

Global Knowledge Review (Second Revision)

TA to PDMA-Punjab in Incorporating Climate Compatibility Considerations into Reconstruction and Village Planning

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Executive Summary

Disasters range from natural events such as floods, earthquakes, cyclones to disasters caused by human factors such as oil spills, transport accidents and infrastructure collapses. They can be sudden, such as earthquakes, or may build up gradually, such as a drought, and either type can cause large scale population displacement. One of the most important consequences of 'climate change' will be the increase in the frequency and magnitude of extreme events such as floods, droughts, windstorms and heat waves. Climate change may also trigger other secondary effects that create hazards in which climate or weather conditions play a fundamental role, such as snow avalanches, landslides and forest fires.

The number and impact of hydro-meteorological or weather related, geophysical and technological disasters has already been noted to be on the increase in Europe in the period 1998-2009, with natural hazards causing nearly 100 000 fatalities and affecting more than 11 million people and overall a loss of about EUR 150 billion in the 32 EEA member countries. Climate-related disasters are common in Asia and it is generally believed that frequency and magnitude of extreme climatic events is increasing as a result of climate change, although there remains great uncertainty in projections of likely changes. Many of the worst disasters have occurred in Asia, and 77% of people displaced by disasters in 2010 were in this region. Most of these disasters were climate-related - about 90% of all sudden onset disasters were due to climatic factors. Pakistan is no exception, suffering from extreme flood events in 2010 and 2011.

Whether natural hazards become disasters depends on the vulnerabilities of the exposed communities and the intrinsic hazard, which can be represented by the equation 'Disaster Risk = Hazard +Vulnerability'. Disaster risk reduction can be achieved by reducing exposure to hazards (avoidance), lessening vulnerability of people and property (resistance), managing land and the environment more wisely, and improving preparedness for adverse events (resilience). Policy across the world already aims to develop rural economies and enhance quality of life whilst protecting the environment and reducing the risks of disasters. These long-standing objectives are entirely consistent with the need to cope with climate change. Consequently, there are many initiatives worldwide to assist in climate-compatible reconstruction giving an opportunity to do 'development differently'.

This report provides an overview of the findings of a desk-based review of literature, knowledge and experience related to natural disasters, rural planning and incorporation of adaptation techniques and low carbon construction for climate resilience in buildings and infrastructure. This review is focused on Europe and Asia and summarises the current experiences of these issues in rural Punjab, Pakistan. This information was gathered through a review of published literature on disasters together with our own project-related experience and reports and other grey literature. The review led to a synthesis of lessons learned from disaster recovery, and recommendations for incorporating climate change adaptation in reconstruction planning.

The key issues considered consist of:

- Rural Planning: The fifth IPCC assessment is currently anticipated to include consideration of climate change impacts in rural areas, such as the interconnections between landscape and regions, housing and settlements, economic base and livelihoods and infrastructure as well as social capital and resilience. In Europe, the European Rural Development Policy is undergoing a health check, and despite recognising the need to strengthen this policy to include issues such as climate change at present the focus does not appear to be on building resilience into construction efforts in rural areas. In Pakistan, as in much of Asia, there is no overarching rural planning system. Each country has its own practices, and few enforce regulation of rural development. The World Bank recommends that a rural planning approach should be based on building awareness and training construction workers alongside formal planning processes.

- Building Standards and Codes: The Eurocodes are mandatory for European development, and the first phase of the development of the European Framework on climate change (2009-2012) will include measures to improve climate resilience and promote best practice through this code (focusing on improving energy efficiency through assessments and certifications on energy performance and heating installations). Few developing countries have their own standards and codes for climate resilience, but may adopt the UK BREEAM or the US LEED standards, both of which are focused on sustainable building and development practices. There are movements in Asia towards 'green' building codes on energy efficiency and climate change adaptation. This is not yet the case in Pakistan, where building codes are largely new, stimulated by an earthquake in 2005, being the "Building Code of Pakistan (Seismic Provisions-2007)", focused on earthquake resilience and designed to be applicable to urban structures rather than village structures.

- Post-disaster Reconstruction: Reconstruction offers a chance to incorporate tools that will aid prevention or mitigation of hazards through disaster risk reduction, as well as incorporating projections of changes in climate. This has been recognised in the global strategy for "Building the Resilience of Nations and Communities to Disaster" set out in the Hyogo Framework for Action (HFA) 2005-2015, which explicitly calls for "*the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change".* Designs for buildings, construction methods and arrangements for service delivery need to be planned so that the risk of future damage to buildings and services is reduced. There are a large number of manuals and guidelines for reconstruction already available, key guidelines identified as relevant to this project are have been identified and tabulated in Chapter 2. Historically, Pakistan's planning approach to tackle these disasters was mostly reactive, although it is now a signatory to the HFA, with a National Disaster Management Framework (2007) and a Ministerial Strategy on Disaster Risk Reduction in Pakistan, for both national and provincial levels in Pakistan. Disaster Risk Reduction Development Plans are being prepared for the sensitive zones of Pakistan, with responsibilities spread across many levels. What is still lacking includes an overarching manual that will assist reconstruction of the large flood damaged areas of rural Punjab, as The "Seismic Retrofitting and Repair Manual for Buildings for Earthquake Vulnerability Reduction Project (EVRP)" was developed from grass-roots initiatives in December 2009; and,

- Low carbon in reconstruction: By using passive design and renewable energy technologies, reconstruction can go one step further in enabling communities to harness the climate to provide heat, cooling and energy in their homes and public buildings and infrastructure. This can enable rural communities to ensure their energy needs remain low and their energy supply potentially more secure to follow a more sustainable development path whilst helping the global community manage the carbon dioxide emissions that are driving anthropogenic climate change.

Climate change heightens the risks and urgency of dealing with long-standing problems related to reconstruction, but it also creates the opportunity for win-win situations where measures to improve socio-economic conditions can be planned in a way which reduces the vulnerability and risks associated with climate change. Practical measures to reduce climate related problems and introduce energy-efficiency can reduce the need for rural energy and open new renewable energy markets. Pakistan has few codes or guidelines for rural planning or construction and these do not address sustainability or climate change. By preparing new general guidelines there is an opportunity to make sufficient reference to climate compatibility considerations, although reconstruction should be context-specific highlighting the main risks and approaches rather than aiming to be prescriptive.

Acronyms

Acronym	Description
APEC	Asia-Pacific Economic Cooperation
BREEAM	BRE Environmental Assessment Method
CCA	Climate Change Adaptation
CCRA	Climate Change Risk Assessment
CDKN	Climate and Development Knowledge Network
CIRDAP	Centre on Integrated Rural Development for Asia and the Pacific
DaLA	Damage and Loss Assessment
DCO	District Coordination Officer
DDMA	District Disaster Management Authority
DFID	Department for International Development
DRR	Disaster Risk Reduction
DRR-GNDP	Disaster Risk Reduction Guided National Development Plan
EEA	European Environment Agency
ERC	Emergency Relief Centre
EU	European Union
EVRP	Earthquake Vulnerability Reduction Project
FHA	Federal Highway Authority
GFDDR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse Gas
HFA	Hyogo Framework for Action
IDMC	Internal Displacement Monitoring Centre
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Risk Reduction
ITDG	Intermediate Technology Development Group
IUCN	International Union for the Conservation of Nature
LDA	Lahore Development Authority
LEED	Leadership in Energy and Environmental Design
MG	Matching Grant
MP	Member Provincial Assembly
MOH&W	Ministry of Housing and Works
MWG	Ministerial Working Group
NDMA	National Disaster management Authority
NGO	Non-governmental Organisation
NRC	Norwegian Research Council
NESPAK	National Engineering Services Pakistan (pvt) Ltd
NHA	National Highways Authority
NRM	National Reference Manual
PCATP	Pakistan Council of Architects and Town Planners
PDHS	Pakistan Demographic and Health Survey
PDMC	Provincial Disaster Management Commission
PDMA	Provincial Disaster management Authority
PHE	Public Health Engineering Department

Acronym	Description
PDNA	Post-disaster Needs Assessment
PEC	Pakistan Engineering Council
PWD	Public Works Department
SAARC	South Asian Association for Regional Cooperation
TMA	Tehsil Municipal Authority
TOP&C	Town Officers for Planning and Coordination
UNDP	United Nations Development Program
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction
WFP	World Food Program
WCDR	World Conference on Disaster Reduction
WASA	Water and Sanitation Authority
WAPDA	Water and Power Development Authority

1. Introduction

1.1 Background

Disasters are occurring with increasing frequency across the world. They range from natural events such as floods, earthquakes, cyclones to disasters caused by human factors such as oil spills, transport accidents and infrastructure collapses. They can be sudden, such as earthquakes, or may build up gradually, such as a drought. Disasters can also cause large scale population displacement.

A report by the UN's Economic and Social Commission for Asia and the Pacific (2006) [1] highlights that of the number of natural disasters recorded per year the total number of people affected each year has doubled from the 1990s to the 2000s and most of the victims are from developing countries. The report recognises that a developing country's entire economy can be affected by both the physical and human resource impacts following a natural disaster. For instance, the cost of the damage caused in Asia and Pacific Region in 2004 equated to about $55 billion, whilst in Pakistan significant financial repercussions have been recognised during flood and earthquake events.[2] Countries such as Pakistan with large rural populations and a high dependency on agriculture are very vulnerable to climate-related disasters. The impact of even normal variations in rainfall can account for several percent of the GDP, and extreme events can clearly have dramatic economic impacts

Coupled with this is the widely recognized *"change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*"[3]. According to the Intergovernmental Panel on Climate Change (IPCC) (2007) one of the most important consequences of 'climate change' will be the increase in the frequency and magnitude of extreme events such as floods, droughts, windstorms and heat waves. Climate change may also trigger other hazards in which climate or weather conditions play a fundamental role, such as snow avalanches, landslides and forest fires.

By balancing risk and severity of a disaster, stakeholders have the choice to reduce disaster risks by considering and reducing the causal factors of disasters ('disaster risk reduction'). This can be achieved by reducing exposure to hazards, lessening vulnerability of people and property, managing land and the environment more wisely, and improving preparedness for adverse events. As highlighted by the United Nations Development Programme (UNDP), this is about doing 'development differently', to make development better and adapting development policies to take these natural hazards into account.[4]

An array of potential adaptive responses are available to human societies to respond to these natural and climate related hazards, ranging from purely technological (e.g., sea defences), through behavioural (e.g.,

[1] United Nations-Economic and Social Commission for Asia and the Pacific (2006) Enhancing Regional Cooperation in Infrastructure Development Including that Related to Disaster Management, Bangkok

2 see National Disaster Risk Framework Guidelines 2007 http://www.ndma.gov.pk/Docs/NDRMFP.doc

[3] United Nations Framework Convention on Climate Change. Article 1.

[4] UNDP briefing note (2007) Adapting to Climate Change: doing development differently. Available online at: http://www.undp.org/climatechange/adapt/downloads/UNDPAdaptationBrief_Nov07.pdf

altered food and recreational choices), to managerial (e.g., altered farm practices) and to policy (e.g., planning regulations). The need for adopting methods for adaptation is more urgent for those countries most vulnerable to climate change (such as the least developed countries, small island developing states and African countries prone to extreme weather events such as drought, storms, floods and desertification).[5]

Climate change is a critical concern in South Asia where Pakistan is located. Countries in this region have large populations living in vulnerable rural areas and have economies which are very dependent on agriculture which in turn depends on climatic conditions. Floods and droughts are common occurrences which are currently only partially mitigated by flood protection works or irrigation systems. In addition populations living in coastal areas and river deltas are at risk of sea level rises and back water flooding as well as from coastal cyclones.[6] These risks could undermine Pakistan's long-term economic development, political stability and human security in the long run.[7] Pakistan therefore needs to draw lessons from the global community on how to address some of the underlying factors that renders so many people vulnerable and to ensure that reconstruction efforts address the risks that are posed by climate change to reduce the risk of disasters whilst understanding the context in which they are being applied, as this will influence the construction response solution. This can be achieved through adaptation, a strategy for minimising the effects of expected changes in climate, and more broadly through climate-compatible development.[8]

The methodology used for gathering this information included a review of literature on disasters, synthesis of lessons learned from disaster recovery, and recommendations for incorporating climate change adaptation and low carbon construction materials and techniques in to reconstruction planning. An extensive search of online databases and libraries revealed many of the sources and others were found by reviewing the bibliographies of known references on the topic. In addition we have drawn on our own-project related experience and reports and other grey literature. Sources were chosen based on their focus on disaster recovery and/or planning and their applicability to disaster situations or hazards faced by the Punjab Region following the recent devastating floods.

1.2 Objectives

This report will provide an overview of the findings of a desk-based review of existing literature and information available on global knowledge and experiences related to natural disasters, rural planning and incorporation of adaptation techniques for climate resilience in buildings and infrastructure.

The objective is to ensure that the fieldwork planning takes account of knowledge and experience gained in other recent disasters elsewhere in Pakistan or other parts of the world. It will also provide background on reconstruction planning which can be incorporate into our guidelines for buildings and infrastructure in the Punjab to manage climate change related risks (such as flooding). It is an initial review and will be updated as necessary if additional data is collected during the study.

[5] European Commission Climate Action official website: http://ec.europa.eu/clima/faq/adaptation/index_en.htm.

[6] Aslam, M A (2001) Scoping Study for IUCNs Possible Involvement within the Climate Change Sector in South / South East Asia, IUCN.

[7] UN OCHA (2010) Pakistan Flood Response Factsheet, Nov 3. 2010. Available online at: http://pakresponse.info/LinkClick.aspx?fileticket+ekh82IrLXVQ%3D&tabid+96&mid=667

[8] LEAD Pakistan (2008) Pakistan's Options for Climate Changer Mitigation and Adaptation: scoping Study Report.

1.3 Structure of Report

This report is structured as follows:

Chapter 1 – introduction

Chapter 2 – global experience with post-disaster planning

- types and impacts of recent climate related disasters
- reducing the impact/risk of disasters
- rural planning
- implementation

Chapter 3 - experience with post-disaster planning in Pakistan, following a similar structure to Chapter 2

Chapter 4 – experience of climate compatible planning and construction (including low carbon options)

Chapter 5 - conclusions and recommendations

2. Overview of Post-disaster Planning (Asia and Europe)

"Disasters can provide opportunities for sustainable development. But sustainable relief and reconstruction requires that rehabilitation efforts should be integrated into long-term development strategies. The theme of mobilizing sustainable relief and reconstruction – transforming disasters into opportunities for sustainable development - explores problems and possibilities including vulnerability, risk mitigation, planning and response. The aim is to develop guidelines for 'sustainable relief and reconstruction' in order to provide a framework for development-oriented sustainable relief and reconstruction activities."

Source: UN-HABITAT (2005) Sustainable relief and reconstruction in post-crisis situations.

2.1 Introduction

The objective of this chapter is to identify the global knowledge and experiences of managing disaster risk reduction alongside climate change adaptation in reconstruction to integrate climate resilience in building and infrastructure. The knowledge and experiences will be centred on Europe and Asia, which includes both developed and developing countries and some of the worst natural disasters experienced in recent times; five of the ten most severe natural disasters in 2004 occurred in the Asia and Pacific Region[9].

2.2 Rural Planning

In this review, we are concerned with planning policies related to rural planning, both pre- and post-disaster. The definition of 'rural areas' and 'rural planning' vary, which can lead to confusion between planners, policy-makers and implementers, as highlighted by the report from the International Institute for Environment and Development (IIED) on Rural Planning in the Developing World (Environmental Planning Issues No. 20, December 2000)[10].

For the purposes of this review:

- 'rural areas' will be understood to mean areas which are typically: located outside of the limits of a city, town or a designated commercial, industrial, or residential centre; characterized by farms, vegetation, and open spaces; low population density; having much of the land devoted to agriculture; served by diffuse systems for water supply, sanitation and other services; and without a discernible locational pattern.
- 'rural planning' as being the strategy used to maintain and improve rural living standards, social, economic and welfare services and to provide solutions to rural issues, such as risk of hazards and housing needs.

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[9] United Nations-Economic and Social Commission for Asia and the Pacific (2006) Enhancing Regional Cooperation in Infrastructure Development Including that Related to Disaster Management, Bangkok

[10] Available online at: http://pubs.iied.org/pdfs/7828IIED.pdf

Rural planning can be undertaken at different institutional levels, such as:[11]

- At *community level*: management of their localities by groups responsible for particular services, e.g. water point or irrigation committee, school governors. Communities plan and implement activities from their own resources and may contribute to District plans.
- - At *District level*: representation of the people; delivery of public services and infrastructure projects; management of a substantial District budget;, maybe raising local revenue; strategic planning for the District including infrastructure, land use and allocation/regulation of water and other natural resources.
- At *Provincial level*: coordination of District plans, financial audit and provision of specialist services not available within Districts, e.g. scientific, engineering and veterinary services.
- At *National level*: raising and distribution of revenue for public services; policy-making and strategic planning. In most countries, line ministries remain the main service providers, commonly through staff in provincial outstations.

The development of rural planning globally has been in a state of flux as the objectives of planning evolve over the years, shifting from dealings related to increasing agricultural production, through greater efficiency and effectiveness, to explicit concerns in recent years about equity issues and the reduction of poverty and vulnerability. For instance, rather than concentrating on supporting agricultural development through irrigation and drainage projects, there is now a broader concern with water resource allocation and comprehensive watershed management and with the equity and sustainability of access to water .

In terms of climate change, the fifth IPCC assessment (due in 2013/2014) is currently anticipated to include consideration of these impacts in rural areas, such as the interconnections between landscape and regions, housing and settlements, economic base and livelihoods and infrastructure as well as social capital and resilience. This updated information is therefore not yet available for this review.

2.2.1.1 Europe

Rural Policy in Europe has been aimed at diversifying the economy to improve its competitiveness whilst protecting and enhancing the environment and quality of life. The European Rural Development Policy 2007-2013[12], which has been the guiding policy, focuses on three themes:

- Improving the competitiveness of the agricultural and forestry sector. This includes restorative and preventive measures against natural disasters.
- Improving the environment and the countryside. This includes: the prevention of natural hazards and fires, as well as mitigating climate change through the extension and improvement of forest resources by afforestation adapted to local conditions and enhancing biodiversity; use of appropriate agricultural and forestry practices to reduce greenhouse gas emissions and preserve the carbon sink effect and organic matter in soil (thereby integrating the aim of the Kyoto Protocol targets for climate change mitigation).
- Improving the quality of life in rural areas and encouraging diversification of the rural economy.

Following calls to introduce a broader range of policies, including those related to climate change, and to respond to new challenges and opportunities affecting rural Europe this policy is undergoing a 'healthcheck'. "*'The strengthening of EU rural development policy is an overall EU priority because the*

[11] International Institute for Environment and Development (IIED) *(Environmental Planning Issues No. 20, December 2000)* Rural Planning in the Developing World with a Special Focus on Natural Resources: Lessons Learned and Potential Contributions to Sustainable Livelihoods An Overview. Available online at: http://pubs.iied.org/pdfs/7828IIED.pdf

[12] European Union Rural Development Policy 2007-2013. Available online http://ec.europa.eu/agriculture/rurdev/index_en.htm

EU's rural areas are a vital part of its physical make-up and identity. According to a standard definition, more than 91% of the territory of the EU is "rural", and this area is home to more than 56% of the EU's population. Furthermore, the EU's range of striking and beautiful landscapes are among the things that give it its character." [13]

This review is being done at a national level, with a synthesis of the reviews planned for the EU as a whole (Individual country responses can be found at http://enrd.ec.europa.eu/rural-development-policy/introduction/en/introduction_home_en.cfm). At present the focus does not appear to be on building resilience into construction efforts in rural areas.

2.2.1.2 Asia

There is no overarching rural planning system in Asia as each country has its own practices. The former Soviet Union and other current or former communist states have had strong top-down centralised planning systems, whereas countries which have benefited from Western development assistance have gone through a range of alternative approaches. These range from traditional centralised systems based on extensive land use surveys etc to more modern participatory approaches based on participation. Few countries have strict planning policies that would say govern development on flood plains, and much is left to individual decisions.

The Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) is a regional, intergovernmental and autonomous organisation established on 6 July 1979 to meet the felt needs of the developing countries at that time as an institution for promoting integrated rural development in the region. Its' focus is, however, more on the economic aspects of development, than an overarching planning strategy for rural development. Countries within Asia therefore tend to have their own rural planning strategies. For instance, in Malaysia since 2007 rural planning was being managed through Village Action Plans that are agreed by the villages themselves, through a bottom-up approach of participation. The approach has positive effects but issues such as migration and lack of funding.

The World Bank note in a report in 2010[14] despite the institutional arrangements for regulating development being virtually non-existent in rural areas of most developing nations community participation is fully achievable. They recommend that a rural planning approach should be based on building awareness and training construction workers as much as on formal planning processes as housing is usually planned, designed and built by owners themselves or by local craftsmen. However, some physical planning is still required to ensure a basic road network and essential services within the settlements, so this approach needs to be supplemented with regional plans, for example or if an entire floodplain has attracted high-risk land uses (which also need to respond significantly to natural features, such as geology, topography, hydrology, and ecology).

2.3 Building Standards and Codes

Codes and standards are sets of rules that specify the minimum acceptable level of safety. Their use includes constructed objects such as buildings and non-building structures where the main purpose of which is usually to protect public health, safety and general welfare as they relate to the construction and occupancy of buildings and structures.

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[13] European Commission: Agriculture and Rural Development: Official Website http://ec.europa.eu/agriculture/rurdev/index_en.htm

[14] SaferHomes, Stronger Communities. A Handbook for Reconstructing after Natural Disasters, Abhas K. Jha, with Jennifer Duyne Barenstein, Priscilla M. Phelps, Daniel Pittet, Stephen Sena. Global Facility for Disaster Reduction and Recovery World Bank 2010

2.3.1.1 Europe

Building standards and codes exist and are enforced across the EU, and are continually updated. One such example is the **Eurocodes**: a set of unified international codes of practice for designing buildings and civil engineering structures which are based on 30 years development and have been used in Europe and abroad.[15] The primary objectives of the Eurocodes are to improve structural safety and to enhance the competitiveness of the European construction industry – and the professionals and industries connected with it, both within and outside the EU.

The Eurocodes are mandatory for European public works and aim to become the de-facto standard for the private sector – both in Europe and world-wide, with the following purposes:

- enabling building and civil engineering works to comply with the Construction Products Directive, particularly mechanical resistance and stability, and safety in case of fire.
- As a basis for specifying public construction and related engineering service contracts.
- As a framework for drawing up harmonised technical specification for construction products.

The first phase of the development of the European Framework on climate change (2009-2012) will include measures to improve resilience and promote best practice through the Eurocodes. One area that has a climate change/building best practice leaning is energy consumption for buildings-related services. This accounts for approximately one third of total EU energy consumption. Initiatives are being created in this area as significant energy savings can be achieved, thus helping to attain objectives on climate change and security of supply[16]. The four key points of the relevant EU Directive are:

- a common methodology for calculating the integrated energy performance of buildings;
- minimum standards on the energy performance of new buildings and existing buildings that are subject to major renovation;
- systems for the energy certification of new and existing buildings and, for public buildings, prominent display of this certification and other relevant information. Certificates must be less than five years old;
- regular inspection of boilers and central air-conditioning systems in buildings and in addition an assessment of heating installations in which the boilers are more than 15 years old.

The common calculation methodology should include all the aspects which determine energy efficiency and not just the quality of the building's insulation and an integrated approach will take account of aspects such as heating and cooling installations, lighting installations, the position and orientation of the building, heat recovery, etc.

2.3.1.2 Asia

There is no unified building code for construction in Asia, most developing countries (if they do not have their own standards and codes) tend to adopt the UK BREEAM[17] or the US LEED[18] standards, although such codes and standards are rarely applied in rural areas.

[15] Eurocodes Official Website: http://www.eurocodes.co.uk/Content.aspx?ContentId=4#

[16] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings http://europa.eu/legislation_summaries/other/l27042_en.htm

[17] BREEAM official website: http://www.breeam.org/page.jsp?id=374

[18] LEED official website: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988

2.3.1.3 BRE Environmental Assessment Method (BREEAM)

BREEAM is an environmental assessment method and rating system for buildings launched in 1990. It sets the standard for best practice in sustainable building design, construction and operation by assessing a building's specification, design, construction and use, set against established benchmarks.

Country-specific BREEAM schemes can be created by adapting the specifications to local social, cultural, climatic etc conditions, translating into the local language with local assessors and aligning them with the country's building regulations. Such schemes can act as a mass market driver to influence the local construction industry to go above and beyond building regulations.

2.3.1.4 Leadership in Energy and Environmental Design (LEED)

LEED is an internationally-recognized green building certification system. Developed by the U.S. Green Building Council (USGBC) in March 2000, LEED provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions. LEED projects are in progress in 41 different countries – among these Canada, Brazil, Mexico and India.

LEED promotes sustainable building and development practices through a suite of rating systems that recognize projects that implement strategies for better environmental and health performance. LEED is applies to all building types – commercial as well as residential and works throughout the building lifecycle – design and construction, operations and maintenance, tenant fit-out, and significant retrofit.

In addition, in Asia movements are being made to use 'green' building codes related to energy efficiency, to assist in mitigating climate change. For instance, some countries in Asia Pacific have already established green building standards and rating tools: Japan the "CASBEE" and Malaysia the "GBI"; others are in the process of developing rating systems or are just considering the process.

2.4 Recent Disasters

2.4.1 Types of Disaster

There are two types of disasters: natural and manmade, and these can be of varying degrees of severity, as shown in Table 2.1 below. Human factors can also have a profound impact on the nature and impact of natural disasters.

Table 2.1: Typical Categories of Types of Disaster

Type	Natural	Manmade
Major	Flood; Cyclone; Drought; Earthquake	Setting of fires ; Epidemic ; Deforestation ; Marine Pollution ; Chemical pollution; Wars
Minor	Cold wave; Thunderstorm; Heat wave; Mud slide ;Storm	Road / train accidents, riots; Food poisoning ; Industrial disaster/ crisis ; Environmental pollution

Source: Assam Government, India, Disaster Management[19]

[19] Assam Government, India, Disaster Management Official website: http://karimganj.nic.in/disaster.htm

2.4.1.1 Europe

The European Environment Agency (2011)[20] reports that the number and impact of disasters has increased in Europe in the period 1998-2009. The hazards covered in this report related to hydrometeorological or weather related (storms, extreme temperature events, forest fires, droughts, floods), geophysical (snow avalanches, landslides, earthquakes, volcanoes) and technological (oil spills, industrial accidents, toxic spills from mining activities).[21] The largest natural disasters in Europe in 2009 and 2010 were mainly floods, storms and earthquakes. [22] These disasters caused very high economic damage but, with the exception of heat waves and earthquakes, relatively low loss of life (Table 2.2). Extreme temperatures cause almost 80% of disaster-related fatalities in Europe, with almost all of the remainder due to earthquakes. This is a very different pattern to developing countries. Heat-related deaths are likely to be under-reported in many developing countries, but the death-rate reported from other types of disasters are much higher in developing countries than in Europe.

Although the economic damage of these European disasters was high in absolute terms, it was small as a percentage of total GDP when compared to the total GDP (the GDP of the EU is around €12tn/year) - the annual average loss due to disasters is around 0.1% of GDP (as compared to 25% GDP in the case of the 2005 earthquake in Pakistan) and about 1% of the population was affected.

Another important feature of disaster risk management in Europe is insurance. Although this only covered about 25% of losses, suggesting considerable improvements in cover are possible and necessary, this is still a far higher percentage than in most developing countries.

Table 2.2: Disasters caused by natural hazards in Europe in 1998 - 2009

Hazard type	Recorded events	Number of fatalities	Number of people affected (million people)	Overall losses (billion EUR)	Insured losses (billion EUR)
Storm	155	729	3.803	44.338	20.532
Extreme temperature events	101	77 551	0.005	9.962	0.186
Forest fires	35	191	0.163	6.917	0.097
Drought	8	0	0	4.940	0.000
Flood	213	1 126	3.145	52.173	12.331
Snow avalanche	8	130	0.01	0.742	0.198
Landslide	9	212	0.007	0.551	0.206
Earthquake	46	18 864	3.978	29.205	2.189
Volcano	1	0	0	0.004	0.000
Total	**576**	**98 803**	**11.112**	**148.831**	**35.739**

[20] European Environment Agency (EEA) (2011) Mapping the impacts of natural hazards and technological accidents in Europe. Technical report No 13/2010. Available online at: http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural

[21] Such as earthquakes in Izmit (Turkey) 1999, the storms *Lothar* and *Kyrill* (western, central, and parts of eastern Europe) 1999 and 2007, and widespread flooding episodes in the central areas of the continent and in the United Kingdom. Floods and landslides of 2005 in the Alpine region; the forest fires in Greece and other parts of eastern Europe in 2007 and 2009 and drought events affecting the Iberian Peninsula in 2005, 2006 and 2008 also were of importance.

[22] IDMC and NRC (2011) Displacement due to natural hazard-induced disasters: Global estimates for 2009 2010. Available online at: http://www.internal-displacement.org/8025708F004BE3B1/(httpInfoFiles)/15D7ACEC7ED1836EC12578A7002B9B8A/$file/IDMC_natural-disasters_2009-2010.pdf

2.4.1.2 Asia

Climate-related disasters are unfortunately common in Asia, although the climate is very variable across the continent, reflecting its size and diverse nature. The extreme weather events that tend to occur include extreme heat waves, extra-tropical and tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms, and dust storms. It is generally believed that frequency and magnitude of extreme climatic events is increasing as a result of climate change, but there remains great uncertainty in projections of likely changes in tropical cyclones, monsoons, and El Niño.[23] The largest natural disasters in Asia between 2008 and 2010 were mainly climate-related apart from the 2008 Sichuan earthquake.

2.4.2 Impacts of Natural Disasters

According to the Internal Displacement Monitoring Centre (IDMC) and Norwegian Refugee Council (NRC) (2011)[24] in 2010 42.3 million people worldwide were displaced by sudden-onset disasters caused by natural hazard events. *"Climate-related disasters [*hydrological, meteorological or climatological] *– primarily floods and storms – continued to be the main sudden-onset triggers responsible for most of the displacement in 2009 and 2010. They caused the displacement of over 15 million people in 2009 and over 38 million people in 2010. The largest disasters of 2009, floods and storms in India, together displaced at least five million people. However, these disasters were dwarfed by the 2010 floods in China and Pakistan, which displaced at least 15 million and 11 million people respectively. In 2008, climate-related disasters displaced at least 20 million people."*[25]

Slow onset-disasters, such as drought are not included in these figures and are not see easy to quantify and define. Around 100m people were affected by drought each year in 2009 and 2010, about two-thirds in Asia, but the number displaced as a direct or indirect result of these is not known. A much larger number are thus affected by droughts than floods, but generally not in such visible ways.

Displacement triggered by geophysical disasters – volcanic eruptions, earthquakes and tsunamis – was also significant, with at least 1.5 million people uprooted in 2009 and over four million in 2010. The figure was much worse in 2008 because of the devastating earthquakes in Sichuan, China. Other major earthquakes include Sumatra, Indonesia in 2009, Haiti and Chile in 2010, and Japan in 2011.

2.4.2.1 Europe

Between 1998 and 2009 some of the world's costliest disasters were in Europe, where natural hazards caused nearly 100 000 fatalities and affected more than 11 million people and caused great economic damage. The largest disasters due to natural hazards caused, overall, a loss of about EUR 150 billion in the 32 EEA member countries. [26]

England does not suffer from flooding on the scale of some Asian countries. However significant economic damage does occur with some loss of life. As an example, the floods in May, June, July 2007 were the

23 IPCC (2007) Working Group II: Impacts, Adaptation and vulnerability, chapter 11 Asia. Available online at: http://ipcc.ch/ipccreports/tar/wg2/index.php?idp=419

24 IDMC and NRC (2011) Displacement due to natural hazard-induced disasters: Global estimates for 2009 2010. Available online at: http://www.internal-displacement.org/8025708F004BE3B1/(httpInfoFiles)/15D7ACEC7ED1836EC12578A7002B9B8A/$file/IDMC_natural-disasters_2009-2010.pdf

25 IDMC and NRC (2011) ibid

26 IDMC and NRC (2011) op. cit.

wettest months on record in the country for the last 200 years and many lessons can be learned from these which are relevant for Pakistan[27]. The response was criticised because the recovery process was delayed due to the lack of information, with slow responses by some local councils, hidden flood damages not accounted for and a general resistance of the insurance industry towards aspects that required payment.

2.4.2.2 Asia

As shown below (Table 2.2) the worst disasters were in Asia – 77% of people displaced by disasters in 2010 (87% in 2009) were in Asia. Most of these disasters were climate-related - about 90% of all sudden onset disasters were due to climatic factors. Flooding and storms account for virtually all of the sudden-onset climate-related disasters.

Table 2.3: Sudden Onset Disasters Causing Most Displacement in 2010

Country	Type	Start date	Number displaced	Percentage of total displaced
China	Flood	07/05/2010	15,200,000	36%
Pakistan	Flood	28/07/2010	11,000,000	26%
Chile	Earthquake	27/02/2010	2,000,000	5%
Haiti	Earthquake	12/01/2010	1,500,000	4%
Colombia	Flood	06/04/2010	1,500,000	4%
Colombia	Flood	01/07/2010	1,500,000	4%
Thailand	Flood	10/10/2010	1,000,000	2%
Mexico	Flood	20/09/2010	810,000	2%
Nigeria	Flood	13/09/2010	560,000	1%
India	Flood	05/09/2010	523,000	1%
		TOTAL	**35,593,000**	**84%**

2.5 Post-disaster Reconstruction

Reconstruction relates to the long-term efforts designed to return life to normal levels after a disaster. In this phase, permanent infrastructure is rebuilt, ecosystems are restored and livelihoods are rehabilitated.[28] This is sustainable only if the population's vulnerability to future disasters is reduced within the framework of building measures, i.e. by the correct choice of location and disaster-oriented construction techniques,[29] as shown by the example of flood risk detailed in section 2.7 above.

Different countries approach post-disaster reconstruction in different ways, depending on the scale of the disaster, the nature of national planning processes, and scope of international assistance. Governments may establish a reconstruction plan specific to the incident or rely on their standard national developmental plan. In cases where reconstruction is being financed with international support, the international

[27] The approaches for community participation in Cumbria were considered very relevant to China by a team who visited from the Chinese Academy of Governance in 2010 as part of their programme to set up a disaster risk management system in China

[28] This follows the definition for 'rebuilding' provided in the IUCN (2010) Integrating environmental safeguards into flood relief, response and recovery. Available online at: http://cmsdata.iucn.org/downloads/pk_flood_response.pdf

[29] GTZ – Guidelines for Building Measures after Disasters and Conflicts (2003). Available online at: http://www.gtz.de/de/dokumente/en-gtz-building-guidelines.pdf

community has the potential to influence post-disaster planning and decision-making and introduce international best practices in environmentally sustainable reconstruction and recovery.

A global standard that can be used by governments and international development partners to assess damages and losses and synthesize needs for recovery, reconstruction and risk management after a natural disaster is the Post-Disaster Needs Assessment (PDNA).This is made up of the Damage and Loss Assessment (DaLA) (which analyzes the damages caused by the disaster and the economic losses) and the Human Recovery Needs Assessment (HRNA) which is a qualitative tool focusing on the human development and social impacts of the disaster by bringing in the affected communities' perspectives.

The 'Safe Homes, Stronger Communities: a Handbook for Reconstructing after Natural Disasters' prepared by GDFRR (2010) shown in the table below sets out guiding principles for post-disaster reconstruction planning.

Table 2.4: Guiding Principles for Post-disaster Reconstruction

No	Purpose	Description
1	A good reconstruction policy helps reactivate communities and empowers people to rebuild their housing, their lives, and their livelihoods.	A reconstruction policy should be inclusive, equity-based, and focused on the vulnerable. Housing reconstruction is key to disaster recovery, but it depends on the recovery of markets, livelihoods, institutions, and the environment. Diverse groups need diverse solutions, but biases will creep in, so a system to redress grievances is a must.
2	Reconstruction begins the day of the disaster.	If traditional construction methods need to change to improve building safety, governments must be prepared to act quickly to establish norms and provide training. Otherwise, reconstructed housing will be no less vulnerable to future disasters than what was there before. Adequate transitional shelter solutions can reduce time pressure and should be considered in a reconstruction policy. Owners are almost always the best managers of their own housing reconstruction; they know how they live and what they need. But not all those affected are owners and not all are capable of managing reconstruction; so the reconstruction policy must be designed with all groups in mind: owners, tenants, and landlords, and those with both formal and informal tenancy.
3	Community members should be partners in policy making and leaders of local implementation.	People affected by a disaster are not victims; they are the first responders during an emergency and the most critical partners in reconstruction. Organizing communities is hard work, but empowering communities to carry out reconstruction allows their members to realize their aspirations and contribute their knowledge and skills. It also assists with psychosocial recovery, helps re-establish community cohesion, and increases the likelihood of satisfaction with the results. This requires maintaining two-way communication throughout the reconstruction process and may entail the facilitation of community efforts. A real commitment by policy makers and project managers is needed to sustain effective involvement of affected communities in reconstruction policy making and in all aspects of recovery, from assessment to monitoring.
4	Reconstruction policy and plans should be financially realistic but ambitious with respect to disaster risk reduction.	People's expectations may be unrealistic and funding will be limited. Policy makers should plan conservatively to ensure that funds are sufficient to complete reconstruction and that time frames are reasonable. Rebuilding that reduces the vulnerability of housing and communities must be the goal, but this requires both political will and technical support. Housing and community reconstruction should be integrated and closely coordinated with other reconstruction activities, especially the rehabilitation and reconstruction of infrastructure and the restoration of livelihoods.
5	Institutions matter and coordination among them improves outcomes.	Best practice is to have defined a reconstruction policy and designed an institutional response in advance of a disaster. In some cases, this will entail a new agency. Even so, line ministries should be involved in the reconstruction effort and existing sector policies should apply, whenever possible. The lead agency should coordinate housing policy decisions and ensure that those decisions

No	Purpose	Description
		are communicated to the public. It should also establish mechanisms for coordinating the actions and funding of local, national, and international organizations and for ensuring that information is shared and that projects conform to standards. Funding of all agencies must be allocated equitably and stay within agreed-upon limits. Using a range of anticorruption mechanisms and careful tracking of all funding sources minimizes fraud.
6	Reconstruction is an opportunity to plan for the future and to conserve the past.	What has been built over centuries cannot be replaced in a few months. Planning and stakeholder input help to establish local economic and social development goals and to identify cultural assets for conservation. Even a modest amount of time spent designing or updating physical plans can improve the overall result of reconstruction. Reconstruction guidelines help ensure that what is valued is preserved, while encouraging more sustainable post-disaster settlements. Improving land administration systems and updating development regulations reduces vulnerability and improves tenure security.
7	Resettlement disrupts lives and should be minimized.	Resettlement of affected communities should be avoided unless it is the only feasible approach to disaster risk management. If resettlement is unavoidable, it should be kept to a minimum, affected communities should be involved in site selection, and sufficient budget support should be provided over a sufficient period of time to mitigate all social and economic impacts.
8	Civil society and the private sector are important parts of the solution.	The contributions of nongovernmental organizations (NGOs), civil society organizations (CSOs), and the private sector to reconstruction are critical. Besides managing core programs, these entities provide technical assistance, advocacy, and financial resources of enormous value. Government should encourage these initiatives; invite NGO, CSO, and private entity involvement in reconstruction planning; and partner in their efforts. Government should also require accountability and make sure that these interventions are consistent with reconstruction policy and goals.
9	Assessment and monitoring can improve reconstruction outcomes.	Assessment and monitoring improve current (and future) reconstruction efforts. Unnecessary assessments can be minimized if there are policies that require institutions to share assessment data and results. Local communities should participate in conducting assessments, setting objectives, and monitoring projects. Using reliable national data to establish monitoring baselines after the disaster increases the relevance of evaluations. Monitor both the use of funds and immediate physical results on the ground and evaluate the impact of reconstruction over time.
10	To contribute to long-term development, reconstruction must be sustainable.	Sustainability has many facets. Environmental sustainability requires addressing the impact of the disaster and the reconstruction process itself on the local environment. The desire for speed should not override environmental law or short-circuit coordination when addressing environmental issues. Economic sustainability requires that reconstruction is equitable and that livelihoods are restored. Livelihood opportunities in reconstruction should be maximized. Institutional sustainability means ensuring that local institutions emerge from reconstruction with the capability to maintain the reconstructed infrastructure and to pursue long-term disaster risk reduction. A reliable flow of resources is essential and institutional strengthening may be required.
The last word:	Every reconstruction project is unique.	The nature and magnitude of the disaster, the country and institutional context, the level of urbanization, and the culture's values all influence decisions about how to manage reconstruction. Whether government uses special or normal procurement procedures, how it weighs the concerns of speed versus quality, and what it considers the proper institutional set-up and division of labour will also vary. History and best practices are simply evidence to be weighed in arriving at the best local approach.

Source: GDFRR (2010) 'Safe Homes, Stronger Communities: a Handbook for Reconstructing after Natural Disasters'

2.6 Reducing Impacts of Natural Disasters

Whether natural hazards become disasters depends on a combination of factors - the impact and intensity of the hazard and the characteristics of the people, institutions, environment and infrastructure that are affected by it. This interrelationship can be shown by the following equation: **Disaster Risk = Hazard +Vulnerability** (defined in Table 2.4 below)[30]

Table 2.5: Definitions of Disaster Risk, Hazard and Vulnerability

	Disaster Risk	Hazard	Vulnerability
Definition	Risk is a measure of the expected losses due to a hazardous event of a particular magnitude occurring in a given area over a specific time period. Risk is a function of the probability of particular occurrences and the losses each would cause.	Phenomena that pose a threat to people, structures, or economic assets and which may cause a disaster. They could be either man made or naturally occurring in our environment.	The extent to which a community, structure, service, and/or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster prone area

Accordingly, there is an opportunity during reconstruction to incorporate tools that will aid prevention or mitigation of the hazards into reconstruction efforts by reducing the risks or vulnerabilities of communities to potential disasters. This can be achieved by:[31]

- preparing disaster risk assessments for the land to be built on or which is to be rebuilt; assessing the risk of hazards in cooperation with the population and national institutions (risk of flooding, landslides, lava stream, other exposures) (for instance using GIS mapping to identify hazard prone areas);
- assessing what scope there is for building measures to reduce the risk of disasters: disaster-resistant construction for new buildings, repair works, and reconstructions;
- considering possible use of early warning systems for earthquakes, floods, volcanic eruptions; and
- disaster precautions (e.g. education and training of local organisations, reserve supplies of sufficient disaster-resistant infrastructure, such as emergency shelter for future use).

In this way, physical infrastructure can be developed to withstand disasters, reduce and even prevent damage from natural disasters, for example, drinking water systems can be designed to act effectively for flood management,[32] depending on the risks identified. The Hazard Maps being prepared in support of this project have been used to inform this aspect and the risk identified are considered in Chapter 4 below.

2.6.1 World Conference on Disaster Reduction (WCDR) and Hyogo Framework for Action (HFA)

The Hyogo Framework for Action (HFA) 2005-2015 was negotiated at the Second World Conference on Disaster Reduction (WCDR), follows this approach by setting out a global strategy for "Building the Resilience of Nations and Communities to Disaster" (HFA: 2005-2015). The HFA was adopted by 156 countries (including Pakistan). It explicitly calls for "*the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change, which would include the clear identification of climate related disaster risks, the design of specific risk reduction measures and an improved and routine use of climate risk information by*

[30] Assam Government, India, Disaster Management Official website: http://karimganj.nic.in/disaster.htm

[31] GTZ – Guidelines for Building Measures after Disasters and Conflicts (2003). Available online at: http://www.gtz.de/de/dokumente/en-gtz-building-guidelines.pdf

[32] UN-Economic and Social Commission for Asia and the Pacific (2006) Enhancing Regional Cooperation in Infrastructure Development Including that Related to Disaster Management, Bangkok.

planners, engineers and other decision makers." It also went on to note that *'[a] gender perspective should be integrated into all disaster risk management policies, plans and decision-making processes, including those related to risk assessment, early warning, information management, and education and training*.' This Framework for Action encourages using techniques such as GIS as a tool to facilitate decision making, as well as understanding impacts after disaster.

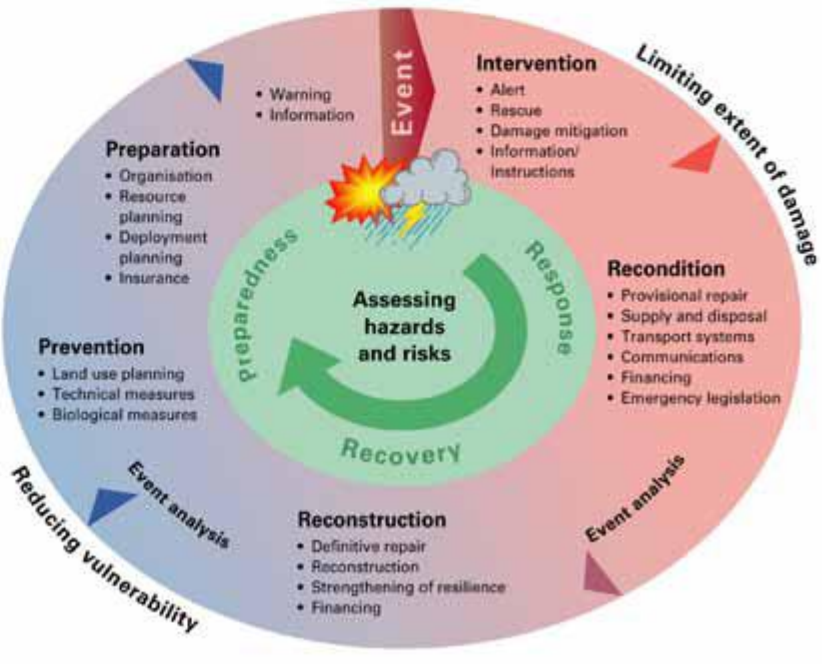
A similar sentiment for linking climate change adaptation to disaster risk reduction was echoed in the IPCC 4th Assessment report (as it emphasized the need for an iterative risk management approach in dealing with climate change) and by internationally recognised disaster risk NGOs, such as Tearfund (2008)[33].

2.6.2 Linking Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)

2.6.2.1 Europe

The approach in Europe has shifted from defence against hazards (mostly by structural measures) to a more comprehensive, integrated risk management approach (IRM) to take in the full disaster cycle — prevention, preparedness, response and recovery, as shown by Figure 2.6 below.

Figure 2.6 Cycle of integrated risk management



Source: European Environment Agency (EEA) (2011) Mapping the impacts of natural hazards and technological accidents in Europe. Technical report No 13/2010.

In relation to reconstruction, there are several institutions involved in the coordination of post-disaster:

[33] Tearfund (2008) Linking climate change adaptation and disaster risk reduction. Available online at: (http://tilz.tearfund.org/webdocs/Tilz/Research/CCA_and_DRR_web.pdf)

i) The Monitoring and Information Centre (MIC)[34], operated by the European Commission in Brussels. This is the operational heart of the Community Mechanism for Civil Protection and any country affected by a major disaster – inside or outside the EU – can launch a request for assistance through the MIC. During emergencies the MIC plays three important roles:

- **Communications hub:** Being at the centre of an emergency relief operation, the MIC acts as a focal point for the exchange of requests and offers of assistance, thereby cutting down on the administrative burden of liaison and providing a central forum for participating states to access and share information about the available resources and the assistance offered at any given point in time.
- **Information provision:** The MIC disseminates information on civil protection preparedness and response to participating states as well as a wider audience of interested, such as disseminating early warning alerts on natural disasters and circulates the latest updates on ongoing emergencies and interventions.
- **Supports co-ordination:** The MIC facilitates the provision of European assistance at two levels: at headquarters level, by matching offers to needs, identifying gaps in aid and searching for solutions, and facilitating the pooling of common resources where possible; and on the site of the disaster through the appointment of EU field experts, when required.

As the use of the mechanism is not restricted to interventions within the EU, any third country affected by a disaster can also make an appeal for assistance through the MIC. Following a formal request for assistance from a third country, different procedures are applied to activate this assistance.

ii) The European Commission, through its Directorates-General for Research and Information Society and its Joint Research Centre.[35] This commission facilitates the development of disaster forecasting and disaster management, developing systems such as the IES the European Forest Fire Information System, the European Flood Alert System alongside the Global Disaster Alert and Coordination System.

iii) The Civil Protection Financial Instrument, adopted in March 2007. This allows the European Commission to contribute to the creation and development of early warning systems to provide timely and effective provision of information that allows action to be taken to avoid or reduce risks and ensure preparedness for an effective response.

The EU is currently developing a European Framework to enhancing the EU's resilience to the impact of climate change (see Commission of the European Communities (2009) White Paper: Adapting to climate change: Towards a European framework for action). The paper recognises that although the severity of the impacts of climate change will vary by region, the EU is well placed to facilitate coordination and the exchange of best practices between Member States on climate. The review is of each policy area (region and sector (e.g. agriculture, fisheries, forests, energy) to identify the actual and potential impacts of climate change, costs of action / inaction and the proposed measures for interaction with policies in other sectors. The policy review is due to be complete by 2011 and the framework implemented in 2014.

The UK adopted the Climate Change Act in 2008 and is conducting a Climate Change Risk Assessment (CCRA) to understand the level of risk posed by climate change to the UK, to be presented to Parliament by 26 January 2012. Reports are being produced on the key climate risks for each of the 11 sectors identified for priority action: agriculture, water, flood and coastal management, marine and fisheries, forestry, biodiversity, business, built environment, transport, energy and health. A synthesis report on each sector findings will identify the interdependencies which will ultimately lead to the implementation of a new

[34] MIC official website: http://ec.europa.eu/echo/civil_protection/civil/prote/mic.htm
[35] http://ec.europa.eu/echo/civil_protection/civil/prote/developing_technologies.htm#fp

National Adaptation Programme from 2012.[36] It remains to be seen how this framework and CCRA will interact with IRM approach, but it is anticipated it will reach into the heart of the disaster risk reduction and climate change adaptation strategies in Europe.

2.6.2.2 Asia

The approaches in Asia vary according to the region, as there are vast differences in risks and ability to cope with these risks.

In South Asia climate change is recognised as an important issue. The South Asian Association for Regional Cooperation (SAARC) produced a Comprehensive Framework on Disaster Management (2006-2015) for South Asia (aligned with the implementation of the HFA). During the SAARC summit in 2007 concern was raised by the leaders over climate change and the need to pursue a climate resilient development in South Asia. The relevant agreements that followed are the Dhaka Declaration and SAARC Action Plan on Climate Change (2008) and the Thimphu Statement on Climate Change (2010); and the SAARC Convention on Cooperation on Environment (2010). In April 2010, Leaders at the 16th SAARC Summit called for the commissioning of a SAARC Intergovernmental Climate-related Disasters Initiative, to integrate CCA with DRR, and expressed deep concern over dual challenge of addressing the negative impacts of climate change and pursuing socioeconomic development. This is still awaiting implementation.

The Strategy for Disaster Risk Reduction and Emergency Preparedness and Response in the Asia Pacific region: 2009 to 2015 (2008) produced by the Asia-Pacific Economic Cooperation (APEC) included recommending recovery from disasters being achieved using a long-term development approach. This goes beyond building houses, schools and hospitals that can withstand predicted natural disasters, such as earthquakes, floods and landslides, to again create a more integrated approach that includes investing in the government's ability to respond, creating disaster management plans, and educating people about disaster risks.

This approach is similar with the European IRM approach and shows that at least on a high level globally there is agreement on the need to take into account and incorporate disaster risk reduction and climate change adaptation in reconstruction and disaster response at a policy level and beyond.

The integrated risk management approach is thus very widely accepted in principle, but it is not necessarily always applied in practice. The World Bank/GFDDR [37] recommends that a comprehensive post-disaster reconstruction plan should contain the following:

Table 2.7: Generic Content of a Comprehensive Post-Disaster Reconstruction Plan

Issue	Description
Land use	In a non-disaster situation, a comprehensive plan would address land uses for all purposes, including transportation, governmental, industrial, commercial, and residential. After a disaster, the planning exercise may focus primarily on land for housing and infrastructure reconstruction, but should not ignore other land use requirements, especially any others that have been affected by the disaster. This component of the plan addresses the issues and questions listed below.
Housing needs assessment	How many houses have been destroyed or damaged? Is it safe to rebuild in the same location? Are there multi-dwelling buildings (apartments)? Are there tenancy, land rights, or titling issues? What is the housing need in different categories?

36 See Defra's Climate Change Action Plan 2010 for more details: http://www.defra.gov.uk/publications/files/pb13358-climate-change-plan-2010-100324.pdf

37 SaferHomes, Stronger Communities. A Handbook for Reconstructing after Natural Disasters, Abhas K. Jha, with Jennifer Duyne Barenstein, Priscilla M. Phelps, Daniel Pittet, Stephen Sena. Global Facility for Disaster Reduction and Recovery World Bank 2010

Issue	Description
Assessment of land availability	If in-situ reconstruction is possible, can adequate DRR measures be implemented in available sites? If relocation is required, is there public land available? What are the criteria for choosing relocation sites? What are people's preferences in relocating? What are the underlying socioeconomic and political dynamics?
Land allocation planning	What is government policy on land for housing reconstruction and other purposes? Will housing reconstruction be plotted (single-family) development or apartment construction? What will be the process for acquiring and allocating land? What will be the policy on land allocation for social and physical infrastructure? Is there any need for land consolidation or land pooling?
Titling	What sort of tenure is to be granted to those who have been allotted land? How will the property rights documents be created and provided? How will the rights of women be protected? The outputs of this component will include (1) maps showing locations for housing reconstruction, (2) tentative or conceptual housing layouts (housing design is a separate activity), (3) housing project briefs with cost estimates, and (4) policy recommendations, if required.
Land use zoning and building codes	Land use zoning is a systematic way of managing the nature and intensity of land use in a specific area. The output is a map (with an accompanying table) showing various zones where specific uses or a mix of uses may be permitted. This component should address such questions as: Is there a system for land use zoning? Is it adequate to address DRR requirements? To reduce risk while accommodating future growth, what type of land use zoning is required? What is the institutional mechanism for implementation of the zoning? Is it market friendly? User friendly? How will informal settlements of the urban and rural poor be integrated into the land use zoning?
Building codes and development regulations	This component relates to the design, construction, and performance of buildings. The issues that need to be addressed include: Is there a regulatory system in place? How effective is it? Are prevailing codes responsive to prevailing hazard risks? What codes need to be put in place? How would they relate to land use zoning? Do existing procedures for building permission need improvement? What is the architectural heritage of the region? How can building codes accommodate local traditions? Do local building techniques need enhancement for disaster resilience? How will the new building codes affect housing affordability? How will codes apply to informal settlements of the urban and rural poor? The typical output is a set of Building Codes, Building Bylaws, or Development Control Regulations (the rule book for building design and construction).
Guidelines and manuals	If time or institutional constraints make it unrealistic to update building codes and regulations in advance of reconstruction, an alternative is to produce advisory guidelines and manuals that can be used in reconstruction. These guidelines and manuals should be based on standards and codes from an area with similar building technologies and housing designs. There are risks associated with using standards that are inappropriately stringent or from areas with different building technologies. The promulgation of the guidelines should be accompanied by a social communications program, training of builders, and a strategy for overseeing reconstruction. How to Do It: Post-Disaster Planning Where Planning Law and Institutional Capacity Are Weak, for more guidance on this situation.
Physical plan	Several key elements of physical planning are listed here. Planning may address them collectively, or each may be dealt with separately if the situation demands it.
Road layout	What is the existing road network in the settlement or region? Is it adequate for speedy evacuation and rescue in the event of a disaster? Are new road connections required to reduce risk and enhance preparedness? Are new roads required to provide connectivity to housing reconstruction locations? What is the extent of damage to roads? Are engineering improvements required? The output of this component will include road network maps and project briefs for road construction.
Plot layout	This relates to proposed housing reconstruction. While detailed design of housing layouts is a separate activity, at the planning stage it is important to prepare at least a conceptual layout of the proposed housing to ensure that the land allocation is adequate and that major issues have been addressed. The output is a set of plot layout plans.
Planning for infrastructure and services	This component deals with network alignments and land allocation for infrastructure services. The critical services include water supply, wastewater management, solid waste management, and storm-water management. Power supply and telecommunications networks may also be important. In all these cases, the existing systems need to be documented and proposed improvements need to be conceptually worked out to the extent that is required for assessing land-related issues. The output is a set of maps. Project formulation for infrastructure is a separate activity, but may be carried out concurrently or integrated with the planning process.
Planning for public buildings and social infrastructure	This component deals with allocation of land for facilities related to health, education, government, recreation, community development, and disaster shelters. In the planning process, the questions that need to be addressed are: What facilities existed pre-disaster? Should refuges be built? What is the extent of damage? Do any facilities need relocation? Were pre-disaster

Issue	Description
	facilities adequate? What does the reconstruction policy envisage: restoration of pre-disaster levels or improvement? What is the land requirement? What facilities are required as part of new housing to be created? The output of this component is a set of maps showing locations of proposed facilities and project briefs for creating them.
Local economic development	A comprehensive planning process needs to look at the economic base of the settlement/region and the need for interventions in the post-disaster situation. For example, if the disaster has destroyed livelihoods and economic diversification is a dire necessity, then the planning process needs to generate proposals for creating new job opportunities. In most cases, this will have a land allocation or land use zoning dimension. The output will consist of project briefs and, where relevant, maps showing land allocation.
Cultural heritage conservation	Issues related to cultural heritage conservation. In the planning process, conservation imperatives will find reflection in land use zoning, building regulations, and land allocation for cultural projects where relevant.
Implementation strategy	Everything decided or developed in the planning process will remain wishful thinking if inadequate attention is paid to the strategy for implementation. While immediate post-disaster needs (usually "restoration") will find funding easily, for long-term recovery it may be necessary to develop strategies to generate funding from multiple sources. This section of a plan should bring together the "big picture" of the reconstruction process, define the implementation process, estimate overall funding requirements, and assign roles, responsibilities, and tasks.

Source: http://www.housingreconstruction.org/housing/book/export/html/695

2.7 Reconstruction Guidelines

Reconstruction should be done in accordance with the same building codes and standards, to ensure that what is built is adequate and the urgency for reconstruction should not be used as an excuse for non-compliance with codes or with acceptable standards. Failure to comply with such codes is a common cause of disasters for instance: poor quality construction was one of the causes that provoked the collapse of houses in the earthquakes of 2001 in El Salvador (Hilda Elena Romero de Bojórquez, Asociación A-Brazo); and it is widely believed that the extensive damage and loss of life in schools in the 2008 earthquake in Sichuan was caused by poor compliance with codes. However, in many countries which are most vulnerable to disasters there are simply no building standards or codes, and there are none that are universally adopted despite attempts along this vein, i.e. the International Building Code (a model building code developed and adopted mainly in the United States, although it was intended to have no regional limitations). In these cases there is a need for guidelines of best practice.

NGOs, independent forums, think tanks have published their own guidelines, often specific to reconstruction post-disaster. As climate change is perceived to be increasing the future risk of natural disasters, they often encourage reconstruction projects to focus on ways to reduce this risk by ensuring that what is rebuilt is safer and more disaster-resilient than what was there before and that communities as well as governments need to be involved in this process and informed of these processes.

Key guidelines identified as relevant to this project are available from GTZ, UN Habitat, National Disaster Management Authority (India) and numerous others, as listed in Table 2.8.

Table 2.8: Summary of Key Guidelines Identified as Relevant for this Project

Date	Description	Locations	Online Resource	Author etc
Policy / Planning of reconstruction				
2010	Safe Homes, Stronger Communities: a Handbook for Reconstructing after Natural Disasters. Prepared to assist World Bank staff, as well as the Bank's government counterparts, engaged in large-scale post-disaster housing reconstruction programs	Global	http://www.housingreconstruction.org/housing/	Global Facility for Dis Reduction and Recovery (GFD
2008	ProAct - Climate compatibility and disaster resilience	Global	http://proactnetwork.org/proactwebsite/media/download/	ProAct Network

Date	Description	Locations	Online Resource	Author etc
			PApolicies/drr_caa_policy_paper.pdf	
2007	How to turn practice into policy	Global	http://www.tearfund.org/webdocs/Website/Campaigning/Policy%20and%20research/Practice%20into%20Policy%20D5.pdf	TearFund
2006	Technologies for Adaptation to Climate Change	Global	http://unfccc.int/resource/docs/publications/tech_for_adaptation_06.pdf	UNFCC
2005	A Toolkit for Delivering Water Management Climate Change Adaptation Through the Planning System	UK	http://www.espace-project.org/publications/library/SEERA%20toolkit_1-5.pdf	The Environment Agency and South East of England Reg Assembly, as part of the ESP project
2003	Guidelines for Building Measures after Disasters and Conflicts – pp88 -92	Global	http://www.gtz.de/de/dokumente/en-gtz-building-guidelines.pdf	Deutsche Gesellschaft Technische Zusammenarbeit (GmbH, Eschborn 2003
Case Studies				
Aug-08	ProAct - The role of environmental management and eco-engineering in disaster risk reduction and climate change adaptation	Global	http://proactnetwork.org/proactwebsite/media/download/CCA_DRR_reports/em_ecoeng_in_drr_cca.pdf	ProAct Network
2008	Indigenous Knowledge from Disaster Risk Reduction: Good Practices and Lessons Learned from Experiences in the Asia-Pacific Region	Asia-Pacific	http://sheltercentre.org/sites/default/files/ISDR_IndigenousKnowledge.pdf	UNISDR Asia and Pacific Regio
Guidelines on how to develop hazard maps, assessments, guidelines etc.				
2009	Guidance Notes on Safer School Construction. Highlight key points that should be considered when planning a safer school construction and/or retrofitting initiative and a compilation of basic design principles to identify some basic requirements a school building must meet to provide a greater level of protection.	Global	http://toolkit.ineesite.org/toolkit/INEEcms/uploads/1005/INEE_Guidance_Notes_Safer_School_Constr_EN.pdf	Darren Hertz. Published by Inter Agency Standing Committee, UNISDR, the World Bank, GFDDR, and the Inter-Agency Network for Education in Emergencies (INEE)
Risk Assessment and Community Involvement				
2004	Guidelines for planning in the re-building process – Resource pack	South Asia	http://practicalaction.org/docs/region_south_asia/guidelines-planning-rebuilding.pdf	Intermediate Technology Development Group – South Asia
Earthquakes				
Various	Collection of information and publications on seismic resistance of various building technologies	Various	http://www.world-housing.net	World Housing Encyclopaedia, an EERI and IAEE initiative,
Ongoing	Earth-based building materials and technologies	India	http://www.earth-auroville.com	Auroville Earth Institute, Tamil Nadu, India
2010	Model Bamboo houses and mitigating against climate change	Ecuador, Guayaquil	http://www.inbar.int/Board.asp?Boardid=296	International Network for

Date	Description	Locations	Online Resource	Author etc
				Bamboo and Rattan,
2008	Confined Masonry for one and two storey buildings in low-technology environments: a guidebook for technicians	Pakistan	www.seismic.co.net	Seismic Co. Tom Schacher
2007	"Bunga" houses built with compressed stabilized earth blocks; earthquake-resistant structures derived from traditional houses of cylindrical shape	India	http://hunnar.org	Hunnarshala Foundation for Building Technology and Innovations, Bhuj, India
2006	Improving the Earthquake Resistance of Small Buildings, Houses and Community Infrastructure.	Global	http://www.preventionweb.net/english/professional/publications/v.php?id=1390	AC Consulting Group Limited
Various	Guidelines for earthquake-resistant construction of non-engineered rural and suburban masonry houses in cement sand mortar in earthquake-affected areas	Pakistan	www.erra.gov.pk	ERRA, Government of Pakistan
2005	Manual for restoration and retrofitting of rural structures in Kashmir	Kashmir, India	http://kashmirdivision.nic.in/Disaster_Management/Man_res_retro_kmr_chpt1.pdf	UNDP, UNESCO, NCPDP
Sea Level Rises / Tsunami				
2007	After the Tsunami: Sustainable Building Guidelines for South East Asia.	South East Asia	http://www.preventionweb.net/english/professional/publications/v.php?id=1594.	Schneider, Claudia et al. Nairobi: United Nations Environment Programme.
2006	Eco-housing Guidelines for Tropical Regions, Dec 2006	Global	http://www.rrcap.unep.org/ecohouse/2005-08/ecohouse%20guidelines_261106_for%20review.pdf	United Nations Environment Programme Regional Resource Centre for Asia and the Pacific:
2001	Home Owners Guide to Safer Homes	Caribbean	http://www.oas.org/pgdm/document/preplan/homeownr.doc	USAID / OAS
2001	Guide to Safe Building Practices (Hurricane focused)	Caribbean	http://www.oas.org/pgdm/document/preplan/guidbldg.doc	USAID / OAS
	Lessons from Aceh: Key considerations in post-disaster reconstruction	Indonesia	http://developmentbookshop.com/product_info.php?cPath=12&products_id=1576	Disasters Emergency Committee (DEC) Member Agencies
Flooding				
2010	Monsoon Flood 2010 Pakistan: Rapid Technical Assessment of Damage and Needs for Reconstruction in Housing Sector	Pakistan	http://www.unhabitat.org.pk/Publication.html	UN-Habitat and National Disaster Management Authority Pakistan
2010	Guidelines for flood resistant house	Pakistan	http://www.unhabitat.org.pk/Publication.html	UN-Habitat, UN-Pakistan

Date	Description	Locations	Online Resource	Author etc
2008	Manual on hazard resistant construction in India: For Reducing Vulnerability in Buildings Built without Engineer	India	http://www.ncpdpindia.org/Manual_on_Hazard_Resistant_Construction_in_India.htm and http://data.undp.org.in/dmweb/pub/Manual-Hazard-Resistant-Construction-in-India.pdf.	UNDP India and NCPDP
2005	Handbook on Design and Construction of Housing for Flood-Prone Rural Areas of Bangladesh	Bangladesh	http://sheltercentre.org/sites/default/files/handbook_complete-b.pdf	Prepared under the Asian Urban Disaster Mitigation Program (AUDMP) (this did not include Pakistan). Published by Asian Disaster Preparedness Center
Higher Temperatures				
2010	Designing for Future	UK	http://www.innovateuk.org/ourstrategy/innovationplatforms/lowimpactbuilding/design-for-future-climate-report-.ashx	Technology Strategy Board
2007	Climate change and innovation in house building Designing out risk	UK	http://www.nhbcfoundation.org/LinkClick.aspx?fileticket=viZ9mWU9cqQ%3D&tabid=339&mid=774&language=en-GB	NHBC Foundation
2007	Climate Change Adaptation By Design: a guide for sustainable communities	UK	http://www.tcpa.org.uk/data/files/bd_cca.pdf	TCAP (Shaw, R., Colley, M., and Connell, R)
2006	Technology, Post-Disaster Housing Reconstruction and Livelihood Security	Global	http://www.practicalaction.org.	Twigg, John
2000	Climatic Design of Buildings using Passive Techniques	Global	http://sheltercentre.org/sites/default/files/Climatic_Design_of_Buildings_using_Passive_Techniques.pdf	Hans Rosenlund. Building Issues 2000, Vol. 10 (1)
Housing, Schools, Roads etc				
2003	Housing Reconstruction after Conflict and Disaster, Dec 2003	Global but example from Vietnam	http://www.odihpn.org/documents/networkpaper043.pdf	Sultan Barakat, Humanitarian Practice Network (at Overseas Development Institute):
2008	Manual setting out how to prepare a transport plan, design road routes, cost and then construct using simple road construction techniques for rural roads based on best practices from rural road-building programmes in Africa, Asia and the Pacific. [No specific focus on climate change]	Africa, Asia and Pacific	http://www.ilo.org/asia/whatwedo/publications/lang--en/docName--WCMS_100216/index.htm	International Labour Organisation
2001	Hazard resistant construction - School Vulnerability Reduction (Caribbean project)	Global	http://www.oas.org/CDMP/schools/schlrcsc.htm	USAID, OAS, ECHO

These guides can provide valuable instructions and practical actions for a variety of stakeholders in the reconstruction process and are considered in more detail in Chapter 4. Taking the example from the UK guides on 'designing for the future' 2010, potential strategies for reducing the risk of damage caused by flooding in flood risk areas:[38]

*'**Avoidance** – the simplest and most pragmatic approach to avoiding flood risk is not to build in flood risk areas. An additional factor of safety can be incorporated by design responses such as raising the floor level of a building to prevent water ingress under extreme circumstances. This is the fundamental strategy that underpins current official guidance for new development.'*

*'**Resistance** – in areas where flood water is likely to reach a building – for example, areas that have low flood risk today but might become more susceptible to flood risk in the future – it may be possible to 'dry-proof' buildings to prevent water entering. This can be achieved by incorporating permanent or temporary barriers such as door dams and non-return drainage valves and is only effective for floods of short duration and heights up to around 1m. Above this level, water pressure is likely to cause structural damage and the majority of apparently solid wall constructions will leak. Success here also depends on completeness in the defence; a missing air brick cover will render the entire defensive system useless.'*

*'**Resilience** – there may be situations where there is an unavoidable risk of flooding that cannot be dealt with by site or wider area controls. Under these circumstances there is much that can be done to minimise the damage and simplify reinstatement once the floods have subsided. This is a technique sometimes referred to as 'wet proofing'.*

One recent synthesis of key lessons for flood resilience learned from evaluations of relief and recovery since the 1980s from Africa, Asia and the Americas, suggested the following: [39]

Reconstruction:

- Raised plinths and foundations
- Combining a strong frame with lighter wall material that can be replaced after floods, which has been used successfully in Vietnam by the Vietnamese Red Cross and IFRC
- Raised shelves to protect valuables.
- Using more durable building materials which resist water damage.
- Planting water-resistant plants and trees to protect shelters from erosion
- Establishing community committees to monitor construction quality and settlement planning
- Community outreach to promote hazard resistant design approaches in future building.

Settlement Planning:

- Prohibiting resettlement in the most hazardous areas, if possible.
- Improving access to safe land. Many people must choose to live in floodprone areas to ensure access to shelter or livelihoods
- Limiting obstruction of natural channels, using absorbent paving materials and roof catchments to reduce runoff, and designing drainage to minimize intensity of water flows.
- Community emergency shelters and evacuation routes.

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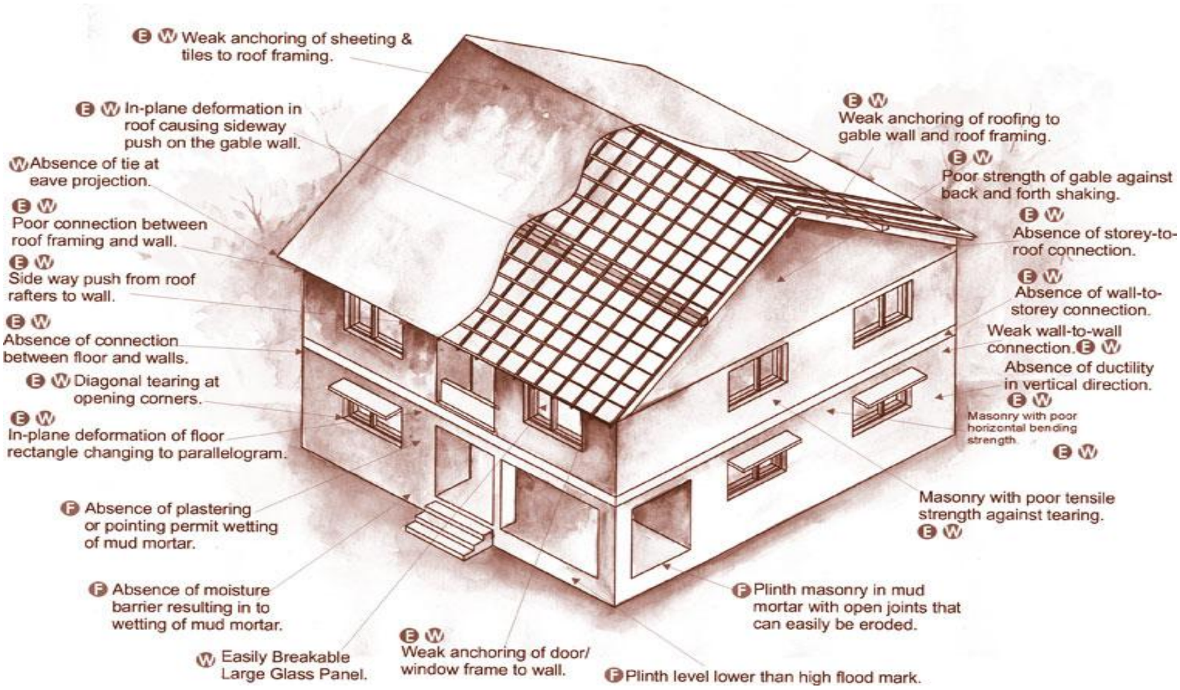
[38] Design for Future Climate Report: Opportunities for adaptation in the built environment (UK Technology Strategy Board), 2010. Available online at: http://www.innovateuk.org/ourstrategy/innovationplatforms/lowimpactbuilding/design-for-future-climate-report-.ashx

[39] Provention Consortium (2008) Flood disasters Learning from previous relief and recovery operations. Available online at: http://www.alnap.org/pool/files/ALNAP-ProVention_flood_lessons.pdf

- Early warning systems, including rain or river gauges and community monitoring, to alert communities to flood threats.

The construction methods can be represented in the guidelines as diagrams or pictures alongside text to engage the reader and perhaps cross language and reading barriers, as shown from the extract on the 2008 Manual on hazard resistant construction in India shown in Figure 2.7 below.

Figure 2.7: Example of using graphics to inform users of construction options



Source: UNDP India and NCDCP (2008) Manual on hazard resistant construction in India: For Reducing Vulnerability in Buildings Built without Engineer

2.8 Services (Water Supply, Transport, Electricity, Sanitation, Solid Waste etc)

In addition to building designs and construction, facilities for service delivery need to be built in such a way that the risk of future damage to utilities from disasters is reduced. The infrastructure itself, such as a system for storm-water runoff, can provide some protection from the impacts of natural disasters. Accordingly, when reviewing plans and policies for reconstruction account also needs to be taken of the infrastructure impacts in relation to DDR and CCA. Types of interventions are listed in Table 2.9 below.

Table 2.9: Typical Infrastructure Interventions for Housing and Community Reconstruction

Short-term interventions	Medium- to long-term interventions
Electric power systems	
Give priority to functions that support other lifelines, such as treatment and pumping of water.	Incorporate DRR mechanisms in reconstructed systems and facilities. Provide power for households and community facilities and for pumping water and running generators and tools used in reconstruction. Consider alternative energy generation options in housing and community building design and community planning.

Short-term interventions	Medium- to long-term interventions
	Develop a DRR plan for electric power installations.
Transport systems	
Prioritize access to critical facilities, such as hospitals, emergency centres, and fire stations. Initial rehabilitation of roads should support housing reconstruction, especially transport of materials to disaster site. Consider modest early repairs and more permanent reconstruction later on.	Incorporate DRR mechanisms in reconstructed systems and facilities. Provide housing site access and egress, including access by emergency vehicles for delivery of construction materials. Retrofit and upgrade to improved codes and standards. Design roadway systems for sites to encourage walking and bicycling. Plan for public transit access. Develop a DRR plan for the transport sector.
Water systems	
Water loss increases health and fire hazards, and causes loss of cooling systems for telecommunications and computers. Strengthen and support structures. Provide alternative domestic water supply until systems are restored. Repair, clean, and disinfect wells, boreholes, water storage tanks, and tankers. Improve leak detection. Monitor water quality. Rehabilitate water distribution and treatment works. Educate population on point-of-use treatment of drinking water.	Incorporate DRR mechanisms in reconstructed systems and facilities. Test for availability and quality of potable water before selecting relocation sites. Provide water for reconstruction purposes, such as mixing concrete. Provide water for households. Consider meter installation during rehabilitation of system. Develop a DRR plan for all water installations and facilities.
Sewerage system and storm-water runoff	
System loss causes untreated sewage discharge into water bodies or increased environmental and health hazards. Provide emergency sanitation systems. Prevent defecation in areas likely to contaminate food chain or water supplies. Educate population on hygiene.	Incorporate DRR mechanisms in reconstructed systems and facilities. Improve shut-off and diversion systems. Segregate combined overflow systems. Consider small-scale sewage treatment options. Design site for rainwater capture for landscaping and other non-potable purposes. Use permeable paving materials to maximize infiltration of water. Consider incorporating cisterns in site designs for collection of rainwater. Develop a DRR plan for all sewerage and storm-water installations and facilities.
Solid waste	
Unmanaged waste can pollute and obstruct water sources and provide breeding grounds for insects and vermin. Develop systems and designate sites for domestic, industrial, construction, hospital, and hazardous waste management, including recycling of disaster debris.	Develop integrated solid waste management plan if none exists. Maintain interim facilities until normal operations resume, and maintain debris and construction waste recycling until reconstruction tapers off. Re-establish normal solid water management services as soon as possible. Incorporate recycling and composting services in solid waste management plan.
Public buildings (health facilities, schools, and police and fire stations)	
Social consequences and compromised health and safety result from the lack of these facilities. Prioritize restoration of power supply, transportation access, and water supply.	Incorporate DRR mechanisms in reconstructed buildings. Prioritize school reconstruction to minimize disruption to school, and therefore family, life. Construct community meeting spaces or incorporate community space in other early public building reconstruction projects. Restore public facilities to improved construction and service standards. Design new public buildings with energy efficiency and multiple uses in mind.

Short-term interventions	Medium- to long-term interventions
	Develop a DRR plan for all public buildings.

Source: *:FEMA, 1995, Plan for Developing and Adopting Seismic Design Guidelines and Standards for Lifelines, FEMA Publication 271 (Washington, DC: FEMA),* http://www.fema.gov/library/viewRecord.do?id=1528; *FEMA, 2004, Using HAZUS-MH for Risk Assessment, FEMA Publication 433 (Washington, DC: FEMA),* http://www.fema.gov/plan/prevent/hazus/dl_fema433.shtm; *PAHO, 2002, "Emergencies and Disasters in Drinking Water Supply and Sewerage Systems: Guidelines for Effective Response," http://wwww.reliefweb.int/rw/lib.nsf/db900sid/LGEL-5E2DJV/$file/paho-guide-1998.pdf?openelement; and Water, Engineering and Development Centre (WEDC), 2005, "Technical Guidance Notes for Emergencies, Nos. 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, and 14," http://www.who.int/water_sanitation_health/hygiene/envsan/technotes/en/index.html*

Additional tools are being developed to consider impacts on these services through web-based modelling, such as GIS. For instance, a generic solution to help cities after flooding via the development of a GIS model is being developed by the Flood Resilience Community, with the help of the City of Paris Engineering School.[40] This will be a web-based tool which will help urban planners see how they can rebuild a city after a flood event. It will allow non-resilient infrastructure networks such as roads, sewerage systems, water supply pipes, electricity cables and telephone lines to be identified easily and can identify network problems and will help urban planners (re)construct the networks so that floods will cause less damage in the future.

2.9 Challenges to Post-disaster Reconstruction

Reconstruction programmes can experience challenges on unparalleled scales: see criticism of efforts in 2005 in Sri Lanka after the Tsunami and in northern Pakistan after the earthquake where supply of permanent homes was hampered by a lack of strategic and professional expertise, coupled with a shortage of skilled labour and materials.[41] The aim should therefore be to provide the best program and support that is available in the given circumstances.

Reconstruction must meet physical needs (functionality and configuration) as well as economic and technological (including practical building systems and building materials), social and aesthetic needs (thus respecting the culture of the affected population) on a local scale.[42] It needs to be context specific and there should not be an assumption of a 'magic formula'.

Coupled with that is the need to avoid too technocratic a bias, and reconstruction must be planned in a way which is safe as well as affordable and acceptable. As John Twigg has noted:[43]

'*There is a strongly technocratic bias in many reconstruction programmes: an emphasis on technically 'safe' housing without certainty that such housing is affordable or culturally acceptable. Large-scale programmes are particularly likely to be technology-driven, introduce new and expensive construction technologies, and bring in big contractors and outside workforces … Indigenous building knowledge is often devalued by outsiders – and indeed by local people, …Yet modern building methods do not*

40 http://www.floodresiliencity.eu/en/frcnews/newsletter012010/gismodels/index.php?mod=login&sel=setcookie

41 Goodfellow, I. (2006) Architects face challenges in Sri Lanka a year on from tsunami disaster. Building design, January 20th 2006, pp 8; and Saunders, G. (2006) in Blacker, Z. (2006) A matter of life and death. Building design, January 20th 2006, pp 8.

42 Tas, N., Cosgun, N. and Tas, M (2007) A qualitative evaluation of the after earthquake permanent housings in Turkey in terms of user satisfaction – Kocaeli, Gundogdu permanent housing model. Building and environment, Vol. 42, pp 3418-3431.

43 John Twigg, Benfield Hazard Research Centre: Technology, Post-disaster Housing Reconstruction and Livelihood Security, 2002/2006 Available online at: http://www.abuhrc.org/Publications/Working%20Paper%2015.pdf

automatically provide greater safety. … (whereas) some indigenous building technologies are well adapted to hazards."

Even apparently flimsy housing can sometimes make sense as a coping strategy against disasters: parts of it can be dismantled and moved at short notice so that they are saved to build with again. This happens sometimes in Bangladesh, when monsoon floods threaten, and particularly if there is a risk of erosion by rivers. Researchers in the Indian city of Indore noticed that in slums vulnerable to flooding, some people held their corrugated metal roofs in place with rocks rather than bolts or nails, so that they could lift them off and take them to safety if there was a danger of the house being swept away.[44]

Ms Stephenson of UN-HABITAT Pakistan writing of her experiences working on rural housing construction post-earthquake in Kashmir (2008)[45], warned that as in this instance reconstruction efforts were owner-driven there was a need to know where the owners are starting from, to predict what they may do, and to understand and meet their needs for technical support. Understanding of local conditions (including skills and materials) was needed to provide local solutions (i.e. principles as well as standards).

Consideration also needs to be given to additional local social issues, such as gender and disabilities. For instance, following the severe flooding in Pakistan in 1992 a local NGO hired female relief workers assess women's needs during the floods and their experiences in reconstruction efforts in two villages which had been completely flooded.[46] Under this scheme, local women were being involved in the reconstruction efforts through formation of women's groups to discuss women's views on the design and layout of new houses, aid women to take part in construction and provide the women with joint ownership of the houses with their husbands together with rights which were protected in the event of divorce or separation, attributed with assisting in reducing marital conflict and domestic violence.

As reconstruction is not occurring in a vacuum these experiences have shown that although model villages may be technically ideal and ensure high standards of quality control they may not be fully replicable or affordable, and guidelines need to cover the real as well as the ideal situation (yet still ensure sufficient resilience). There can therefore be a framework for more specific investigation of appropriate measures and techniques in a specific locality.

Reconstruction can be tackled in several conceptually different ways. For example World Reconstruction Conference (May, 2011)[47] considered the following different ways of managing urban reconstruction (which could also largely be applied to rural reconstruction):

- Owner-Driven Approach (ODA) vs. Agency-Driven/Community-Driven Approach (ADA/CDA);
- In-Situ Reconstruction vs. Ex-Nihilo (or Relocated) Reconstruction; and
- Single-Family Reconstructed Housing Units vs. Multi-Family Reconstructed Housing Units.

The merits and disadvantages of these methods were debated in the conference, concluding that when designing a housing reconstruction program beneficiary selection must be the first step. This should be

44 John Twigg, Benfield Hazard Research Centre: Technology, Post-disaster Housing Reconstruction and Livelihood Security, 2002/2006 Available online at: http://www.abuhrc.org/Publications/Working%20Paper%2015.pdf

45 Maggie Stephenson (UN-HABITAT, Pakistan), Notes from experience in post-earthquake rural housing reconstruction in Pakistan. Presented at Building Back Better workshop, Beijing, China, July 2008. Available online at: http://www.un.org.cn/public/resource/9330387be56a506bac9cae9aef6d5400.pdf)

46 John Twigg, Benfield Hazard Research Centre: Technology, Post-disaster Housing Reconstruction and Livelihood Security, 2002/2006 Available online at: http://www.abuhrc.org/Publications/Working%20Paper%2015.pdf

47 World Reconstruction Conference (May, 2011). Available online at: http://www.wrc-2011.org/wbwrc/wrc_documents/WRC_ProceedingsMedRes150.pdf

based on compiled data from the Detailed Housing Damage Assessment, to devise the eligibility criteria (which should aim to be adequately inclusive to address the needs of the most vulnerable sections of the urban population, i.e. occupants of illegal settlements on public lands or occupants having insecure legal tenure, temporary inhabitants or renters, etc.). The next key issue is the effective communication of the eligibility criteria to all the affected population to ensure fair and equitable opportunities, and identification of financial assistance for these efforts, such as materials, grants, or low-interest loans. Local knowledge is essential to fill in this gap and there are opportunities for NGOs to be used as an interface between the people and government, by communicating people's needs and priorities to the government.[48]

[48] Shaw, R. (2003) Role of non-government organisations in earthquake disaster management: an Asian perspective. Regional development dialogue, Vol. 24, No. 1, pp 117- 129.

3. Post-disaster Planning in Pakistan

3.1 Introduction

3.1.1 Pakistan

Pakistan's estimated population in 2011 is over 187 million, making it the world's sixth most-populous country. In 2010, the percentage of rural and urban population in Pakistan was 72% and 28%, respectively. Some current demographic statistics for Pakistan:

- Over 50,000 villages
- Literacy: 37% (but with striking gender differences – female literacy is just 10%)
- Occupation: Agriculture (24% of GDP employs 48% of total work force)
- Problems: poor living standards; poor education; poor health; lack of clean drinking water; inadequate sanitation; poor communication

(Source: Presentation by: Khalid Mehmood, University of the Punjab Lahore in 2009)

The Medium Term Development Framework (2005-2010) prepared by the Planning Commission[49] notes that in the rural areas of Pakistan the majority of employment and productive activities are related to the agriculture sector, whilst the production base of the urban areas is in manufacturing and services.

At independence, Pakistan was a predominantly rural country and still is today, although the urban population is increasing as a result of the structural transformation of the economy: people were thought to be migrating to urban areas because of expectations that there would be opportunities for better employment and higher incomes. Pakistan is therefore in transition from an agricultural and rural to a modern industrial economy, which is leading to rapid urbanization, infrastructure development, environmental degradation, soil erosion and water and air pollution etc.[50]

According to the Pakistan Demographic and Health Survey (PDHS) of 2006-07, the country has alarmingly high rates of maternal mortality (276 per 100,000 live births), infant mortality (78 deaths per 1,000 live births) and under-five child mortality (94 deaths per 1,000 live births). Similarly, in 2001 Pakistan had a gross school enrolment rate of 84.3% and an overall literacy rate of 53%, which are amongst the lowest in the world. Access to potable water is 93%, of which only 24% of rural households have access to piped water, and more than half of Pakistan’s population has poor access to sanitation facilities. These statistics represent national averages; the situation is considerably worse in many rural areas where weak infrastructure service delivery is profoundly visible.[51]

[49] Planning Commission (2005) Medium Term Development Framework (2005-2010) Available online at: www.planningcommission.gov.pk/mtdf.html

[50] National Disaster Management Framework (2007) http://www.ndma.gov.pk/Docs/NDRMFP.doc

[51] Rural Support Planning Network website: www.rspn.org

3.1.2 Rural Punjab

The Punjab province located in the north-eastern part of Pakistan is the most populous and largest province by its 73,621,290 and is home to half the population of the country. More than two third (68.7%) majority of its own population lives in rural areas than the rest even less than one third (31.3%) has settled in urban areas.[52]

The Punjab is divided into four climatic zones with around 50% area of its area is arid and semi arid. It is approximately 700 km long and 300 km wide and is traversed by the Indus River and its four eastern tributaries. Punjab means "land of five rivers", the life blood of Pakistan. The four doabs[53] (areas between two rivers), i.e. Bari, Rachna, Jech and Sind Saghir, have been settled as a result of rapid irrigation development by the British regime before independence. Extensive canal irrigation system and planned areas (Bar lands) were developed by the British which made it largest efficient irrigation network *"and converted a vast vacant area of agricultural land into a productive and commercialized area and hence the marketing process brought prosperity to the area"* (Islam, 1987, p. 173-174). Therefore based on the rich agricultural raw material *"Punjab is the most industrialized province of Pakistan; its manufacturing industries produce textiles, sports goods machinery, electrical appliances, surgical instruments, metals bicycles, and rickshaws, floor coverings and processed foods"*. In fact behind all these development the rural masses work hard in agriculture-the primary sector and thus they contribute about 68% to annual food grain production in the country.[54]

The inner core of the doab areas is called the *bar* - the British planned, canal-irrigated land which is productive and protected, being located away from the rivers and generally safer in comparison to adjacent lands along the river banks. The latter are older unplanned settled areas called *salaba* - the *bet* areas, which are essentially on the flood plain (although protected by dykes or other infrastructure against flooding to some extent and in some locations).

3.1.2.1 Livelihoods

Approximately two-thirds of the Punjabi population reside in rural areas and agriculture is the chief source of income and employment in Punjab. A few large landholders own a disproportionate amount of land and more than 4 million family farms have plots of less than 5 ha, and 25% of all farms consist of less than 1 ha. At present about 50% of farmers own and operate their farms, while 26% are tenant farmers. Sharecroppers who work land belonging to large-scale farmers are often in debt to their employers.

For many of the poorest rural people income partly depends on non-farm sources. The causes of poverty in rural areas include lack of education, poor access to health services, large family size, gender discrimination, unequal land distribution and vulnerability to environmental degradation. Natural disasters, notably the 2005 earthquake and the recent flood disasters of 2010 and 2011 have had profound impacts on poverty and livelihoods.

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[52] Provincial Disaster Management Authority (PDMA) (2008) "Disaster Risk Management Plan: Punjab." With the technical and financial assistance of NDMA and UNDP in Pakistan. 48/8 Lawrence Road, Lahore (pp.1-2 and 12)

[53] '*Doab*' is a Persian word which means 'two waters'. The land between two rivers was named *doab* by the Mughals. The *doabs* were given names compounded from those of their confining streams. For example, the *doab* between the Ravi and Chenab rivers is called "Rechna" and similarly the land between the Jhelum and Chenab rivers is called Jech. Thus each *doab* has two *bet* lands along the rivers, and one *bar* area in the middle.

[54] PDMA (2008) Op. cit.

3.1.2.2 Services

As highlighted above, lack of access to social and infrastructure services, particularly education, health, and water and sanitation, is often one of the most pressing issues facing rural communities. Inequality of access to these services is a further problem, as women and children often have low access, particularly in relation to public and private health and education systems. Focusing on infrastructure services in the Punjab region:

Water supply is variously provided by public utilities, commercial organisations, communities or individuals, usually by a system of pumps and pipes.

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Inadequate sanitation is a major cause of disease world-wide and improving sanitation is known to have a significant beneficial impact on health both in households and across communities. The word 'sanitation' also refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal. It can involve:

- Basic sanitation - refers to the management of human faeces at the household level.
- On-site sanitation - the collection and treatment of waste where it is deposited. Examples are the use of pit latrines, septic tanks.
- Food sanitation - refers to the hygienic measures for ensuring food safety.
- Environmental sanitation - the control of environmental factors that form links in disease transmission. Subsets of this category are solid waste management, water and wastewater treatment, industrial waste treatment and noise and pollution control.
- Ecological sanitation - an approach that tries to emulate nature through the recycling of nutrients and water from human and animal wastes in a hygienic manner.

In the Punjab, water supply systems and sanitation are managed by the Public Health Engineering Department (PHE) and the Water and Sanitation Authority (WASA).

Solid waste management relates to the collection, disposal, management and monitoring of waste materials. The term usually relates to materials produced by human activity, and is solid waste management is generally undertaken to reduce their effect on health, the environment or aesthetics. There is often scope for reusing or recycling waste. Solid waste is mainly a problem in urban areas, but is increasingly a concern in rural areas and can have public health significance. Debris from un-managed disposal of solid waste can block culverts and thus contribute significantly to flood damage.

The management of non-hazardous waste in the Punjab depends on the locality. For instance, in Lahore, residential, commercial and institutional waste is managed by the local government agency known as Lahore Development Authority (LDA). In the rural areas of Punjab, the local Public Health Engineering Department is responsible for managing the collection and destruction of non-hazardous waste (residential, institutional, commercial and industrial). The methods for disposal of rural waste in the Punjab are generally open dumping, recycling or reuse.

Electricity services in the Punjab are managed by the Water and Power Development Authority (WAPDA) and private electric supply companies depending on the area. Transportation links are managed by the Federal Highway Authority (FHA), National Highway Authority (NHA) and Local Authorities.

3.2 Rural Planning

In the 20th century the "top-down approach" for rural development programmes was the normal practice for government officials and policy makers. However, during the last quarter century there has been considerable debate about potentially better strategies for development and redevelopment in disaster-prone areas and the two approaches have been compared.[55]

3.2.1.1 1970-1990

The Matching Grant (MG) and Member Provincial Assembly's (MP) programmes were the two major rural development programmes of this period. MG projects represented a "bottom-up planning approach" whereas the MP programme was undertaken through a "top-down planning approach". The effectiveness of these two approaches were investigated in a study undertaken in rural Punjab for plain, mountainous and desert areas notably in Sargodha, Attock and Cholistan districts, concluding that:

- Rural Development Programmes are more effective and sustainable when they follow a 'bottom-up' approach, with grass roots participation of the people and genuine involvement and commitment of relevant and adequately organised lower levels of local authority and NGOs.
- Projects tend to be appropriated by the larger landowners (zamindars) in favour of clan groups to which they belong. This effect is less marked however in the case of projects incorporating a bottom-up approach.'
- Projects which result in time saving by women tend to be more effective because women can translate time saved into money earned and such money earned tends to be used for *improvements in living conditions and maintenance of projects.*
- Rural Development Programmes bring better results in planned (*Bar*) lands as compared to the unplanned (*Bet*) lands.'

The first three general observations (above) on the performance of projects under different planning approaches are useful, but it is the fourth point which is potentially of importance for planning in the (*bar*) and (*bet*) villages of flood zones in Southern Punjab. Usually the same planning approach has been implemented in both types of land and this has had unforeseen consequences of different effects, defects and unrealised impacts.

A research study on the *bar* and *bet* divide at Herriot-Watt University in the mid 1990s and completed in 2002[56] analysed the effect of the planning approaches with reference to this *bar* and *bet* divide. It concluded that:

- Rural development projects in the *bar* land are more effective in achieving household participation in construction of the projects in response to more household consultations.
- More household benefits for more households can be achieved on *bar* land than on *bet* land.

Although it is more difficult to achieve good participation on bet land, the MG programme was beneficial to all classes of both types (*bar* and *bet*) of village communities during the period 1980-85. The MP regime (with top-down planning) by contrast was deficient in both areas (*bar* and *bet*) but it failed to a greater extent in the *bet* villages. A key defect in the *bet* land was that it could not create self-reliance among the locals. This issue deserves greater consideration in future planning

[55] Islam, Qamar (2008) 'A Comparative Study of Matching Grant and MPAs Programme for Rural Development in the Perspectives of Devolution Plan in Pakistan' PhD Thesis, Department of City and Regional Planning, University of Engineering and Technology, Lahore, Pakistan, 2008. (see pages 29-34, 100-102, 126-127 , 149-158 and 246-258)

[56] Islam,Q (2001) 'Top-down and 'bottom-up' approaches to rural development in the 1980s: Case studies in Punjab, Pakistan' M.Phil Thesis, Centre for Environment and Human Settlement (CEHS), School of Planning and Housing, Edinburgh College of Art, Heriot-Watt University, Edinburgh, United Kingdom, 2001. (see pages 9-10, 70-72, 237-256)

3.2.1.2 2000-2008

The new government replicated it under "Devolution Planning" of Pakistan with reference to "Local Government Ordinance 2001", under the clause of "*Section-119: Bottom up Planning"* for Matching Grant Programme for Whole Pakistan. A research study to evaluate these "Decentralisation Planning Approaches" and assess the effectiveness and sustainability of physical and social type projects managed in this way was undertaken from 2003 to 2008 at University of Engineering and Technology-Lahore.[57] This study advised:

(i) Remedies of MG replications through improved Citizen Community Boards

The models on the Citizen Community Boards (CCBs) and MG programme already designed were tested in 2005. They proved to serve their purpose and have shown positive changes through their performance and effectiveness in the rural landscapes of the central region in Pakistan.

(ii) Decentralized planning of CCB formation and registration model

It has been suggested that Town Officers for Planning and Coordination (TO P&C) should initiate CCB formation by mutual consultation with the concerned local people of the villages, and this has been indicated in a flow diagram of the CCB formation and registration model. This reflects the commitment of local government and local communities to make registration of CCBs at grass roots (union council) levels through respective project managers serving under ADLG offices.

(iii) Decentralized planning of proposed MG approval model

This proposed model can serve the purpose of MG planning, approval and banking procedures as it gives detailed guidance to the planners, policy makers and town officials serving in infrastructure and financial allocations of approved projects. Previously, the mode of agreement for the project under a replicated MG programme had not been clear. To submit 20% of the total cost on a proposed project in cash is still difficult in *bet* areas, as well as villages in mountainous and desert regions. However, it is suggested that the proportion of costs borne by the locals should be reduced from 20% to 15% and then to 10% for physical and social projects in the more vulnerable villages.

3.2.2 Building Standards and Codes

Building codes are largely new in Pakistan (the first introduced in 1986), and an earthquake in 2005 was an important stimulus for their further development. In 2005 the Federal Ministry of Housing and Works were assigned (using the National Engineering Services Pakistan (pvt) Ltd (NESPAK)) to develop a broad based structural awareness for making buildings safe through disaster resistant construction techniques. Officials of NDMA and a UNDP expert in the Ministry of Housing and Works coordinated NESPAK through the National Engineering Council and the Pakistan Council of Architects and Town Planners (PCATP) produced the 'Building Code of Pakistan (Seismic Provisions-2007)', adopted in September 2008. The Building Code requirements are intended for application in all buildings and building-like structures of reinforced concrete, steel and masonry (excluding infrastructure such as tunnels, transmission power lines, dams etc). They were to be the minimum standards required for the structural design of buildings using these different materials and their tests and inspection needs. As part of these codes seismic zones were

[57] Referred to in Islam, Q (2008). Op. cit.

mapped for the whole of Pakistan with zones identified from 1 – 4 on the basis that future buildings should be designed for a level of earthquake ground motion that has a 10% probability of exceedance in 50 years..

Various building projects were subsequently implemented under the Ministry of Housing and Works after the earthquake 2005, giving an opportunity for lessons learnt from the efforts and experience of local experts of the PWD to be incorporated into an updated set of Building Codes (bearing in mind the need for affordable actions and regional sensitivity (due to their diversified characteristics). A review of these codes identified that codes relating to rural planning and structures, village level seismic retrofitting and repairs to buildings, were missing (these building codes were designed to be applicable to urban structures rather than village structures). The Secretary of the MOH&W has requested that the DRR Consultant generate research methodologies that will help them develop a National Reference Manual and Guidelines in National Housing Policy, Housing and Land use Planning (Meeting of DRR Consultant with the Secretary MOH&W on 6th Jan 2010). This Manual and Guideline is not yet available from the MOH&W.

A further set of Buildings Codes fo Pakistan (Energy Provisions) 2011 have also been produced in draft to aid the design of better systems that minimize energy consumption and improve energy efficiency. This is related to low carbon development, which is considered in Chapter 4 of this report.

3.3 Recent Disasters

3.3.1 Types of Disasters

3.3.1.1 2011 Pakistan Floods

As reported in Dawn,[58] since late August 2011, more than 300,000 people have been left homeless and at least 300 have died in the southern Sindh Province as monsoon rains have been pouring down. 5.3 million people and 1.7 million acres of arable land in the country's main breadbasket have been affected. Vital crops have been washed away, sewerage and freshwater canals have been breached and two million people are left at risk of disease or are already suffering from malaria, hepatitis and other sanitation-related diseases. Three-quarters of a million people are living in temporary shelters and seven thousand people have been bitten by snakes in the water.

Four heavy spells of rain from mid-August to mid-September 2011 flooded half of rural Sindh. The southern Sindh districts have become virtual lakes. The affected districts, which have an average yearly rainfall of 150mm, have been inundated by 1000mm of rainfall in the last three months. 22 of the province's 24 districts have been flooded, ten of them severely, including several where millions of people were displaced just one year ago. The worst-affected districts of Badin, Mirpurkhas and Thar have received eight times the usual levels of rain.

"Our opinion is that it's already worse than last year, not because of the numbers but the impact on a population already severely affected by last year's mega-flood," said Oxfam's country director for Pakistan, Neva Khan. "We're talking about the same population," she added.

[58] See http://www.dawn.com/tag/pakistan-floods. Last accessed on 16 September 2011.

Prior to the August 2011 floods, the worst natural disasters in Pakistan since 1935 were reported by IRIN Asia – Humanitarian News and Disaster[59] to be:

3.3.1.2 2010 Pakistan Floods

The 2010 floods began in late July 2010, resulting from heavy rainfall, flash and riverine floods in the north and north-western regions of Pakistan (parts of Khyber Pakhtunhwa, Gilgit Baltistan, Balochistan, and Azad Jammu and Kashmir) combined to create a moving body of water equal in dimension to the land mass of the United Kingdom, or 41,000 km^2. Approximately one-fifth of Pakistan's total land area was under water, approximately 796,095 km^2 (307,374 sq mi). According to Pakistani government data the floods directly affected about 20 million people, mostly by destruction of property, livelihood and infrastructure, with a death toll of close to 2,000. At least 1.8 million homes were damaged or destroyed in devastated villages from the Himalayas to the Arabian Sea.[60]

Between independence in 1947 and 2010, Pakistan faced eight severe flood disasters. These floods have resulted in more than 8,000 deaths, affected more than 100,000 villages and towns, and eroded some 285,000 ha of land with the cumulative financial loss of earlier floods estimated at about PKR 765 billion. This cost is thought to be small in comparison with the 2010 floods.

3.3.1.3 2010 Hunza Lake Disaster

A landslide in January 2010 in Attabad village in north of the country killed 20 people and led to around 40 houses sliding into the Hunza River. Debris from the landslide caused the river to dam, leading to the formation of a large lake which threatened to flood downstream areas. Some 20,000 were forced to leave their homes by June 2010.

3.3.1.4 2007 Cyclone Yemyin

At least 380 people were killed in Balochistan, 250 in Sindh and 100 in NWFP as a result of flash floods triggered by Cyclone Yemyin, which struck coastal areas in early July 2007. Around 350,000 people were displaced, 1.5 million affected and more than 2 million livestock perished.

3.3.1.5 2005 Kashmir Earthquake

A 7.6-Richter scale quake struck the Kashmir region (known as Azad Kashmir, near the city of Muzaffarabad, affecting Gilgit-Baltistan and the Khyber Pakhtunkhwa provinces of Pakistan) on the India-Pakistan border and parts of north-western Pakistan on 8 October 2005. According to official figures, at least 73,000 people were killed and more than 3.3 million made homeless. Work continues even today to rebuild damaged infrastructure. The earthquake also affected countries in the surrounding region with tremors felt in Tajikistan, western China; Indian-administered Kashmir and Afghanistan. The severity of the damage caused by the earthquake is attributed to severe upthrust, coupled with poor construction.

[59] IRIN Asia – Humanitarian News and Disaster Website: http://www.irinnews.org/Report.aspx?ReportId=90115. Last Accessed 26 August 2011.

[60] UN OCHA (2010) Pakistan Flood Response Factsheet, Nov 3. 2010. Available online at: http://pakresponse.info/LinkClick.aspx?fileticket+ekh82IrLXVQ%3D&tabid+96&mid=667

In Azad Kashmir, the three main districts were badly affected and Muazaffarabad, the state capital of Kashmir, was hardest hit in terms of casualties and destruction. Hospitals, schools, and rescue services including police and armed forces were paralysed. There was virtually no infrastructure undamaged and communication was badly affected. More than 70% of all casualties were estimated to have occurred in Muzaffarabad. Bagh, the second most affected district, accounted for 15% of the total casualties. This disaster had important impacts in development planning and responses to disasters in Pakistan.

3.3.1.6 2000 Drought in Balochistan

At least 1.2 million people in Balochistan were affected by drought, and over 100 died, mostly because of dehydration, and millions of animals perished. The drought lasted over 10 months. This drought also affected Cholistan in southern Punjab and Tharparkar district in Sindh province where 143 deaths and 2,200,000 affected people were reported.

3.3.1.7 1974 Hunza Earthquake

A 6.2 Richter scale quake hit Kohistan and surrounding areas including parts of Swat, Hunza and Kashmir in 1974. About 5,300 people were killed, 17,000 injured and 97,000 affected. Landslides and rock falls contributed to the damage.

3.3.1.8 1970 East Pakistan Cyclone

The Bhola tropical cyclone which struck the territory in 1970 was the deadliest tropical cyclone ever recorded and is rated as one of the worst natural disasters in modern times. Up to 500,000 lost their lives, primarily as a result of the storm surge that flooded much of the low-lying islands of the Ganges Delta.

3.3.1.9 1950 Pakistan Floods

Monsoon rain in 1950 killed an estimated 2,900 people across the country. Punjab Province, including the city of Lahore, was among the worst hit when the River Ravi flooded. Over 100,000 homes were destroyed, leaving around 900,000 people homeless.

3.3.1.10 1945 Balochistan Earthquake

A 7.8 Richter scale earthquake hit south-western Balochistan on 28 November 1945. The epicenter was 98 km south-west of the town of Pasni. Apart from massive damage to property, the quake led to a 40-foot tsunami causing the deaths of over 4,000 people.

3.3.1.11 1935 Quetta Earthquake

A 7.7 Richter scale earthquake virtually levelled the city of Quetta in the province of Balochistan. About 60,000 people were killed and an entire city destroyed in one of the deadliest earthquakes to hit South Asia. The epicenter was about 153km from Quetta.

3.3.2 Impacts of Natural Disasters

Pakistan has therefore been on the receiving end of multiple natural disasters over the years and was already a resource-stressed country suffering high temperatures, water shortages and ongoing degradation of agricultural land as well as increases in population. Taking the most frequent types of disasters, the impacts seen can be summarised as:

- Floods: The most frequent hazards are floods. They occur during the monsoon season. From July to September, heavy rain in the plains and catchment areas of the *bet* lands, together with snow melting in the mountains, causes the swelling of the rivers and heavy flooding occurs resulting in great destruction to lives and livelihoods. Punjab and Khyber-Pakhtunkha provinces and various parts of Sindh have been severely damaged by floods. These also disrupt the power supply, as well as socio-economic, physical and lifeline infrastructure.

- Droughts: The main reason for drought is failure of the monsoon, combined in some locations with lack or poor management of irrigation. Drought has brought extensive damage to Baluchistan, Sindh and South Punjab where the average rain fall is low (200-250 mm). Severe drought in 2000-2002 affected livelihoods, resulted in human deaths, pushed tens of thousands of people into migration and killed a large number of cattle.
- Earthquakes: Pakistan lies in a seismic belt and suffers from frequent earthquakes of various magnitudes. The earthquake of 2005 was the biggest disaster in the northern areas of the country.
- Cyclones: These can cause large-scale damage. From 1975 to 2001, 14 cyclones were recorded. The coastal areas of Sindh are most vulnerable. A cyclone in 1965 killed over 1000 people in Sindh. Another cyclone in Sindh killed 258, affected over 666,000 people and destroyed over 75,000 houses.

Table 3.1: Overview of Nine Major Disasters in Pakistan during the Period 1926-2006 (Damages and Losses)

No	Disaster Type	People Homeless	People Killed	People Injured	People affected	Total affected	Total Damage 000$	%	Ranking
1	Wind Storm	22,597	11,654	1,183	1,057,000	1,080,780	4,100	2	6
2	**Earthquake**	**2,853,585**	**142,812**	**88,096**	**1,294,429**	**4,236,110**	**5,019,255**	**8**	**2**
3	**Flood**	**8,927,685**	**11,702**	**1,262**	**38,669,447**	**47,598,394**	**2,746,030**	**86**	**1**
4	Land Slide	3,100	384	114	200	3,414	-	0	7
5	Famine	-	-	-	300,000	300,000	-	1	4
6	Epidemic	-	283	211	16,275	16,486	-	0	5
7	Extreme Temperature	-	1,406	324	250	574	-	0	7
8	Drought	-	223	-	2,269,300	2,269,300	2,47,000	4	3
9	Insect Infestation	-	-	-		-	-	-	8
	Total	11,806,967	168,464	91,190	43,606,901	55,505,058	8,016,385	100	
Flood 2010		**1,744,471**	**1,984**	**2,946**	**20,184,550**	**20,184,550**			

Source: United Nations World Food Programme (WFP, Analysis of Natural Disasters in Pakistan (Presented at NDMA One UN DRM Quarterly Review November 2010)

Based on the information provided from the report detailed above, the frequencies with which disasters struck in Pakistan amounted to a total of 136 times in a period of 80 years. The disasters comprised floods (37%), earthquakes (16%), wind storms (15%), extreme temperatures (11%), landslides (9%), epidemics (7%), and drought (3%). More than one-third of the disasters occurred during the 62 years between 1926 and 1988, whilst two-thirds occurred in the 17 years between 1990 and 2006.

Climate change is an additional stress for the economy and was a key topic discussion by the Ministry of Environment of the Government of Pakistan at the Copenhagen Climate Conference in 2009. According to a recently published index, Pakistan was ranked 12th on the list of countries most vulnerable to the impacts of climate change (IUCN 2009). Coupled with this is the knowledge that the close dependence of the rural poor on natural resources makes them most vulnerable to the impact of climate change.[61]

3.4 Post-disaster Reconstruction

Historically Pakistan's planning approach to tackle these disasters was mostly reactive. The Calamity Act of 1958 governed the organisation of emergency response in Pakistan whilst the Provincial Relief Commissionerate worked at the provincial level, and the Emergency Relief Cell (ERC) organised disaster response by the federal government. Disaster management has subsequently undergone reform, mainly in response to the aftermath of the earthquake in 2005, to address the lack of systematic approach towards disaster risk management in the country. This will be implemented under the National Disaster Management Authority (NDMA) of Pakistan in collaboration with the United Nations Development Programme (UNDP) and coordinated by the Ministry of Housing and Works to achieve its objectives systematically in phases and stages.

3.5 Reducing impacts of Natural Disasters

3.5.1 World Conference on Disaster Reduction (WCDR) and Hyogo Framework for Action (HFA)

Pakistan is a signatory to the HFA and after the earthquake disaster of 2005 in the northern areas of Pakistan a DRR consultant from the United Nations Development Program (UNDP) started working with a number of experts and decision makers from various working groups and organizations to decide how to proceed in terms of HFA (2005) from national to provincial levels in the country. This has been supported by the International Strategy for Disaster Risk Reduction (ISDR) programme, aimed at enabling all communities to become resilient to the effects of national, technological and environmental hazards and reducing the compound risks they pose to socio-economic vulnerabilities in modern societies.

The stakeholders who developed a response at national and provincial levels in Pakistan include the UNDP planning expert (based in Islamabad) representatives of the Ministerial Working Group (MWG) of the Ministry of Housing and Works (MOH &W), the Institute of Planners Pakistan, the Pakistan Engineering Council (PEC), the Pakistan Council of Architects and Town Planners (PCATP), and the National Disaster Management Authority (NDMA) who jointly developed a "Ministerial Strategy on Disaster Risk Reduction in Pakistan".

Table 3.3 below shows how the HFA objectives have been adapted and made relevant to the Ministry of Housing and Works (MOH&W) at various levels in Pakistan.

[61] Oxfam GB (2009) Climate Change, Poverty and Environmental Crisis in the Disaster Prone Areas of Pakistan.

Table 3.2: Deduction of Objectives of Ministry of Housing and Works

Objectives-HFA in Global Context	Adapted Objectives of MOH&W in Pakistan
"a. To conclude and report on the review of the Yokohama Strategy and its Plan of Action with a view to updating the guiding framework on disaster reduction for twenty-first century.	1. To explore Disaster Risk Reduction (DRR) based guidelines based on recommendations from national and international experts for Housing Policy in Pakistan.
b. To identify specific activities aimed at ensuring the implementation of relevant provisions of the Johannesburg Plan of Implementations of the world summit on sustainable development in vulnerability, risk assessment and disaster management.	2. To explore DRR based guidelines based on recommendations from national and international experts for the National Reference Manual of Planning Standards in Pakistan 3. To identify DRR based guidelines for planning, architectural design and other disciplines in the Building Codes of Pakistan (seismic provision)-2007 for safe planning, designing and building constructions in Pakistan.
c. To share good practice, and lessons learned to further disaster reduction within the context of attaining suitable development and to identify gaps and challenges;	4. Making communities disaster resilient through non structural measures and training to cope with hazards and disasters.
d. To increase awareness of the importance of disaster reduction policies, thereby facilitating and promoting the implementation of these policies	5. In order to safeguard our villages, towns, cities & regions, DRR based Guided Development Plans must be prepared through DRR experts for City, Regional Urban/ Rural Planning institutions & development authorities in all provinces of Pakistan.
e. To ensure reliability of appropriate disaster-related information to the public and disaster management agencies in all regions, as set out in relevant provision of the Johannesburg Plan of Implementation".	6. To establish a hierarchy of Disaster Risk Reduction Units to safeguard housing schemes and projects by inspections and examinations under respective teams of DRR Experts.

Source: (i) International Strategy for Disaster Reduction (ISRD) " World Conference on Disaster Reduction" held on 18-22 Jan 2005; Kobe. Hugo Japan, p.3. (ii)Hugo Framework of Action 2005-2015 (Building the resilience of nations and communities to disaster. www.unisdr.org/wcdr

The expected output of the Ministry of Housing and Works in Pakistan is shown in Table 3.3 below.

Table 3.3: Expected Output of Ministry of Housing and Works

Expected Output from-Hyogo Framework Action	Deducted Output online from-Hugo Framework Action in Pakistan
Taking the objectives from HFA into account in the next 10-15 years the following result is expected: "The substantial reduction of disaster losses, in lives and in social, economic and environmental assets of communities and countries"	Taking into account the of the Pakistan Ministry of Housing and Works in 10-15 years the following result is expected: "A considerable reduction of disaster losses, in lives and in social and physical infrastructure will be achieved if guidelines based on DRR strategy are applied in physical and land use planning relevant to respective provincial/regional government, their development authorities and institutions ."

Source: Hyogo Framework for Action (2005-2015), p.3, www.unisdr.org/wcdr

At present the reconstruction efforts and responsibilities are spread across the national, provincial, district, tehsil and UC level, as set out below, and at all levels, coordination will be strengthened through the cluster approach, working through 12 clusters (the cluster approach is a coordinated system for humanitarian assistance through the UN ERC, which is composed of UN agencies and national and international NGOs which coordinate their activities around specific humanitarian service).

3.5.1.1 At National Level: National Disaster Management Authority (NDMA) and Commission (NDMC)

At the federal level, the overall leadership and coordination of the humanitarian response clearly rests with the National Disaster Management Commission (NDMC) under the Chairmanship of the Prime Minister (see the National Disaster Management Ordinance, 2006) acting with the support of the Humanitarian Coordination. The executive arm created was the National Disaster Management Authority (NDMA), intended to coordinate and monitor implementation of national policies and strategies on disaster management that have been identified under the National Disaster Risk Management Framework 2007[62], and to create a National Disaster Response Force. A National Institute of Disaster Management would be created to plan and promote training and research and development of core competencies in disaster management measures. The National and Provincial/Regional Commissions would be the policy making bodies, while the District Management Authorities would be the implementing and coordinating arms. It was also intended that the NDMA will work with ministries on integration of disaster risk reduction into sectoral policy, planning and implementation such as the National Planning Commission and the Ministry of Finance in order to integrate disaster risk reduction into the National Development Plan and the National Poverty Alleviation Strategy. The National Disaster Management Act was adopted in 2010 and reiterates the structure under the 2006 Ordinance.

This system encourages a devolved and de-centralized mechanism for disaster management, i.e. country-wide Provincial Disaster Management Commissions (PDMCs), Authorities (PDMAs) and District Disaster Management Authorities (DDMAs) .

3.5.1.2 Provincial Disaster Management Authority (PDMA) and Commission (PDMC)

At provincial level, PDMAs are “mandated to set up an effective system to look after disasters and calamities whether natural, man-induced or accidents."63. They should coordinate and monitor implementation of the national policy, national plans in the province and prepare provincial disaster management plans, lay down guidelines for creating provincial line departments and be responsible for managing disasters in the province.

The PDMA is headed by a Chairman who is also the Secretary of the Relief and Crises Management Department of the Government of Punjab. The Director General is appointed by the Provincial Government. The Authority is required to serve as secretariat of the Provincial Commission (see below). It will work on development, implementation, monitoring and evaluation of disaster risk management activities in vulnerable areas and sectors in the province. The Provincial Authority is responsible for a variety of functions.

The Provincial Disaster Management Commission (PDMC) is chaired by the Chief Minister; the leader of the opposition and a member to be nominated by him. Other members are appointed by the Chief Minister. They may include stakeholders from provincial departments e.g. Civil, Red Crescent Society, Health, Home, Irrigation, Police, Fire Services, Rescue 1122, university faculty, research institutions, civil society organizations, representatives from commerce, industry and insurance, and other technical experts in the province. The PDMC Chairman is tasked with facilitating links between national objectives and provincial priorities. The Director General of the PDMA will serve as the Member/ Secretary of the PDMC.

3.5.1.3 District Disaster Management Authority (DDMA)

At the District level, the DDMA established by the provincial government in hazard-prone areas on a priority basis comprise the Nazim, District Coordination Officer (DCO), Police Officer ex officio and EDO Health etc. The Local Government can nominate other officers as members of the DDMA. They may include

[62] Copy available from NDMA Pak - http://www.ndma.gov.pk/Docs/NDRMFP.doc

[63] PDMA Official Website: http://www.pdma.gov.pk/About_PDMA.php. Last accessed 29 August 2011.

EDOs for revenue, education and agriculture, Red Crescent, NGOs, media, private sector, fire services or any other local stakeholders.

The DDMA prepares district disaster management plans, coordinates the monitoring of national and provincial disaster management plans in the district, identifies and mitigates disaster risks and lays down guidelines for making disaster management plans in its departments. This includes reviewing and upgrading local early warning systems and capacity building of district staff. The DCOs will be supported to lead and coordinate the overall humanitarian response.

3.5.1.4 Tehsil and Town Authorities

At the Tehsil level, the Tehsil Municipal Authority (TMA) has been made an independent entity and must work in three areas: water supply & sanitation, drainage and provision of fire services. It is independent of the District and receives its budget directly from the province. The Tehsil Nazim has no clear disaster response and management functions, whilst the Tehsil Revenue Department responds to disasters under the district framework.

Institutions at this level are at the frontline of disaster risk management. For many town authority departments this is the lowest level of administration where they interface directly with communities; agriculture, education, health, police, revenue and others. Extension workers of the above departments can play a significant role in promoting risk reduction. For example agriculture extension workers can promote awareness of drought, and flood resistant crops. Health workers can raise people's awareness about potential diseases that may occur after a flood or drought and how to face them. Education workers can work on school disaster preparedness.

Similarly, Tehsil authorities have an important role in organizing emergency response and relief; e.g. damage and loss assessment, and recovery needs assessments. In such cases tehsil and town nazims lead in risk reduction and respond operations with the help of the tehsil or Town Municipal Officer and in consultation with the DDMA. Other key players include extension workers, police, fire services, community organizations (COs), traditional leaders and NGOs.

3.5.1.5 Union Councils Levels

Union councils are the lowest tier in the governance structure and formed by elected representatives from village and block levels. These bodies have an important role in the allocation of resources for local development works. Union councils can play an important role in advocating demands of communities to the District Councils and DM Authorities. Community demands may include requests for allocation of resources from local budgets for hazard mitigation and vulnerability reductions activities; e.g. spurs of flood control, rainwater harvesting structures for drought mitigation, vocational training for livelihoods to reduce vulnerability etc. Therefore it will be important to develop orientation and knowledge of local political leadership at this level. More capable union councils may develop local policies and guidelines for vulnerability reduction.

3.5.1.6 Others

The humanitarian community would work through the PDMAs, most of which have been reinforced through the creation of humanitarian coordination centres and provincial / area hubs (including in Hyderabad, Multan, Peshawar, Quetta and Sukkur) and deployment of more than 50 cluster coordinators. The capacity of existing community organizations is being developed and enhanced by district and tehsil authorities by establishment of new groups to work on disaster risk management. CBOs can be trained in local early warning systems, evacuation, first aid, search and rescue, fire fighting etc. Linkages would be developed between CBOs and relevant local agencies; agriculture, banks, and health and veterinary services to promote disaster preparedness. Skills and knowledge of CBO leadership will also be developed in financial management, people management, resource mobilization, interpersonal communication, presentation and negotiation skills. The provision of Citizen Community Boards (CCBs) in Local Government Ordinance (LGO-2001) provides good opportunities to communities and to mobilize resources for issues like local level disaster risk management.

Additionally, as a cross-sectoral issue there are various other departments that are responsible for various aspects of DRR. These are set out in detail in Appendix A to this report.

3.5.2 Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)

As in many other countries, DRR through safe and sustainable housing in Pakistan is proposed through ministerial strategies, with elements integrated with decentralized planning processes.

Table 3.4: DRR Relevant Policies in Pakistan

Sector	International Convention / Policy /Program/ Document
Disaster management	Hyogo Framework for Action: 2005-15
	National Disaster Management Framework
	Guidelines for the preparation of District Disaster Management Plans
Environment	National Sustainable Development Strategy NSDS 2009
	National Environmental Policy 2005
	National Environment Action Plan 1997
	Convention on Biodiversity 1992 and Biodiversity action Plan fo Pakistan 2000
	Convention on Combating Desertification 1992, National Action Programme to Combat Desertification Pakistan 2002
	United Nations Framework Convention on Climate Change 1992, Pakistan's First National Communication on Climate Change 2003
	National Sanitation Policy 2006
	Draft National Drinking Water Policy
Development	Mid Term Development Framework 2005 – 10
	Millennium Development Goals, and Pakistan's MDG Priorities, National MDG Progress Report 2006
	Poverty Reduction Strategy Paper
	National Housing Policy 2001
	National Women development Policy
	National Policy of Children
	Tenth Five Year Plan, Approach Paper 2009
	National health Policy
	National Education Policy
	Vision (2030) 2007

Source: Rural Development Policy Institution – Islamabad and Plan (2010) Neighbouring Risk: An Alternative Approach to Understanding and Responding to Hazards and Vulnerability in Pakistan.

Pakistan's Government (with technical assistance from the UN) is currently drafting a national climate change strategy with an action plan to mitigate adverse events and to address issues of adaptation and Pakistan-specific scenarios in sectors such as energy, agriculture, water, disaster management, capacity building and public awareness to try and reduce these impacts.

3.6 Reconstruction Guidelines

Under the directives of NDMA and UNDP, the Ministry of Housing and Works has demanded planning guidelines to prepare proper Disaster Risk Reduction Development Plans for the sensitive zones of Pakistan. There exists a general practice of national, provincial, structure, master and local level planning at various levels in the respective departments but they have not been properly integrated with the DRR strategies and managements, particularly for seismic zones. Under the guidelines for "Disaster Risk Reduction Guided Plans" the respective gaps in plans can be classified in a hierarchical manner from national to local level DRR Guided Plans:

- DRR Guided National Development Plan (DRR-GNDP)/National Level
- DRR Guided Regional Development Plan (DRR-GRDP)/Provincial Level
- DRR Guided Structure Development Plan (DRR-GSDP)/District Level
- DRR Guided Master Development Plan (DRR-GMDP)/City or Town Level TDCP has adopted in Muree Master Plan (CMSC-DRR Consultant-2009)
- DRR Guided Local Development Plan (DRR-GLDP)/Qasba or Village Level
- Housing schemes, Outline Development Plans, any other Development Programs plans and projects ongoing under government or NGOs at physical or socio-economic infrastructure level.

These plans will meet the mitigation strategies for different types of infrastructure development projects of the respective indicators. The ministry, with the help of UNDP and NDMA, developed and implemented sector-specific training courses, set the material and organized three-day training workshops (on different topics related to DRR effective planning and strategies) for MWG members and professionals from other institutions and development authorities in November and December 2009.

The intention under Section 8 of the National Disaster Management Framework (2007) was to:

- Develop national building codes for safer construction of houses, buildings and infrastructure in hazard-prone areas for multiple hazards; e.g. earthquakes, floods, landslides, storms/cyclones;
- Develop sample designs for houses, high-rise buildings and infrastructure (bridges, roads) for safer construction in hazard-prone rural and urban areas;
- Promote sample-safer-designs through media and other channels in order to enhance mass level awareness and application;
- Promote compliance and enforcement of local building laws requiring prescribed standards under national building codes in hazard-prone urban areas;
- Conduct training of builders, contractors and masons on safer construction methods;
- Allocate funds to promote safer construction practices;
- Implement pilot programmes on safer construction in hazard-prone areas to enhance awareness;
- Monitor construction of government buildings and infrastructure in hazard prone areas to ensure that safer construction techniques are followed;
- Develop guidelines for conducting of damage and loss assessments within the infrastructure and housing sectors in the wake of a disaster, and conduct assessments after disasters;
- Incorporate disaster risk assessment in the planning process for construction of new roads and bridges;
- Promote use of hazard risk information in land-use planning and zoning programmes;
- Organize emergency repairs for restoration of public transport routes;

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- Base planning upon hazard risk maps available with the NDMA and other technical agencies; e.g. PMD, FFC, WAPDA, SUPARCO and circulate these to all development ministries and departments;
- Develop guidelines on incorporation of disaster risk assessment (and vulnerability analysis) in project identification, design and planning;
- Organize orientations for line ministries about the guidelines on risk assessment;
- Issue policy directive to all line ministries about incorporating disaster risk assessment (and vulnerability analysis) in project design and planning;

- Make mandatory the inclusion of vulnerability reduction measures in implementation of development projects, if located in hazard-prone areas;
- Monitor the progress on implementation of vulnerability reduction measures in all development projects in hazard-prone areas;
- Obtain and maintain data on public sector infrastructure in hazard-prone areas in order to plan vulnerability reduction initiatives and organize reconstruction operations;
- Assist the NDMA in evaluation of losses and damages.

Many of the above have yet to be implemented and therefore what is still lacking includes an overarching manual that will assist reconstruction of the large flood damaged areas of rural Punjab. From 2010 two model projects are being trialled by the MWG to identify improvements that are made with proper planning and implementations under Pak PWD and the results are awaited.

The "Seismic Retrofitting and Repair Manual for Buildings for Earthquake Vulnerability Reduction Project (EVRP)" was developed from grass-roots initiatives in December 2009. This document is a useful joint effort by NDMA and UNDP in Pakistan, but its application was intended for northern buildings and development of solid structures as it relates to the repair and retrofitting of masonry structures and the strengthening of walls and columns of earthquake-damaged parts. Nevertheless, this manual may also be useful in areas affected by floods.

As these processes evolve, gaps currently remain in relation to structural aspects of awareness of DRR strategy for housing challenges by earthquakes, cyclones, floods and other disasters in three major aspects: (i) Location and sitings, (ii) Layout and design of housing, and (iii) construction techniques (Malik, A.N., 2009).

3.7 Implementation of Reconstruction Efforts

In late July 2010 Pakistan experienced flash floods and landslides triggered by a massive and unprecedented amount of rain over the north-west of the country. The flooding caused severe damage to infrastructure in the affected areas; entire villages were washed away, urban centres were flooded, homes destroyed, and thousands of acres of crops and agricultural lands damaged, with major soil erosion impacting some areas. Around one-fifth of the country's landmass was eventually submerged and ultimately more than 20 million people (one-eighth of Pakistan's population) in 78 of 121 districts in Pakistan were affected (see Refugees International (2010) Confronting Climate Displacement: Learning from Pakistan's Floods).

Government and humanitarian community needs assessments have been executed in all affected provinces to identify severely affected families who require life-saving humanitarian assistance. Baseline figures for losses and damages by province are provided below.

Table 3.6: Affected Populations and Damages by Federating Unit[64]

Province	Deaths	Injured	Houses Damaged	Population Affected	Severely Affected Districts	Moderately Affected Districts
Punjab	110	350	500,000	8,200,000	Muzzafargarh, Rajanpur, Mianwali, R.Y. Khan, Layyah, D.G. Khan, Bhakkar	Multan, Sargodha, Khushab, Jhang
Sindh	199	1,072	1,098,720	7,000,000	Kashmore, Shikarpur,	S. Benazirabad,

[64] The term "federating unit" refers to both provinces and regions.

Province	Deaths	Injured	Houses Damaged	Population Affected	Severely Affected Districts	Moderately Affected Districts
					Jacobabad, Larkana, Qambar-Shahdadkot, Thatta, Dadu, Jamshoro	Hyderabad, Matiari, T.M. Khan, Tandu Allah Yar, Sukkur, Khairpur, Naushero Feroze, Ghotki
KPK	1,156	1,198	200,799	3,800,000	Tank, D.I. Khan, Kohistan, Peshawar, Charsada, Nowshera, Lower Dir, Upper Dir, Shangla, Swat	Lakki Marwat, Bannu, Abbottabad, Battagram, Mardan, Chitral, Karak, Kohat, Malakand, Mansehra, Swabi, Buner, Hangu, Haripur
Balochistan	48	102	75,261	1,300,000[65]	Nasirabad, Jaffarabad	Sibi, Kachi, Killa Saifullah, Loralai, Mussakhail, Sherani, Hamai, Jhal Magsi, Kohlu, Barkhan
Other federating units	254	147	9,928	300,000	Neelum	Bagh, Bhimber, Kotli, Mirpur, Muzafarabad, Neelum, Rawlakot, Astor, Diamir, Ghanche, Ghizer, Gilgit, Hunza-Nagar, Skardu
Total	**1,767**	**2,869**	**1,884,708**	**20,600,000**		

Sources: NDMA, PDMA (9 September 2010) & www.pakresponse.info, 7 September 2010)

The Government of Pakistan in partnership with the United Nations launched a flash appeal and a revised flash appeal requesting approximately 1.9 billion USD[66] for immediate relief in 2010 and early recovery through to the end of 2011. This effort is one of the largest humanitarian appeals to date. Various federal, provincial and district level military (60,000 Army, Navy and Air Force) personnel were involved in the relief activities for state and civic structures, and around 16 UN agencies, 500 international and national humanitarian organisations, as well as millions of Pakistani philanthropists, from private enterprise to ordinary citizens, responded to the needs of 20 million flood-affected Pakistanis.

The 2010 flood was the first event where the flooding was mapped through the Collaborative Satellite Assessment (CoSA), to produce the damage assessment procedure using remote sensing to delineate the extent of inundation on a daily basis. This data has been used to create a maximum inundation extent map, which was subsequently used to guide more detailed on-the-ground assessments and to analyze the flood impact on four sectors: housing, agriculture, transportation, and irrigation. The data also helped validate the order of magnitude of the field-collected damage estimates reported by the affected provincial governments.

"for the most part … flood-affected people wanted to go home as soon as possible to salvage what was left of their assets, safeguard their belongings and begin to rebuild their lives. For those without land tenure or documentation of property ownership, the need to secure property was particularly acute since in many instances the flood waters had wiped away land demarcations… Many moved back to flood prone areas because they had no other available alternatives"[67]

[65] This figure is composed of 700,000 affected people affected residing in Balochistan, and 600,000 IDPs from Sindh who have taken refuge in Balochistan as a result of the floods.

[66] Equivalent to 162,848,998,260 PKR

[67] UN OCHA (2010) Pakistan Flood Response Fact sheet, Nov 3. 2010. Available online at: http://pakresponse.info/LinkClick.aspx?fileticket+ekh82IrLXVQ%3D&tabid+96&mid=667

The relief effort has been mixed, with the international community and NDMA generally being unable to keep pace with the rapidly changing nature of the disaster and lacking sufficient staff and resources. Consequently the local district authorities and communities initially had to respond with limited international and national support. This highlights concern raised about the limited focus on implementing DRR in the flood prone areas and use of a top down approach with no local priorities, minimal funds allocated within districts for 'emergencies' or supporting financial plans with lack of training of relevant staff and a template approach giving a 'one size fits all' look at flood fighting plans and disaster management plans. [68] NGO organisations, such as RedR, are calling for the need to develop training of locals in these areas, as the need to build humanitarian skills was seen as an urgent priority.[69]

[68] Rural Development Policy Institution – Islamabad (2010) Neighbouring Risk: An Alternative Approach to Understanding and Responding to Hazards and Vulnerability in Pakistan.

[69] RedR News (26 July 2010) Pakistan floods, one year on: Lack of local humanitarian skills continues to hinder recovery. http://www.redr.org.uk/en/Newsroom/Latest_News.cfm/pakistan-floods-one-year-on-lack-of-local-humanitarian-skills-continues-to-hinder-recovery-redr-t

4. Climate Adaptation and Mitigation

4.1 Climate Compatibility - linking adaptation, mitigation and development

As discussed in the chapters above, effective management of disaster risk is a critical tool in reducing vulnerability to future natural disasters. This can be achieved by 'climate change adaptation', being '*The process or outcome of a process that leads to a reduction in harm or risk of harm, or realisation of benefits, associated with climate variability and climate change'*.[70] However, alongside this is scientific consensus that increases in carbon dioxide emissions into the environment are an anthropogenic cause of climate change and that the economic model of growth that the world has seen in the last fifty years is closely correlated to the rapid increase of carbon dioxide in the atmosphere. This implies that human activity can change the amount of carbon emissions released into the atmosphere and thereby change the impacts on the climate.

Although countries continue to grapple with the process and responsibility for reducing carbon dioxide emissions, it is recognised that development offers an opportunity to both reduce future carbon increases through reductions in embodied carbon in construction and operational carbon during the lifetime of developments through low carbon development. These actions would form part of the tools of climate change mitigation, 'an *anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks*'[71].

Climate change mitigation and adaptation are both aimed at reducing the vulnerability of communities and achieving sustainable development [72] although *"Adaptation is the only response available for the impacts that will occur over the next several decades before mitigation measures can have an effect"*[73] The most important links between disaster risk management and low carbon development are related to three issues:

1. the carbon and greenhouse gas implications of measures to reduce disaster risk;
2. the carbon and greenhouse gas implications of post-disaster and reconstruction in interventions;
3. changing disaster risk for low carbon development options and their limits.[74]

Issues (1) and (2) apply in this instance. Low carbon development is a key goal of the CDKN Asia Strategy and national needs to lower energy demand in Pakistan.

This chapter considers the global knowledge on the twin challenges of mitigation and adaptation in terms of structural actions (i.e. excluding social and economic actions related to land-use planning, early warning

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70 UK Climate Impact Programme (UKCIP) as quoted in GTZ (2003) Guidelines for Building Measures after Disasters and Conflict. Available online at: http://www.gtz.de/de/dokumente/en-gtz-building-guidelines.pdf

71 IPCC (Intergovernmental Panel on Climate Change) (2007) Fourth Assessment Report on Climate Change. Available online at www.ipcc.ch/ ipccreports/assessments-reports.htm

72 Urban, F. Mitchell, T. and Silva Villanueva, P. (2010) Strengthening Climate Resilience Discussion Paper 3 - Risk management: Issues at the interface of disaster risk management
and low carbon development. Available at: http://community.eldis.org/.59e0d267/greening-low-carbon.pdf

73 Stern, D (2006) Stern Review: The Economics of Climate Change. Available online at: http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/stern_review_report.htm

74 Urban, F. Mitchell, T. and Silva Villanueva, P. (2010) . Op. Cit.

systems, insurance policies, legislation and regulatory measures such as zoning and building codes, and education and training activities such as evacuation plans, drills, and preparedness curricula) for climate compatible and disaster resilient development. The climate / disasters will be centred on flooding (river breach / flood protection failure / excess rainfall) and higher temperatures (extreme heat / reduced precipitation) – the key climate risks identified for the Punjab region.

This is achieved by setting out a selection of adaptive measures for climate compatible and disaster resilient construction (i.e. location and design through spatial / site planning, construction techniques, and materials and resources) appropriate for rural village layouts and buildings (such as schools, housing and health centres) based on global knowledge and best practice and interlinking these with principles of low carbon development (related to energy and resource efficient development techniques). This information is to inform the technical assessment report and guidelines on disaster resilient and low carbon construction in the disaster zones in Punjab.

4.1.1 Climate Compatible and Disaster Resilient Construction (adaptation)

The decision whether or not to apply adaptation measures for potential climatic risks is complex and planners must decide how much risk they are willing to take. As set out in international guidance on reconstruction in the Caribbean[75], ideally vulnerability to natural hazards should be considered before construction begins with planners and designers asking the following questions to determine whether adaptation is cost-effective:

- What is the anticipated lifetime of the structure being built?
- What are the intended uses of the building? Will it be used as a shelter?
- What hazards are the buildings exposed to?
- How often is each type of hazard expected to occur within the lifetime of the structure?

4.1.2 Low Carbon Development (mitigation)

IPCC's projections show that whatever mitigating action is taken now, the rise in global temperature and its associated climatic effects are going to continue to take place due to historical carbon emissions. Therefore, at least in the short and medium term, tackling climate change requires both adaptation to climate change and mitigation of greenhouse gas emissions. Climate change mitigation, has recently moved towards 'Low Carbon Development' defined by the UK Department for International Development (DFID)[76] as

1. using less energy and improving energy sources (i.e. cleaner energy);
2. protecting and promoting carbon sinks (i.e. anything that absorbs more carbon than it releases);
3. promoting low or zero carbon technologies and business models; and
4. introducing policies which discourage carbon intensive practices seeks to mitigate the impacts of climate change and promote resilience.

The overall objective is to reduce the amount of carbon dioxide (CO_2) being emitted into the earth's atmosphere.

75 USAID and others for Caribbean Disaster Mitigation Project available online at: http://www.oas.org/CDMP/schools/schlrcsc.htm

76 DFID (Department for International Development) (2009) Eliminating World Poverty: Building our Common Future, DFID White Paper, London: DFID

There are also thoughts that a low carbon development process may in fact contribute to poverty alleviation and economic development in developing countries on the grounds that supporting more efficient energy use, sustaining natural resources and enhancing local income opportunities, options may exist for low carbon development to actually contribute to local livelihoods and national economies[77].

Post-disaster and reconstruction development offers an opportunity to incorporate low carbon technologies, especially in relation to household energy supply and use. Energy is a basic human need for cooking, heating, lighting, boiling water and for other household activities, and is closely intertwined with climate change and development.[78] The use of traditional biofuels such as wood and dungcakes for food cooking is both low thermal efficiency and produces very high concentration of air pollutants that cause respiratory and eye infections.[79] Renewable energy technology such as solar panels, lamps and cookers, small wind turbines, small hydropower and biogas cookers, can be used for lighting, cooking, heating and other household activities and can reduce GHG emissions, reduce dependence on energy imports and increase energy security.[80] Solar power could be important for attaining energy independence as well as a greenhouse gas-free energy system.

Carbon can be a part of the 'whole life' of a product (construction, operation and end of life) seeking to optimise the design and product mix to see the impact on buildings over their appropriate lifespan, rather than optimise every individual product (i.e. lowering the carbon released during the manufacture of the product or extraction of the material (the 'embodied' impact) and the products or materials used during the occupation of the building that cause carbon to be emitted (the 'operational' impact).

Standards, assessment systems and tools for calculating carbon continue to be developed for assessing the carbon impacts of construction. As yet there is no one universally agreed method for considering the low carbon impacts of buildings / development, although many countries are developing their own low carbon initiatives, standards and codes.[81] Their complexity goes beyond the scope of this report.

At the European level a framework standard for assessment methodologies is being developed by CEN/TC350, whilst most European Countries are moving forward with their own methodologies and commitments. Taking the UK as an example, they have made a legal obligation under the Climate Change Act 2008 to reduce emissions by 26% by 2020 (by comparison with a 1990 baseline) and by no less than 80% to 2050. To support this planning documents, such as Planning Policy Statement (PPS) have been altered to include 'Delivering Sustainable Development'(1) Development and Flood Risk (25) supported by

77 Danish Institute for International Studies (DISS) 'Facing the challenge: Low Carbon Development and Poverty Alleviation': Findings from a DIIS conference on the options for addressing both poverty and climate change. Available online at: http://www.diis.dk/sw71480.asp

78 Urban, F. Mitchell, T. and Silva Villanueva, P. (2010) Strengthening Climate Resilience Discussion Paper 3 - Risk management: Issues at the interface of disaster risk management and low carbon development. Available at: http://community.eldis.org/.59e0d267/greening-low-carbon.pdf

79 See World Health Organisation (2006) Indoor Air Pollution. Fuel for Life: Household Energy and Health, www.who.int/indoorair/publications/fuelforlife/en/index.html.

80 Urban, F. Mitchell, T. and Silva Villanueva, P. (2010) Strengthening Climate Resilience Discussion Paper 3 - Risk management: Issues at the interface of disaster risk management and low carbon development. Available at: http://community.eldis.org/.59e0d267/greening-low-carbon.pdf

81 See International Survey on Building Energy Codes (2000) by the Commonwealth of Australia: http://www.climatechange.gov.au/en/what-you-need-to-know/buildings/publications/~/media/publications/energy-efficiency/buildings/international-survey-building-energy-codes-pdf.pdf and current Australian Government Initiatives: http://www.climatechange.gov.au/what-you-need-to-know/buildings.aspx).

Building Regulations (Part L 2010) and initiatives such as the 'Zero Carbon Hub'[82] providing information on examples for buildings and energy in the UK and examples from developed countries worldwide.[83]

Pakistan is making moves towards low carbon considerations, although progress is somewhat slower. An assessment of the gaps, challenges and barriers to energy efficiency in institutional arrangements in Pakistan was recently funded by the United Nations ESCAP and the South Asian Association for Regional Cooperation (SAARC) in 2010.[84] The focus of the assessment was more centred on industry, but included strategies related to buildings such as demonstrating country-wide projects/activities for energy conservation, solar thermal technologies, wind mill/generator manufacturing, promotion of micro-Hydro power stations, solar lighting in a village and introduction of solar pumps. Following on from studies such as these a meeting to consider the ways and means for the adoption and implementation was held at PEC Headquarter, (9th February, 2010,).[85] During the meeting the PEC was informed that much as 30% of the total energy consumption in Pakistan goes to the building sector out of which over 50% can be saved through comprehensive measures. Those attending agreed that all future building designs should be based on energy efficient building code and that retrofitting of existing buildings will also significantly conserve energy through effective construction material and equipment.

Subsequently, the Pakistan Engineering Council (PEC) and National Energy Conservation Centre have prepared in the last year a draft Building Code of Pakistan (Energy Provisions) 2011 to apply to buildings and building clusters that have: a total connected load of 100 kW or greater, or a contract demand of 125 kVA, or a conditioned area of 900 m^2 or unconditioned buildings of covered area of 1200 m^2 or more. 86 The draft form provides energy codes on building envelopes, building mechanical systems and equipment, including heating, ventilation, and air conditioning (HVAC), service water heating, lighting, and electrical power and motors. This Code has yet to be adopted and is not specifically focused on 'Low Carbon Development'.

4.1.2.1 Principles

The design objective of 'Low Carbon Construction' is to reduce embodied carbon and operational energy and to promote renewable energy efficiency through passive design techniques (i.e. does not require mechanical heating, cooling or lighting) and the use of materials that are responsibly resourced, local and can be renewed. For instance, 'the cradle to grave approach' encourages use of materials that can be easily reused and recycled during their lifespan to reduce waste. So, design solutions for low carbon construction are dictated by location as they promote the use of local materials, local labour to reduce embodied carbon and environmental impact. Developing these principles further leads to buildings that are efficient in material use, flexible, reusable, recyclable and adaptable to climate change.

82 Zero Carbon Hub Official Website: http://www.zerocarbonhub.org/

83 See the guidance from the Royal Institute of British Architects ( ) Low Carbon Standards and Assessments. Available online at:http://www.architecture.com/Files/RIBAHoldings/PolicyAndInternationalRelations/Policy/Environment/LowCarbonStandardsSummary.pdf

84 Masood, A. (2010) GAP ANALYSIS on Energy Effi ciency institutional arrangements in Pakistan : promoting energy effi ciency towards a low carbon development path. Available online at: http://eeasia.unescap.org/PDFs/Gap-Analysis-Pakistan.pdf

85 See PEC Official Website :http://www.pec.org.pk/_SeminarIST.aspx

86 Draft Copy available online at: http://www.enercon.gov.pk/images/pdf/draft-_building_code_of_pakistan_energy_provisions_2011.pdf

The intention here is to recommend practical, relatively low cost low carbon technologies that can be utilised in rural villages in a developing country, as opposed to the breadth of options for development in an urban / industrial environment. The various design techniques that can be utilised are:

4.1.2.2 Passive Design techniques

Passive techniques are about designing to the local climate (orientation, solar, wind, geology, topography, water) to inform how to heat, cool and ventilate a building. Established Passive Design techniques include solar gain management through the control of the areas of glazing on facades, sunspaces, solar shading. Ventilation management through aligning windows to create cross-flow or using a difference in opening height to encourage the stack effect (which increases ventilation) and thermal management through insulating, conductive and irradiative materials or thermal mass construction.[87] When these principles are combined technologies such as Trombe walls, solar chimneys and intelligent facades can be implemented and lead to a reduction in operational energy.

4.1.2.3 Locally Sourced Materials

To reduce embodied energy primarily local materials should be used. Waste products can be used in wall construction to avoid manufactured products. For example, 7 million tonnes of straw is generated a year and burnt; it is a good insulator and, in block form, is easy to stack. These low embodied energy materials such as straw bales, rammed earth with high density for instance would assist in lowering carbon alongside passive design techniques.

4.1.2.4 Soft Engineering and Ecological Measures

‘Soft’ engineering or ‘ecological’ measures require some form of ongoing management. An organisation that promotes the use of ecological measures for assisting in absorbing and storing greenhouse gases is ProAct. They recognise that by focusing on using knowledge of ecosystems and their functions in promoting environmental security as natural dynamic barriers against hazard impacts, allows livelihood support or enhancement through sustaining ecological production at relatively low cost. This approach encourages using natural attenuation features of wetland ecosystems such as floodplains, salt marshes, mudflats, reefs and wooded riparian zones in upstream reaches or restoration of flood plains for flood management, and vegetation growth for shade and carbon absorption. *Natural protection structures are dynamic and as long as they are in a healthy and intact state they should be able to adapt to changing conditions such as … local climatic changes*”[88]. These methods can therefore be more responsive than ‘hard’ engineering however they are likely to require knowledge sharing on their purpose and management.

4.1.2.5 Hard Engineering

These are about using low carbon technological solutions such as technology to harness renewable energy (being energy flows that occur naturally and repeatedly in the environment (from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass)) where other than initial plant, installation and maintenance costs, renewable energy should be close to zero carbon. These can be

87 See UN-HABITAT et al. (2010) Energy Efficient Housing: Improvement of Thermal Performance of RC Slab Roofs. Available online at: http://www.unhabitat.org.pk/Publication.html

88 ProAct (2008) The role of environmental management and eco-engineering in disaster risk reduction and climate change adaptation. Available online at: http://proactnetwork.org/proactwebsite/media/download/CCA_DRR_reports/em_ecoeng_in_drr_cca.pdf

coupled with low energy technology, such as energy saving fluorescents or LEDs or fans to allow hard engineering solutions to allow increased energy use without the operational carbon impacts. If renewable technology is not economically viable at the initial construction stage, buildings can be designed to allow adoption of technologies in the future, i.e. roofs pitched between 15° and 40° and facing south provide an ideal location for solar panels.

A general overview on potential energy saving technologies using hard engineering are set out in the table below, (quoted from guidance produced by Leeds City Council (2010), UK):

Table 4.1: Low Carbon Technologies

Technology	Description
Wind Turbines	These harnesses energy from the wind to produce electricity. The most common design is of three blades mounted on a horizontal axis, which is free to rotate into the wind on a tall tower or mast. The blades drive a generator either directly or via a gearbox (generally for larger machines) to produce electricity for consumption on site or sale to the grid. Wind turbines can be mounted on masts that are free-standing or tethered with wire guys. Wind turbines should ideally be mounted nine metres above any obstruction within 100 metres. The greatest amount of power will be generated if turbines have a constant supply of steady wind, which is dependent on the site having a good wind profile (average wind speed of 5-6 m/s or higher) and being free of obstructions such as trees or buildings
Solar photovoltaic (PV) systems (energy)	These systems use energy from the sun to convert solar radiation into electricity, which can be used directly to run appliances and lighting or [for more complex energy supply systems] sold to the national grid. PV systems perform best in direct sunlight, but continue to perform well in reduced light conditions. Systems come in various forms including solar tiles, roof-integrated panels and on-roof panels. PV systems are also available for cladding buildings and covering walkways. Their main benefits are their flexibility, suitability to many situations, ease of installation, low maintenance and production of electricity in the day when it is most needed. Their main drawback is that they are expensive with long-payback periods. Example: Solar Panels
Solar Panels (thermal)	These can be fitted onto or integrated into a building's roof and use the sun's energy to heat a heat transfer fluid which passes through the panel, the fluid is then fed to a heat store (e.g. a hot water tank) to provide part of the domestic hot water demand for the building. Their main benefits are their relatively low capital costs and ease of maintenance, however, their heat production does not always match demand profiles (unless excess heat can be 'dumped' to a suitable use) and the value of energy generated is currently relatively low. Solar hot water panels will work most successfully on a roof inclined at an angle of 20°-40° depending on the latitude of the building, and orientated to face due south.

Source: Leeds City Council (2010) Guidance on Sustainable Buildings. Available online at http://www.leeds.gov.uk/files/Internet2007/2011/32/9.%20energy%20and%20co2%20emissions.pdf

These solutions are likely to require technical skills and understanding both for multiple stakeholders, i.e. installer, user, and those charged with maintaining these technologies. So their installation and use is likely to require supporting information and skills training to make these effective in the long-term. Technology is developing rapidly and small scale PV systems coupled with low-energy lighting and appliances are increasingly affordable and used throughout the developing world as well as in industrialised countries.

4.1.2.6 Role of Culture

Culture links to behaviour, and this is inextricably linked to the efficacy of any physical measures taken to improve energy efficiency.[89] Studies have shown that buildings often do not meet their design criteria (in terms of energy efficiency) when tested after completion. This could be due to original design, or construction, or how building is used. Priority should be given to understanding how buildings perform in practice by monitoring and evaluation of at the commissioning of buildings; post occupancy and thereafter

89 The Final Report on 'Low Carbon Construction: Innovation & Growth Team' of HM Government (UK) (Autumn 2010) Available online at: http://www.bis.gov.uk/assets/biscore/business-sectors/docs/l/10-1266-low-carbon-construction-igt-final-report.pdf

as part of a continuous process of measurement, and feedback and of acting on the indications of the data gathered.

4.2 Climatic risks in Punjab, Pakistan

In order to advise on potential structural measures during design, the risks to be 'adapted' against need to be identified. Based on the hazard mapping that has taken place alongside this global review (see separate Hazard Maps and Hazard Map Report) the key climatic risks (both historical and projected) are:

4.2.1 Flooding

Flooding can occur from a number of sources and could be routine, seasonal occurrence, or an exceptional one. The cause of flooding varies enormously according to location, for example in parts of the UK flood risk is high in regions close to the coast or underlain by permeable rocks (aquifers) such as chalk and sandstone.[90] The situation in Punjab is quite different from the UK, but the main causes are still related to excess river flow or extreme rainfall:

- River – floods occur if the amount of water in the river exceeds the flow capacity of the river channel. If the natural channel is confined by flood banks then failure of these banks can cause serious flooding over large areas. This is particularly the case where long term confinement of the river channels has resulted in situation and hence the river being above the natural ground. Whether the flood develops gradually or rapidly depends on catchment characteristics (slope, size and land use). Operation of hydraulic structures can also have an important impact.
- Land – local flooding can occur following intense rainfall when the water is unable to soak into the ground or enter drainage systems quickly off the land leading to surface water flooding (such as exceeding the absorptive capacity of soils and aquifers in a catchment and the surplus runoff then also exceeding the storage capacity of downstream rivers and systems). This flood water can be polluted with domestic sewage where foul sewers surcharge and overflow when occurring in developed areas. In large, relatively flat catchment, flood levels can rise slowly and natural floodplains may remain flooded for several days, acting as the natural regulator of the flow. In small, steep catchments, local intense rainfall can result in the rapid onset of deep and fast-flowing flooding with little warning ('flash flooding').
- Non-natural or artificial (i.e. reservoirs, canals, and lakes) - where water is retained or stored above natural ground level – this applies equally to the situation in Pakistan where flood banks along the main rivers result in water being retained above natural levels. Flooding due to reservoirs or canals may occur as a result of the facility being overwhelmed or as a result of dam or bank failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage.

The extent of damage to people, buildings, infrastructure and the environment depends on the direction, depth, duration and speed of flood waters.

4.2.2 High Temperatures

In a study for the UK by the Chartered Institution of Building Services Engineers (CIBSE) and Arup[91], two thresholds were used to define temperature related human discomfort in buildings – 'warm' (25°C) and 'hot'

90 Local Communities and Government (UK) (2006) Planning Policy Statement (PPS) 25: Development and Flood Risk

91 CIBSE (2005) Climate Change and the Indoor Environment: Impacts and Adaptation.

(28°C). The 'warm' temperature was used for bedrooms as people tend to be less tolerant of higher temperatures when trying to sleep. Otherwise 'hot' was used. Overheating was said to have occurred in a building if temperatures exceeded the relevant threshold for more than 1% of occupied hours. This study used 35°C as a temperature above which there is a significant danger of heat stress. Dealing with higher indoor temperatures will be particularly important for houses, schools and health centres. Failure to deal with higher temperatures could lead to increased heat stress, possibly leading to increased mortality rates, especially amongst more vulnerable members of society, such as children and old people.[92]

Although this was a UK study, the threshold of 35°C for the risk of heat stress is appropriate globally and is thus an important consideration in Pakistan.

4.3 Design options for Disaster Risk Reduction

These key climate risks in the Punjab Region will form the focus of the adaptive and mitigation (through passive / soft or hard engineering for low carbon) design options identified for rural development are identified in terms of:

- Location
- Site layout
- Buildings (public and private)
- Infrastructure (inc measures for water supply and sanitation, ventilation and cooling, and drainage, access / transport, solid waste which are often affected at both a community and individual property basis)

4.3.1 Flooding

4.3.1.1 Approaches to managing risk of flooding

Recognised strategies for dealing with development in flood risk areas in the UK are:

***"Avoidance** – the simplest and most pragmatic approach to avoiding flood risk is not to build in flood risk areas. An additional factor of safety can be incorporated by design responses such as raising the floor level of a building to prevent water ingress under extreme circumstances. This is the fundamental strategy that underpins current official guidance for new development.*

***Resistance** – in areas where flood water is likely to reach a building – for example, areas that have low flood risk today but might become more susceptible to flood risk in the future – it may be possible to 'dry-proof' buildings to prevent water entering. This can be achieved by incorporating permanent or temporary barriers such as door dams and non-return drainage valves and is only effective for floods of short duration and heights up to around 1m. Above this level, water pressure is likely to cause structural damage and the majority of apparently solid wall constructions will leak. Success here also depends on completeness in the defence; a missing air brick cover will render the entire defensive system useless.*

***Resilience** – there may be situations where there is an unavoidable risk of flooding that cannot be dealt with by site or wider area controls. Under these circumstances there is much that can be done to minimise*

92 Higher temperatures can also lead to an increased risk of drought, which can generate serious stresses particularly in the poor rural areas, by creating food shortages, mal-nutrition and ill health and which often lead to death. Adaptation methods associated with these aspects are beyond the scope of this report.

the damage and simplify reinstatement once the floods have subsided. This is a technique sometimes referred to as 'wet proofing'."[93]

The UK risk-based approach to flood management considers the source (rainfall, fluvial flood, tidal flood) – pathway (channels, flood plains and defences and urban surfaces) - receptor (people, houses, infrastructure, environment) model which takes account of its susceptibility to flooding, the performance and processes of river/coastal systems and appropriate flood defence infrastructure, and of the likely routes and storage of floodwater (i.e. development changes the way in which an area is affected by flooding through the placement of buildings, changes in permeability of surfaces and the topography of earthworks), and its influence on flood risk downstream. Guidance on the depths and velocities of floodwater that cause risks to people is set out in Figure 4.1 below.

Figure 4.1: Combinations of flood depth and velocity that cause danger to people

d * (v+0.5) + DF

Velocity \ Depth	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
0.00	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.50	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.00	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.50	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.00	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.50	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.00	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.00	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.50	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.00	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

Categories of flood hazard:

	From	To	
Class 1	0.75	1.50	Danger for some
Class 2	1.50	2.50	Danger for most
Class 3	2.50	20.00	Danger for all

Note: The table gives values of flood hazard (= d·(v+0.5) +DF)

Source: DEFRA and Environment Agency (UK) (2006) Flood Risk to People, Phase 2. FD2321/TR2 Guidance Document. Key: D= Depth, V = Velocity, DF = Debris Floating

These categories are UK Centric and based on people fully exposed to a flood but the principles of hazard management are generally applicable. The danger level depends on multiple factors related to the particular persons' characteristics, location (i.e. if they are wading which can be affected by factors such as evenness of the ground surface or presence of depressions, potholes, excavations, ditches, or major storm water drains) and their actions (such as evacuation or trying to protect other people or property). This chart also shows that debris carried by a flood (such as trees or parts of buildings) can cause unforeseen damage.

93 Technology Strategy Board (2010) Designing for Future Climate Report. UK. Available online at: http://www.innovateuk.org/ourstrategy/innovationplatforms/lowimpactbuilding/design-for-future-climate-report-.ashx

Buildings are a potential place of refuge in a flood and the partial or complete failure of the buildings in which people are using as safe refuge is consequently a significant factor in the number of deaths resulting from flooding. Therefore correct adaptation of buildings at risk of flood can be of assist in disaster resilience of people during the flood and can limit the actions required for recovery.

Numerous practical steps that can be taken to respond to these challenges during developments, a selection of which is identified in table 4.2 below based on this global knowledge review.

Table 4.2: Selection of design and low carbon solutions for flooding

Design Aspect	Typical Issues	Solution	Source
Location	**Development in inappropriate areas** Cause: Certain areas will be more prone to flooding due to their characteristics, such as being a flood plain, an area of low ground or located near to a source of water that are liable to cause flooding such as rivers. This results in some areas being much more likely to suffer from flooding	Reduce exposure. Consider site location and layout at the outset. Avoid flood plains or areas prone to flooding by building elsewhere or on higher ground. If alternate location or higher ground is not available, then construct on artificially raised ground or build on stilts or construct some double storey buildings that are flood resilient that can be used by the communities as shelter during flooding (together with adequate warning systems)	Technology Strategy Board (2010) Designing for Future Climate Report. UK. Local Communities and Government (UK) (2006) Planning Policy Statement (PPS) 25: Development and Flood Risk
	Breach of Embankments Cause: Floods can either breach embankments (bunds) due to their height, or the fast moving water can erode both the bund walls and foundations. This breach of embankments can result in damage of the bunds, nearby roads and villages	Ensure good management and maintenance arrangements for flood banks. Verify height of banks for future climate projections. Ensure operation rules for barrages and other hydraulic structures do not result in short term releases which exceed channel capacity.	UN-HABITAT et al. (2011) Guidelines for flood resistant house. Global Facility for Disaster Reduction and Recovery (2009) Guidance Notes on Safer School Construction.
Site Layout	**Water Pressure** Cause: failure to allow for flood waters to navigate easily through village by creation of 'pinch-points' where flood waters are channelled into make key stress areas. This results in greater stresses being directed at some buildings / infrastructure increasing likelihood of damage or collapse	Make space for water by using green infrastructure for storage, conveyance and SUDS to re-create flood plains. Manage flood pathways and remove 'pinch points' so heavy rainfall can drain away. Create floodwalls or drainage systems to reduce potential damage and loss to divert flood waters.	UKCIP Briefing Report Climate (J N Hacker, S E Belcher and R K Connell) (2005) Beating the Heat: Keeping UK Buildings Cool in a Warming
Building design (public and private)	**Settlement in Foundation** Cause: Foundation is not able to support the wall load because of reduction in load bearing capacity of foundation soil due to rise in water table. This results in severe cracking in walls and in some cases, part of the building settles down.(scouring)	Deepen foundations depending on materials being used. Raise buildings so rises in ground water table no longer impact the foundations.	DFID et al. (2002) Manual on hazard resistant construction in India for reducing vulnerability of buildings without engineers. UN-HABITAT et al. (2011) Guidelines for flood resistant house. GTZ (2003) Guidelines for Building Measures after Disasters and Conflict
	Severe Cracking / Collapse of Wall (structural Damage) Cause: Prolong the wetting of wall and mortar. This reduces the bearing capacity of materials such as mud mortar and clay wall, and so walls are not able to support their roof. This results in severe	Use flood resilient materials or use mixture of materials in building construction, i.e. supporting structure made from material less susceptible to flood damage (such as brick masonry up to 2-3 feet before mud walls or mix lime mortar as pointing of brick masonry) Raise floors and increase the height of foundations so they are higher than the	

Design Aspect	Typical Issues	Solution	Source
	cracking and even collapse.	outdoor area in order to prevent water from entering the building..	
	Rain Damage Cause: Sustained rain for many hours causes erosion of mortar, or foundations. This can occur when wind driven rain penetrates the overlap between the pitch of the roof and the overlap of different coverings: tile, slate, metal sheet, etc. This results in cracking or even collapse of walls.	Extending the roof overhang at the eaves to protect the supporting wall from the combined effects of wind and rain. Facilitate flow of water off the roof by raising a particular point of the roof with all sides diagonal from the edges Use of guttering to remove excess water into pre-constructed soak-aways. For a flat roof system, incorporate a slope toward drains that deposit water away from walls and occupied areas. These measures could be linked to water harvesting process.	
	Scouring of Wall Base Cause: Fast moving water erodes the foundation of the wall or erodes the wall mortar. This weakens the structure resulting into large holes or cracks or collapse of walls.	Place half of a long metal strip under the soil in edges for easy flow of water from the roof and flood waters along base of buildings. Hammer the roof and area along the walls to prevent water penetration and secure the foundation of the house.	
Services and related issues	**Contamination of drinking water supplies** Cause: Hand pumps positioned beneath flood levels become submerged. This results in affected communities drinking unclean water and after the flood low-lying hand pumps often blocked with sediment and require clearing which further prolongs the problem.	Construct hand pumps and other means of accessing clean water must above flood levels on platforms or high ground. Install rainwater harvesting and storage from roofs or other surfaces for future use (i.e. toilet or irrigation) Use SUDS to collect and store water. Install storm overflood management to prevent surface water contamination	Shaw, R., Colley, M., and Connell, R. (2007) Climate change adaptation by design: a guide for sustainable communities
	Incapacity of drainage facilities Cause: failure to allow for flood waters to drain away from buildings, failure to provide adequate drainage channels that can cope with surface flooding and waste water drains that can be blocked by silt or waste due to lack of maintenance. This results in larger volumes of un-drained water increasing likelihood of water damage to buildings/infrastructure and potential health issues associated with rising sewerage	Adapt roof and local drainage systems to cope with excess rainfall and flooding by: Use of a sustainable drainage system (SUDS). Widen drains to increase capacity. Install one-way valves into drainage pipes to prevent sewage backing up.	Technology Strategy Board (2010) Designing for Future Climate Report. UK
	Solid Waste Disposal There are two causes: **direct dumping** of solid waste into watercourses, drains, culverts, and other drainage structures thus blocking them. During excess rainfall and flooding this results in drainage structures unable to carry the water due to constricted flow and reduced capacity, and therefore overflow thus causing floods. **Indirect dumping** is when solid waste is piled near streams or canals perhaps to form a barrier to artificial water supplies. This	Solid Waste Collection and Disposal: Put measures in place for solid waste collection and disposal to reduce change of solid waste in drains ensuring the hydraulic performance of the drains and increase carrying capacities. Improved and Coordinated Maintenance of Drains and Drainage Structures: the institutional responsibilities need to be clearly defined and the appropriate structures put in place. Consider implementing an integrated waste management system Consider location of solid waste sites in terms of usability and ease of collection	Dr. Peter A. Sam Jr (2002) Are the Municipal Solid Waste Management Practices Causing Flooding During the Rainy Season in Accra, Ghana, West Africa. Oxfam (2008) Domestic and Refugee Camp Waste Management Collection & Disposal

Design Aspect	Typical Issues	Solution	Source
	results in storm water runoff carrying refuse and other solid wastes into the streams reducing their capacity and posing serious health and environmental hazards to residents downstream. **Health issues** :include giving mosquitoes breeding grounds in blocked drains and discarded cans, tyres and other items, increasing risk of malaria, dengue, lymphatic filariasis and yellow-fever amongst others; and Leachate (polluted water) from rain washing through dumped waste can pollute water supplies;.	Consider the removal / destruction of solid waste in terms of health risks and environmental risks and put in an appropriate communal waste disposal and collection points where recycling and reuse options are not applicable. If solid waste will not be removed from sites can use pits >10m from dwellings and >15m from water sources. Approximately 1.5m above water table using a shallow pit approximately 1 to 1.5m deep, with soil to be left to one side to allow for daily covering of waste to reduce smells, flies, rodents, etc and a small fence constructed around the pit to avoid accidents and scavenging. Burning could be used but this brings additional issues associated with smoke at CO2 emissions.	
	Damage or destruction of Access roads Cause: As with buildings, fast moving water can erode the foundations of roads. The result is a weakening of structure resulting in large holes or cracks or collapse of road sections. In extreme flooding roads can be completed broken up by flood waters.		

Source: Mott MacDonald, 2012

Flood risk assessments should be undertaken to demonstrate whether development in a particular area is appropriate and that flood risk can be maintained below an acceptable level for the lifetime of the development whilst ensuring that flood resilient design and construction techniques are adopted, bearing in mind the vulnerabilities of the area, people and flood risk.[94]

4.3.1.2 Case Studies:

Case Studies have shown that various indigenous practices around the globe can assist with flood resilience, so local knowledge and practices on tools and techniques for climatic factors should be undertaken and incorporated where relevant and practicable.[95]

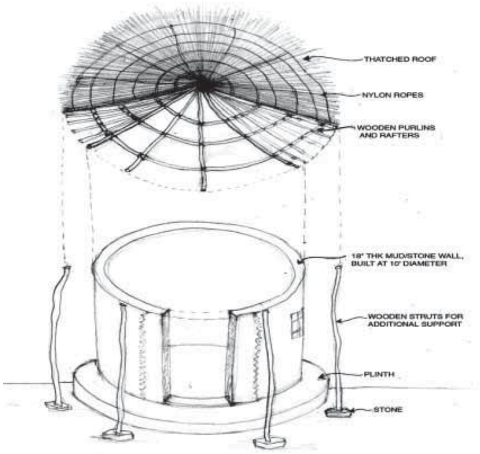
- Indigenous Knowledge and Modern Science give Environment Friendly Shelter Solution in Flood Affected Desert Region of India

The district of Banmer is the westernmost district of the state of Rajasthan, India, located along the border with Pakistan in the Thar Desert region. Floods in 2005 were caused by excessive rainfall (577 mm of rainfall in three days, 300 mm more than the annual average). Official reports recorded 103 deaths and approximately 95 percent of the families in the affected village (over 50,000 people) made homeless.

94 DEFRA and Environment Agency (UK) (2006) Flood Risk to People Phase 2, FD2321/TR2 Guidance Document.

95 ISDR (2008) Indigenous Knowledge for Disaster Risk Reduction: Good Practices and Lessons Learned from Experiences in the Asia-Pacific Region. Available online at: http://sheltercentre.org/sites/default/files/ISDR_IndigenousKnowledge.pdf

Figure 4.2: Diagram of the *dhani*



Source: ISDR (2008) Indigenous Knowledge for Disaster Risk Reduction: Good Practices and Lessons Learned from Experiences in the Asia-Pacific Region. Available online at: http://sheltercentre.org/sites/default/files/ISDR_IndigenousKnowledge.pdf

The local buildings, known as '*dhani*', were constructed out of walls made from a mixture of cow dung and local mud, the roofs or tying and weaving of dried stalks. The dhani were traditionally oriented in a manner appropriate for risks related to sandstorms and high temperatures, so that the wind direction and sun path ensure good ventilation and thermal comfort, whilst window and door openings remained small to reduce heat gain and give less exposure to sand storms. The mud material made them vulnerable to destruction during flooding as they did not have a high water resistant capacity. During reconstruction, water resistance was added by using five percent cement, and compressed into blocks that have high structural strength and water resistant capability.

- Soil and Water Conservation through Bamboo Plantation: A Disaster Management Technique Adopted by the People of Nandeswar, Assam, India

The people of Nadeswar village have developed a pro-active method for reducing the risks of flooding during monsoon season from December to February through planting of bamboo as it protects the bunds from being breached and prevents rapid run off from the river channel when the river overflows during heavy rainy days. Firstly they clear local river channels from silt and sand (silt and sand is used to build bunds along the river and channel). The bund surface has grass planted to pad the bund surface and keep the soil from being eroded as grass roots stabilise top soil. After a month, bamboo shots are planted in pits that are spaced 24 inches over the bunds. The deep-seated roots of bamboo exert pressure in all directions of the main shoot, which allows newer shoots to grow and the roots to bind the soil. Planting of bamboo planting along fish ponds and paddy fields has also been used to prevent soil erosion and stop water from submerging low areas during peak flooding days.

- Traditional Flood Disaster Reduction Measures, Japan

To reduce the impacts of flood, traditional ring dykes have been built (circular dykes surrounding villages) to protect houses and cultivated land areas. The respective village usually maintains special committees that look after the ring dyke, which has been thought to develop self-esteem and strengthen local community ties. To reduce damages from floods, elevated houses called Mizuya have been built with a plinth initially of 2m which has been increased by an additional 1.4m following larger floods experienced by communities.

4.4 Higher Temperatures

Practical strategies for dealing with development in areas subject to high temperatures are set out in the table below.

Figure 4.3: Selection of design and low carbon solutions for dealing with high temperature

Design Aspect	Issue	Solution	Source
Location	**Annual / Extreme High Temperatures** Cause: Certain areas will be more prone to higher temperatures due to their topography and environment. This results in greater chance of issues related to heat stress requiring lowering of temperatures within buildings and higher water demand	The location of development with high temperatures needs to consider: the likely demand for water (both for consumption and for agricultural or industrial activities) the supply available as against projected water demands and the infrastructure requirements for accessing this supply. And design accordingly, such as adopting existing indigenous techniques used by local populations for coping with these issues	
Site Layout	**External Heat Gain** Cause: Prevailing day and night temperatures can	Passive ventilation through orientation and morphology of buildings and streets to minimise heat loss in winter and excessive solar gain during the summer and catch breezes. Orientate buildings so that the main elevation faces within an angle 30° of due south. Main residential roads should run east-west where possible to assist with this. Buildings oriented east of south will benefit more from morning sun, while those oriented west of south will catch late afternoon sun. Evaporative cooling effects from a matrix of green corridors, smaller open spaces, street trees, and green or living roods and walls. Porous cool pavements/roads to allow rainwater infiltration and cooling effect of evaporation Networks of cool roofs make of light coloured materials can prevent solar heat gain and reduce need for mechanical cooling Exclude solar gain through narrow streets or canopies of street trees; Vegetation can provide shade and minimise glare. Increased use of water ponds, roadside swales, flood balancing lakes (the health risks associated with malaria will need to be taken into account) to help cool the air	UKCIP Briefing Report Climate (J N Hacker, S E Belcher and R K Connell) (2005) Beating the Heat: Keeping UK Buildings Cool in a Warming. Publications and GTZ (2003) Guidelines for Building Measures after Disasters and Conflict. Leeds city council guidance on sustainable buildings'.
	Soil Erosion Cause: increased drought may result in reduced plant cover and an increased vulnerability to soil erosion under wet conditions. This could result in changes in soil and nutrient content	Using drought-tolerant trees and plants to protect the soil and minimise erosion by wind and water and inform locals on benefits of plants and vegetation both for share and soil erosion.	Technology Strategy Board (2010) Designing for Future Climate Report. UK.
Buildings (Private and Public)	**Foundation Damage** Cause: Soil Drying Increase will affect water tables and could affect foundations in clay soils. This could result in increased risk of cracking due	Choose appropriate materials that can respond to issues of cracking and that correspond so as not to cause cracking through joints.	

Design Aspect	Issue	Solution	Source
	to different thermal or moisture movements		
	Heat Gain internally Maximum and minimum changes will affect heating, cooling and air conditioning requirements. Daily maximum and minimum will affect thermal air movement which could result in higher heat stress if not regulated to comfortable levels.	Active cooling (such as fans and air conditioners) could have negative implications for carbon emissions as cooling typically uses carbon-intensive electricity. Passive techniques for internal cooling include: Shading by means of roof overhangs or individual elements above or in front of windows. thick, heat retaining outer walls prevent the quick penetration of solar heat. high levels of internal thermal mass (i.e. materials such as concrete and masonry) exposed to the interior space can make use of lower night-time temperatures (i.e. paper board false ceilings) high levels of insulation minimises heat gains through building fabric - i.e. outer walls can be double-layered with a naturally ventilated air cavity with openings above and below to allow the heat that penetrates the outer skin to be dissipated by the natural ventilation in the cavity so the inner layer does not heat up). An aluminium foil covering the outer surface of the inner layer provides an additional barrier against heat penetration into the building. Larger floor-to-ceiling heights will generally help as higher ceilings will also trap hot air above the heads of occupants, making the room feel cooler Orientate living rooms and spaces to the south with larger windows to maximise solar gain; Kitchens, utility rooms, stores, stairs, halls, cloakrooms and bathrooms should generally be orientated to the north and fitted with smaller windows to reduce heat loss	UKCIP Briefing Report Climate (J N Hacker, S E Belcher and R K Connell) (2005) Beating the Heat: Keeping UK Buildings Cool in a Warming. Leeds city council (2010) Guidance on sustainable buildings' UN-HABITAT et al. (2010) Energy Efficient Housing: Improvement of Thermal Performance of RC Slab Roofs. Available online at: http://www.unhabitat.org.pk/Publication.html
	Inadequate Materials Cause: Higher temperatures and increased UV radiation may result in a shorter lifespan for materials	The level of exposure that the building will have to deal with is a key factor in the selection of the materials and construction technique to be used. Materials with high coefficients of thermal expansion will need increased allowances for movement, and more care will be needed with construction details at interfaces between materials with different coefficients of expansion."	Technology Strategy Board (2010) Designing for Future Climate Report. UK.
Services	**Water Scarcity** Cause: Higher temperatures could increase the demand for water and reduce supply as water resources come under greater stress and water can become less frequent or predictable	Incorporation of water saving devices Increase water storage capacity at every scale from rainwater butts to reservoirs Improved irrigation management	Shaw, R., Colley, M., and Connell, R. (2007) Climate change adaptation by design: a guide for sustainable communities.
	Leakage Cause: increased temperature and decreased precipitation. This can result in soil shrinkage, which can impact underground pipework as soils shrink and swell cracking inflexible pipework to create leakage.	Use of flexibly jointed pipework (for drainage, gas or water) resistant to cracking. This also applies to low carbon initiatives as:	Technology Strategy Board (2010) Designing for Future Climate Report. UK
		Recycled water or rainwater butts as the facility will need to be provided to top the tanks up with mains water for situations when the storage tank does not have adequate supply – this may further increase the amount of pipework needed and hence the risk of leaks.	NHBC Foundation (2007) Climate change and innovation in house building Designing out risk.
		solar hot water panels: will increase the complexity	

Design Aspect	Issue	Solution	Source
		and extent of domestic pipework, and hence the probability of leaks	
	Solid Waste Disposal Cause: Failure to manage solid waste can pose health and environmental hazards through the decomposition of waste increasing unpleasant odours from the site. This can result in pollution of water and Methane and carbon-dioxide are the principal gases produced from the decomposition of the organic fraction of solid waste in the landfill.	See section on options under flooding conditions that re as applicable. Use of top covers to retain moisture within the fill and reduce methane emission or Use bottom liners to prevent the seepage of leachate.	Kurniawan, TA (2009, January 29). Excessive Solid Waste Generation and Its Impacts on the Environment. *SciTopics*.
	Transport Cause: Roads can suffer from a heat island effect – absorbing high temperatures and radiating heat throughout the day/night. This can result in buckling of road infrastructure under extreme heat	Road materials (asphalt and concrete mixes) need to be able to withstand extreme temperatures and monitored for issues related to heat absorption and potential safety issues.	

5. Conclusions and Recommendations for Improving Post-disaster Planning

5.1 Introduction

This review of post-disaster planning both globally and in Pakistan indicates a range of tools and processes for planning housing and infrastructure reconstruction in space and over time, to address (and potentially reduce) the risk and impacts of the disasters. With the onset of climate change it has also been recognised globally that there are opportunities (and imperatives) to manage disaster risk reduction alongside climate change adaptation, although methods to do so are still in their infancy. Many of the measures needed to adapt to climate change are similar to current good practice for coping with the present variable climate. This creates synergies between ‘development’ and ‘adaptation’, and hence there are opportunities for climate compatible development which need to be identified and implemented.

There are many initiatives worldwide to assist in climate-compatible reconstruction. However, this is a complex issue, affected by socio-economic, environmental and other aspects of local conditions. The present study brings together a combination of global and national reviews of past experience with field studies in Pakistan which should ensure that climate related hazards are managed in a way consistent with the requirements of sustainable development.

During the 20th century Pakistan faced various small, medium and larger earthquakes, floods, droughts and cyclonic disasters. But the first decade of 21st century has brought unprecedented disaster to the country in particular the 2005 earthquake and recent flood disasters of 2010 and 2011. Globally, there have been numerous other disasters and to help overcome these challenges, the Hyogo Framework Action (HFA-2005) commitment is to achieve: “*the substantial reduction in lives and in social, economic and environmental assets of communities and countries.”* Pakistan has also committed: “*the considerable reduction of disaster losses, in lives and in social and physical infrastructure which will be achieved if Guidelines based on DRR strategy is applied in physical and land use planning relevant to respective province/regional government, their development authorities and institutions*.”

From the post-disaster point of view a lot of effort has already been done in Pakistan, but the planning approaches for development have been neither appropriate nor sufficient. Moreover the same or similar planning policy for disaster prone areas and management have been applied without understanding or considering the different nature and characteristics of *bar* and *bet* areas of the land of five rivers - the rural Punjab - which is the most populated, great granary and core of socio-economic and physical development of the nation. Most of the time the 20th century has seen the dominance of “top down planning” approach.

It was only during the last two decades of 20th century “bottom up planning” approach to development was considered as a better and more effective planning approach than the “top down planning” approach for rural and regional development. Recent research and studies at City and Regional Planning Department (2008), Lahore and formulation of ‘Ministerial Strategy on Disaster Risk Reduction in Pakistan” conducted at UNDP/NDMA, Islamabad (2009-2010) have strongly advocated for “decentralized planning process.” This planning process based on Disaster risk Reduction (DRR) work has been concluded as resilient and sustainable if it involves the local people in decision making in response to the initiatives of local government with the locals and with the promise of Village Organisations (VOs) or Citizen Community Boards (CCBs). However while the whole country is passing through disasters in general and recent large disasters in particular, then on urgent and long run what recommendations can be suggested towards safe and sustainable Pakistan.

5.2 Overview of experience with climate risk management

Floods and storms are the main sudden-onset climate-related disasters which cause mass displacement of people – both globally and in Pakistan. This situation is likely to get worse with climate change, as storms become more frequent with changing patterns of rainfall: changes to seasonality, duration and intensity of rainfall will increase the likelihood and magnitude of floods. Flood defences designed for historic rainfall patterns are increasingly likely to be breached, and the nature of rivers in alluvial floodplains means that it is difficult to 'retrain' rivers which have burst their banks.

Climate related disasters can also build up gradually, in the form of droughts. These can either be catastrophic, taking the form of mass crop-failure, or more gradual as yields and productivity decline and food shortages increase before the next harvest. The causes can be directly-climate related, due to a failure of rainfall for rain fed agriculture or they can lead to increases in pests and hence loss of production. In much of the Punjab the impact of drought is mitigated by irrigation but increasing demands on the river system (including trans-boundary demands) and complexities of management mean that there are many irrigated areas with local water shortages. Globally, drought affects many more people but the impact in most of Punjab is likely to much less than that of flooding.

Risk, however, is a combination of hazard and vulnerability. The impact of floods depends as much on the vulnerabilities of the exposed communities as it does on the intrinsic hazard. The traditional solution is to build flood defences without addressing other aspects of vulnerability. However, this is increasingly regarded as an insufficient approach as well as being unaffordable. Better planning, to reduce construction on flood plains; improved warning systems combined with emergency shelters; better education on the risks and how to cope; insurance; and better building standards are, in the long run, more sustainable solutions than ever-higher flood defences. However, they are difficult to apply in a densely populated region, where the poorest and most vulnerable people have no choice but to live on the most sensitive land and have the fewest resources for coping with it. Minority groups, female-headed households and the elderly are inevitably at greater risk than others.

Concepts of integrated risk management are widely recognised internationally and provide the best way forward, but they can be difficult to apply in practice. Even in the UK it is difficult to persuade people to manage retreat from a vulnerable coastline in the face of strong demands to protect it, however expensive and uneconomic it may be.

5.2.1 Climate compatible planning

Policy across the world aims to develop rural economies and enhance quality of life whilst protecting the environment and reducing the risks of disasters. These long-standing objectives are entirely consistent with the need to cope with climate change both from a perspective of mitigation and adaptation. Climate change adds to the risks and adds to the urgency of dealing with long-standing problems, but it also creates the opportunity for win-win situations where measures to improve socio-economic conditions can be planned in a way which reduces the risk and vulnerability to climate change impacts. For instance, introducing energy-efficiency measures to housing can reduce the need for rural energy and thus reduce the pressures on the national grid as well as create opportunities for local small-scale renewable sources. Although most reconstruction is likely to be owner-driven, there are times when mass reconstruction by a government agency is the most efficient and economical approach, as with the approach that has been taken by the PDMA following the flooding in the Punjab in 2010. If reconstruction is planned there are opportunities for building in resilience and disaster risk reduction through climate change adaptation and mitigation.

5.2.1.1 Adaptation

Globally there are a large number of manuals and guidelines for the design and reconstruction of buildings and infrastructure– many agencies and NGOs have either standard guidelines or ones which they produced after a specific disaster. For example ERRA in Pakistan produced guidelines for designing and reconstructing more earthquake resilient houses after the 2005 earthquake, but not for schools and other public buildings or for broader climate related risks. The Hazard Maps have identified the key hazards in rural Punjab as flooding (river / intense rainfall) and high temperatures (drought / low precipitation) and therefore these guidelines are not appropriate for reconstruction in rural Punjab.

There are many techniques for ensuring the resilience of villages, buildings and infrastructure at all stages of design, construction and occupation stage, as detailed in the tables in Chapter 4. It is most effective to integrate these tools and techniques at the design stage by ensuring that planners, developers and builders give due consideration at design stage as the opportunities are more limited and more expensive if implemented post-construction.

5.2.1.2 Mitigation

The global community recognises the interlinkages between actions related to climate change adaptation and mitigation, with adaptation helping communities resilience in the short to long term, and mitigation aiming to reduce the risk of further anthropogenically caused climate change. Although rural houses in countries such as Pakistan have a small carbon footprint, there are a very large number of houses and there are significant opportunities for low-carbon reconstruction. Many of these, such as individual PV systems, offer direct benefits in terms of livelihoods as well as reducing carbon emissions.

In terms of reconstruction, low carbon construction is a practical mitigatory action that is based on principles of:

1. using less energy and improving energy use;
2. protecting and promoting carbon sinks;
3. promoting low or zero carbon technologies and business models; and
4. introducing policies which discourage carbon intensive practices seeks to mitigate the impacts of climate change and promote resilience.

This encourages use of passive techniques both for the design and construction of development to reduce energy consumption and using techniques to harness energy from our climate. As these techniques vary in complexity and requirements there are multiple options for rural developments ranging from encouraging use of local materials to installing solar photovoltaics to power appliances in the home.

The benefits of this form of construction are not limited to lowering potential emissions through development. Although rural energy consumption is low on a per capita basis, the aggregated across the province or country can equate to a large amount. Any reduction in energy use is good from a point of both national and local energy security, as well as for ensuring energy costs for the rural population remain low. Instigative use of both passive and hard engineering in this area also provides opportunities for poverty alleviation and economic development through 'green' livelihoods.

Incorporating passive and renewable energy technologies is best accomplished as part of the design process, but if this is not feasible allowances can be made for adding these aspects later, i.e. through appropriate roof tilting and directions.

5.2.2 Using building codes and regulations

Planning regulations and building codes exist and are strictly enforced in developed countries but rarely exist in developing countries where planning is haphazard at best and where there are few requirements for building quality. Since rural population is dependent on public sector provision for service delivery and for major infrastructure, there is an urgent need to improve on this situation. Anecdotal information from the 2008 Sichuan earthquake suggested that standards of construction were lower for public buildings than for domestic ones, resulting in a large loss of life in schools during the earthquake. Perhaps this could have been avoided with the right regulations and codes for these types of buildings.

There are few codes or guidelines fur rural planning or construction in Pakistan, it is not surprising that they do not address sustainability or issues related to climate change. There is therefore an opportunity for Guidance to address this gap by enhancing the knowledge and management of construction in rural areas for present and future predictions of risk.

5.3 Providing Guidance

In this project we are considering two aspects of post-flooding reconstruction in relation to climate change in the Punjab: location and design. The Guidance manual that will be produced in response to this document and the perspectives and technical assessment from the field will highlight the options for increasing resilience of model villages through risk reduction based on these two aspects.

The need for flood protection is probably most critical in this context in Pakistan, but location and design of villages also affects issues such as transport networks and waste disposal. For instance, communities may want to rebuild their houses in the same location: there are many very good reasons for this, but some locations are at risk of flooding, and probably increased flooding due to climate change. In this case it may be necessary to encourage relocation, as an important part of flood resilience is in not building in flood risk areas. Our Guidance will aim to provide an overview and raise awareness of the likelihood of continual risk of flooding to encourage avoidance of building in areas seen as high risk by both the local community and government bodies tasked with planning further development and reconstruction.

Preparation of additional guidelines provides an opportunity to make sufficient reference to climate compatibility considerations without perhaps the perceived need for a long and detailed study of codes and regulatory requirements (which may not be flexible enough to respond in disaster recovery situations). Although general guidance will be given, reconstruction should be context specific. Our guidelines will highlight the main risks and approaches rather than aim to be prescriptive. It must also be recognised that most reconstruction is done privately and they may well not work to the guidelines. This is where a synthesis between building codes, regulations and guidance on required and recommended techniques and strategies would be highly beneficial.

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