was to embrace the challenges it presents by devising a solution that adapts to the changing environmental conditions and needs of its low income occupants with the intention of reducing risk to disaster and reducing poverty. The design aim was to create a modular unit that can be self-built and adapted to individual needs as a house, store, shop, workshop, or garden and to meet community requirements. The second stage of design development aimed at identifying a potential design solution to urban population increase, increasing urban poverty, shortage of housing and land for development, and safety from increasing flood incidents.

Design Solution: Designed respecting traditional Chinese culture and construction techniques and systems, the units respond to the availability of material resources locally and construction knowledge and building techniques of local communities. Due to the inconsistent nature of the Yangtze River, the modular unit works in the wet and dry season. Informed by amphibious communities that reside largely on the water and floating homes, the modular units were designed for self-reliance and safety and as they sit on floatable bases which replace traditional foundations they adapt to contextual conditions as flooding. Each unit structure is based on the notion of layered simplicity and can be stacked vertically or attached horizontally and combined in this manner to form a larger home, a home and garden, a shop house etc. Constructed

using vernacular materials as timber or bamboo all beams, rafters and supports are adapted from the bracket technique observed in traditional Chinese construction (Ruan, 2006), and require only systematic application when building. At a second and future stage of development the units can come together in a 'Group Form', creating a new informal settlement typology and plug into centralized vertical service cores positioned strategically on the river and linked to land via services infrastructure.

Case Study Discussion

Of the two projects discussed above the one located in a peri-urban site in Kundasale, Sri Lanka is focused on preventing and minimising floods and flood damage both to the development site, neighbouring sites and wider context through considered planning and design of infrastructure. This project highlights the careful consideration required in new developments and the opportunities that exist for preventing or aggravating future flooding. Project two located in Nanjing, China is focused on inhabiting a flood prone urban site where land scarcity forces the poor to the unsafe edges of cities, using a tradition informed modular architectural system. The proposed design enables homeowners to self-source materials, construct a home and adapt it to their changing needs over time. This concept is aimed at enabling the urban poor to build safer homes cheaply and without the involvement of professionals, thereby preventing both unsafe and unsustainable construction as well as the imposition of alien and generic house models by governments and donor organisations. The project also explored a sophisticated and futuristic infrastructure development around a service core where communities could 'plug in' their modular self-built homes and any supportive structures, in a culturally and community appropriate manner. This is also a potential sustainable solution to urban population growth and the issues of urban sprawl and land shortages, and is aimed at minimising the threat to life, and damage to property, food sources and livelihood activities in the event of flooding. These studies also demonstrates how safe, environment friendly, self-supportive and dynamic communities can be encouraged through understanding the culture and needs of people, and the provision of appropriate infrastructure.

Each contextually unique solution demonstrates the dangers of generic 'one solution fits all' development approaches and also presents the principles of adaptive design that can be transferred to other contextual situations. Both projects prioritise a well-considered study on context and culture and developing project appropriate infrastructure.

Design Framework

The aim of this project was to identify at an initial level a system that would inform a design guideline that could become:

- a. A checklist for stakeholders involved in community development and design, to ensure sustainable and community culture and context suited outcomes.
- b. A method of monitoring community development projects, to ensure they meet international and local policy recommendations and commitments for increasing community resilience to disaster and poverty.

Two culturally and contextually diverse projects were presented and analysed for this purpose and the outcomes compared for further clarification. Three key design criteria were identified from this analysis and these correspond with the key aims of reducing the risk to disaster. These are outlined in table 1:

Table 1: Design Principles (extracted from the case studies)	
Design Criteria	Design Aim
1. Infrastructure development plans informed by site, context, local resources and future site conditions	Minimize flooding and contribution to flooding. If flooding cannot be controlled due to external factors beyond the scope of the design then identify context appropriate design solutions for minimizing its negative effects on environment and community through adaptive solutions
2. Design and detailing of infrastructure based on community culture and context sensitive information	Ensure developments are suited to the socio-cultural and economic needs of communities and focused on safety of human lives, and quick recovery by minimizing damage and disruption to lives, property and infrastructure.
3. Forward looking adaptive infrastructure design solutions	Ensure communities can adapt to changing weather conditions and sustain themselves in periods of flooding and after, leading to provision for multiple sources of community based food production, minimum disruption to livelihoods, means of mobility and accessibility

From table 1 emerges the need for a well-considered and articulated infrastructure, developed with sympathetic awareness, of three design priorities. These are listed in table 2 and essential considerations to ensure suitability of a development to community and context:

Table 2. Design Priorities (extracted from table 1)	
1.	Community culture and needs
2.	Contextual conditions and vernacular systems
3.	Innovative, adaptive and environment sensitive design

The projects explored in this paper point towards the development of infrastructure that is justifiable at multiple levels but starting at the ‘grassroots’ level of community and context and then working outward. This should be the case for all types of development projects, particularly if they are focused on dealing with floods through eliminating or reducing vulnerability, minimising damage, and increasing resilience to future flooding and flood related disasters.

The design solutions developed in each case study project responded to some or all of the criteria listed in table 3 that could constitute the ‘grassroots’ level of a community and contextually appropriate design project, criteria essential to ensure suitability of a development to community and context:

Table 3. 'Grassroots' Level Design Criteria	
1.	Vernacular practices, solutions and materials
2.	Local communities, cultures and livelihoods
3.	Contextual conditions, environment and climate
4.	Local building histories and traditions
5.	Cost effective solutions utilising local practices, knowledge and skills
6.	Economic sustainability (align projects towards a community's capacity to build, maintain, expand and repair itself)
7.	Local capacity building (utilising and retaining local skills, knowledge and practices)
8.	Reducing the negative impact of development (on site, environment and communities)
<i>In addition the projects also aimed to ensure community resilience and sustenance in the event of a future disaster by focusing on:</i>	
9.	Increasing capacity on site for food production, clean water, and safe sewerage disposal
10.	Safeguarding livelihood sources
11.	Increasing livelihood opportunities and economic progress within the community

As can be observed, only the first point is to do with building whereas the second and third points are to do with community building. This shows the difference with conventional community building and relocation approaches which only deal with buildings. As the projects demonstrate if a project responds to the criteria listed above it is likely to offer a more culture and context specific design solution. It is through the constant reinforcing of local culture and context that the dangers of generic solutions and unsuitable developments are avoided.

From the criteria listed in the tables above key characteristics that would be essential for developing a universal yet transferable, adaptable and robust design guideline are given in table 4. However, before establishing these as a system for developing a robust and universal design guide further testing against other case study projects is essential.

Table 4. Key characteristics of a system for developing a design guideline	
1.	adaptable to different contextual situations
2.	adaptable to different cultures
3.	justifiable at micro and macro levels
4.	justifiable socio-culturally, economically and environmentally
5.	adaptable to future disasters

Discussion and Justification for a Design Guideline

Development projects for vulnerable communities are dictated by tight budgets and short timeframes and are mostly implemented after the damaging effects of a disaster when the need for rehabilitation through reconstruction is at its most urgent. In these situations little opportunity exists for well researched solutions involving affected communities in the planning and design processes.. This is also a time when resources are stretched, inflation affects construction costs, and when quality assurance becomes

a challenge. Development projects in these situations follow typical approaches. However such projects rarely work in the short or long term for the benefit of communities or to prevent future disasters. Relocation displaces people from familiar living environments, livelihood opportunities and social structures and has been proven to have long term psychological effects on both economic and physical recovery after a disaster (Oliver, 1992; Quarantelli, 1985). Further aggravating this situation is the culturally and contextually unsuitable infrastructure that often results from rapid developments. Poor planning increases the vulnerability of communities to future environmental, social and economic disasters and defeats the purpose of development and global policies and funding support aiming for disaster risk reduction and poverty eradication.

Identifying the right solutions for the redevelopment of communities is an immense challenge (Parkinson, 2005; Shaw, 2016), particularly when developers are unfamiliar with the complex factors contributing to flooding, the intricacies that inform a community's culture and livelihood practices, and the environments they are dealing with. This is often the case in emerging nations after a disaster when governments, international and national donor organisations engage in redevelopment, and where the guidelines and methods for disaster risk reduction and increasing resilience to disaster and poverty are not clearly understood and adapted to each community and context. In these situations a design guide with clearly identified criteria, established on prior research into communities, could be a valuable tool. Such an outline for design development and project evaluation has the potential to mitigate or reduce the negative effects of post disaster developments. However, such design guidelines need to be considered carefully to avoid the potential dangers of contributing towards a 'one model fits all' concept.

Conclusion

Without comprehensive education of the general public and stakeholders on the topic of 'floods' and 'sustainability', and the significance of each for continued human life on earth, nothing can be achieved. Due to this widespread lack of education the terms 'disaster mitigation' and 'sustainable inhabitation' remain mere rhetoric and far too often are naively translated. The result is development projects failing to achieve the outcomes desired by international policies. In emerging nations this situation is worsened by the lack of accountability and transparency at various stakeholder levels, so vulnerable communities continue to be plagued with development projects that exacerbate their situation further.

What becomes evident from the projects presented in this paper is the need for well-considered infrastructure design to prevent and reduce the incidents of floods and flood damage, and to ensure community resilience and continuity of life, food production and livelihood activities without significant disruption in periods of flooding. Cost effective solutions that utilise vernacular systems and the traditional knowledge of local communities are essential. When such approaches are coupled with innovative adaptive systems and creative environment friendly planning focused on coping with floods and increasing resilience, effective and sustainable solutions can emerge. A well-considered universal design guide is perhaps an essential, urgent solution to the problem of unsustainable development and natural hazard related disasters.

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